CENTER *for* BIOLOGICAL DIVERSITY

EHL

August 25, 2009

Via Electronic Mail

U.S. Army Corps of Engineers
Ventura Field Office
Attn: Aaron O. Allen
2151 Alessandro Drive, Suite 110
Ventura, CA 93001
Email: *Aaron.O.Allen@usace.army.mil*

Via Electronic Mail and Certified Mail with CD of Attached Exhibits

California Department of Fish and Game
Newhall Ranch EIS/EIR Project Comments
c/o Dennis Bedford
4949 Viewridge Avenue
San Diego, CA 92123
Email: *newhallranch@dfg.ca.gov*

Re: Comments on the Newhall Ranch Resource Management and Development Plan and the Spineflower Conservation Plan Environmental Impact Statement/Environmental Impact Report

These comments are submitted on behalf of the Center for Biological Diversity
(the "Center") and the Endangered Habitats League on the Newhall Ranch Resource
Management and Development Plan and the Spineflower Conservation Plan ("RMDP")
Environmental Impact Statement/Environmental Impact Report ("EIR"). The Center is a
non-profit, public interest environmental organization dedicated to the protection of 1
native species and their habitats through science, policy, and environmental law. The
Center has 44,000 members, throughout California and the United States, including in the
Santa Clarita Valley area. The Endangered Habitats League is a nonprofit membership

Matthew D. Vespa • Senior Attorney • 351 California St., Suite 600 • San Francisco, CA 94104
Phone: 415-436-9682 x309 • Fax: 415-436-9683 • mvespa@biologicaldiversity.org

organization dedicated to the conservation of Southern California's unique native
ecosystems and to sustainable land use planning in the region. Thank you for the 1
opportunity to participate in this process.

The RMDP is meant to address the long-term management of sensitive biological
resources within the 11,999-acre Specific Plan area and would implement a variety of
activities, including development-related infrastructure projects along and within the 2
Santa Clara River and its tributary drainages. Additionally, under Alternative 2, the
proposed RMDP would facilitate the build-out of at least 20,885 residential units and
5.55 million square feet of commercial uses. As proposed, the RMDP will have 3
substantial impacts on the environment due to its nature, size, and location.

While the EIR's shortcomings are numerous, this letter focuses specifically on the
EIR's flawed analysis of the impacts of the Project's greenhouse gas emissions under the
California Environmental Quality Act ("CEQA") and the National Environmental
Protection Act ("NEPA"). First, the EIR grossly understates Project emissions through
unrealistic assumptions of vehicle trip length. Moreover, in an apparent effort to
greenwash the project, the EIR misleads decisionmakers and the public by claiming the
Project will be 15 percent below 2005 Title 24 standards. As the 2008 Title 24 standards
that will apply to the Project are already roughly 15 percent below 2005 standards, the 4
Project will simply comply with existing law, and therefore does not represent an
improvement above existing standards.[1] In addition, the EIR's assertion that the
Project's greenhouse gas impacts are less than significant does not withstand scrutiny.
Development of this scale in a remote, biologically sensitive location is fundamentally
incompatible with California's efforts to transition to a sustainable low-carbon future.
The EIR should properly acknowledge that the Project's greenhouse gas impacts are
significant and be revised and recirculated so that all feasible alternatives and mitigation
measures to reduce this impact can be fully explored.

I. The Analysis of Impacts from the Project's Greenhouse Gas Emissions is Inadequate

A. The EIR Understates Project Emissions

In calculating emissions from the transportation sector, the Project depends on the
EIR Traffic Analysis. The analysis blindly assumes that the Project will generate an
internal daily trip capture of 47 percent (EIR, Figure 11, p. 22) yet fails to provide any
substantial evidence that this assumption has any empirical validity. Forty-seven percent 5
is an extremely high number for internal trip capture and likely serves as a gross
overestimation. Because internal and external capture rates are a foundational component
of the traffic, air, and greenhouse gas emissions (GHG) analyses, they too are based on
pure speculation.

[1] According to the CEC, the requirement for when the 2008 standards must be followed is dependent on when the application for the building permit is submitted. If the application for the building permit is submitted on or after 1/1/10, the 2008 standards must be met. It seems highly unlikely that building permit applications will be submitted for this project prior to January 1, 2010.

The most widely accepted method for estimating multi-use trip generation is the Institute of Transportation Engineers' (ITE) *Trip Generation Handbook* (ITE, 2001).[2] Under optimal circumstances a mixed use development would probably only justify an internal capture rate of 10-20 percent. Based on the inflated internal trip capture rate or 47 percent, the RMDP EIR assumes “trip lengths for home-work, home-shop, and home-other of 10.7 miles, 5.2 miles, and 7 miles.” (EIR at 8.0-40.) In calculating transportation-related emissions, the EIR erroneously assumes a largely autonomous 5
development, one in which residents rarely leave in order to shop or work. Experts have found a maximum internal home-work capture rate of 38 percent in isolated developments.[3] This means that at least 62 percent of all other home-work trips are external to the development. Also, the increased number of multiple-worker households decreases the likelihood that people can both live and work within the same community.[4] The EIR also fails to recognize that commercial and maintenance jobs at the Project site will attract workers who do not live there and must commute. These assumptions have no basis in reality and serve to grossly understate Project impacts.

The EIR also repeatedly refers to the applicant’s purported commitment to ensure that dwelling units are 15 percent above Title 24 standards. However, this refers to 2005 standards. The units constructed as a result of this Project will be required to comply with more recently enacted and stringent 2008 Title 24 standards. The 2008 Title 24 6
requirements, for which this project will be required to conform, result in energy savings for residential buildings 13 – 15 percent compared with the 2005 version of Title 24.[5] Accordingly, claiming a 15 percent increase in efficiency is illusory and misleading to decisionmakers and the public.

In addition, the EIR does not acknowledge that Title 24 does not address operational performance, such as the energy use from appliances. The EIR does not 7
address the extent to which these emissions may or may not be improvements from existing requirements.

B. The EIR’s Criteria for Determining Significance is Conceptually Flawed and Misleading

In determining that the Project’s greenhouse gas impacts are not significant, the DEIR uses the following criteria: “Will the proposed Project’s GHG emissions impede compliance with the GHG emission reductions mandated by AB 32?” (EIR at 8.0-29.) Compliance with AB 32 is not the appropriate standard for determining the significance 8
of Project emissions. First, the emission reduction targets set forth in AB 32 mark only a first and interim step toward avoiding dangerous climate change. By myopically

[2] Institute of Transportation Engineers. 2001. *Trip Generation Handbook*. Washington, DC.
[3] Ewing, Reid. 1991. “Developing Successful New Communities” Urban Land Institute. Washington DC.
[4] Wachs, Martin; Taylor, Brian; Levine, Ned; and Ong, Paul. 1993. The Changing Commute: A Case-study of the Jobs-Housing Relationship over Time. In *Urban Studies Journal Limited*. 30(10), pp.1712.
[5] EDAW, *Seattle New Building Energy Efficiency Policy Analysis, Energy Code Case Study – Title 24* at 2 (Nov. 2008).

focusing on AB 32, the Project ignores the long term emission reductions necessary to stabilize the climate. These reductions are significant and simply cannot be achieved if 8
developments like the Project continue to be built in locations far from jobs and meaningful public transit. Second, while the emission reduction targets embodied in AB 32 and Executive Order S-3-05 can inform a significance determination, it is only to the extent that these targets accurately reflect scientific data on needed emissions reductions. 9
Under CEQA, regulatory standards can serve as proxies for significance where they accurately reflect the level at which an impact can be said to be less than significant. *See, e.g., Protect the Historic Amador Waterways v. Amador Water Agency*, 116 Cal. App. 4th 1099, 1109 (2004).

CEQA calls for the identification of "any critical thresholds for the health and safety of the people of the state." Pub. Res. Code § 21000(d). With regard to GHGs, this critical threshold is not AB 32 compliance, but avoiding dangerous anthropogenic interference (DAI) with the climate system. Article 2 of the United Nations Framework Convention on Climate Change (UNFCCC) calls for "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference (DAI) with the climate system."[6] With the United States and over 180 other countries as signatories, the UNFCCC's objective of avoiding DAI with the climate is widely viewed as the international regulatory standard for protecting the global climate. The environmental objective of avoiding DAI is recognized in ARB's Draft GHG Threshold Guidance. (ARB Preliminary Draft Staff Proposal, Recommended Approaches for Setting Interim Significance Thresholds for Greenhouse Gases under the 10
CEQA ("ARB Draft GHG Threshold"), Oct. 24, 2008 at 3.) In its Policy Objective for the Interim GHG Threshold for Industrial Projects, the South Coast Air Quality Management District ("SCAQMD") sets a roughly analogous objective of "reducing GHG emissions to stabilize climate change." (SCAQMD Interim GHG Significance Threshold Staff Proposal (revised), at 3-2.) Notably, both ARB and SCAQMD reject tying significance to AB 32 compliance. The policy objectives of both ARB and SCAQMD's threshold proposals both state that reaching the emission reduction targets set forth by Executive Order S-3-05, whereby emissions are reduced to 80 percent below 1990 levels by 2050, would contribute to avoiding dangerous climate change because these reductions are consistent with a pathway to the stabilization of atmospheric concentrations of GHG emissions at 450 ppm. (ARB Draft GHG Threshold at 3; SCAQMD Interim Threshold Proposal at 3-2.)

Even assuming one could develop a threshold of significance for greenhouse gases based only on near-term 2020 emission reduction targets, reducing greenhouse gas emissions to 1990 levels is not sufficient to put atmospheric concentrations of greenhouse gas emissions on a trajectory to substantially reduce the risk of dangerous climate change. 11
According to the International Panel on Climate Change, developed countries need to reduce emissions to 25-40 percent below 1990 levels by 2020 to stabilize atmospheric

[6] United Nations Framework Convention on Climate Change, art. 2, May 9, 1992, *available at* http://unfccc.int/essential_background/convention/background/items/1349.php.

greenhouse gas concentrations at 450 ppm CO_2eq.[7] Not only does AB 32 fail to reach this near-term objective, but a stabilization target of 450 ppm CO_2eq provides only a 50/50 chance of limiting global average temperature increase to 2°C (3.6º F) from pre-industrial levels and a 30 percent chance that global average temperature would rise more than 3°C (5.4º F).[8] The consequences of a 2°C temperature increase include the displacement of millions of people due to sea level rise, irreversible loss of entire ecosystems, the triggering of multiple climactic "tipping points" such as complete loss of summer Arctic sea ice and the irreversible melting of the Greenland ice sheet, loss of agricultural yields, and increased water stress for billions of people.[9] As dire as the projected impacts are from a 2°C average temperature increase, increases above 2°C would result in impacts exponentially more devastating. At a 3°C temperature increase
from pre-industrial levels, 22 percent of ecosystems would be transformed, losing 7 to 74 11
percent of their extent.[10] An additional 25 to 40 million people would be displaced from coasts due to sea level rise, an additional 1.2 – 3 billion people would suffer an increase in water stress, and 65 countries would lose 16 percent of their agricultural gross domestic product.[11] Accordingly, leading scientists warn that "to preserve a planet for future generations similar to that in which civilization developed and to which life on Earth is adapted . . . CO_2 will need to be reduced from its current 385 ppm to at most 350 ppm."[12] The U.S. Global Change Research Program recently affirmed this finding.[13] Thus, even if 2020 could be viewed as an appropriate time-frame from which to establish a threshold under CEQA, targeting reductions to reach 1990 levels by 2020 is inconsistent with scientific data on the near-term reductions necessary to avoid dangerous climate change. *See* Guidelines § 15064(b); *Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th 1099, 1109 (regulatory standards can serve as proxies for significance only to the extent that they accurately reflect the level at which an impact can be said to be less than significant).

---

[7] S. Gupta et al., *Policies, Instruments and Co-operative Arrangements, in* CLIMATE CHANGE 2007: MITIGATION, CONTRIBUTION OF WORKING GROUP III TO THE FOURTH ASSESSMENT REPORT OF THE INTERNATIONAL PANEL ON CLIMATE CHANGE 776 (2007) (by 2050, emissions would need to be reduced to 80 to 95% below 1990 levels).

[8] UNION OF CONCERNED SCIENTISTS, HOW TO AVOID DANGEROUS CLIMATE CHANGE: A TARGET FOR U.S. EMISSIONS 16 (2007); Malte Meinshausen, *What Does a 2°C Target Mean for Greenhouse Gas Concentrations? A Brief Analysis Based on Multi-Gas Emission Pathways and Several Climate Sensitivity Uncertainty Estimates, in* AVOIDING DANGEROUS CLIMATE CHANGE 270-72 (2006).

[9] Rachel Warren, *Impacts of Global Climate Change at Different Annual Mean Global Temperature Increases* in AVOIDING DANGEROUS CLIMATE CHANGE 95, 98 (2006).

[10] *Id.* at 99.

[11] *Id.* at 96–97.

[12] James Hansen et al., *Target Atmospheric CO_2: Where Should Humanity Aim?* 2 OPEN ATMOSPHERIC SCI. J. 217, 226 (2008). 450 CO_2eq is approximately equivalent to 400 ppm CO_2 stabilization, and 400 CO_2eq is approximately equivalent to 350–375 ppm CO_2 stabilization. Michel den Elzen & Malte Meinshausen, *Multi-Gas Emission Pathways for Meeting the EU 2°C Climate Target, in* AVOIDING DANGEROUS CLIMATE CHANGE 300, 305 (2006).

[13] U.S. Global Change Research Program, GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES at 23 (2009) (finding that "atmospheric concentration of carbon dioxide would need to be stabilized in the long term at around today's levels" to have a "good chance (but not a guarantee)" of avoiding severe, widespread, and irreversible impacts).

C. Even Assuming the Proposed Threshold Is Legitimate, The EIR Has Not Demonstrated that the Project is Consistent

1. The EIR's per capita analysis is fatally flawed because it assumes the Project is the only source of total per capita emissions

The EIR concludes that "the proposed Project's GHG emissions would be lower than the per capita reduction required statewide in order to reduce California's GHG emission levels to 1990 levels by 2020; therefore, the proposed Project would have a less than significant effect on the environment." (EIR at 8.0-58.) The EIR's conclusory assertion that Project impacts are insignificant does not withstand scrutiny. An individual's per capita emissions are not limited to those generated by the Project. A resident of the Project will consume food and durable goods, travel beyond the project 12
site through modes that likely will include air travel and engage in other behavior that contributes to the individual's per capita emissions but is not captured in the emissions generated by the Project. Accordingly, comparing per capita emissions resulting from the Project and per capita emissions in 2020 under AB 32 compares oranges and apples and is not determinative of whether project impacts are significant. Pub. Res. Code §21082.2(c) (Substantial evidence excludes "[a]rgument, speculation, unsubstantiated opinion or narrative, [and] evidence which is clearly inaccurate or erroneous…"); *see also Californians for Alternatives to Toxics v. Dept. of Food & Agric.* (2005) 136 Cal.App.4th 1, 17 ("[C]onclusory statements do not fit the CEQA bill.").

In addition, the reduction targets set by AB 32 do not specify the reduction obligations for new and existing development. Reducing emissions from existing building stock is much more difficult than designing new projects more efficiently. 13
There is no legitimate basis for the EIR to assume that an individual that lives in a project built today should have the same per capita emissions as an individual living in an older development.

2. Determining significance from Business as Usual ("BAU") reductions is inherently arbitrary, a 29 percent BAU reduction is insufficient to claim project impacts are less than significant and, in any event, the EIR does not demonstrate the project is 29 percent below BAU

The EIR's assertion that its "BAU assessment confirms that the proposed Project would have a less-than-significant impact on global climate change" is flawed on multiple grounds.

14

a. *"Business as Usual" is an unworkable metric from which to determine significance*

Determining significance from purported reductions from BAU is inherently arbitrary and does not legitimately inform a significance determination. As the EIR demonstrates, because there is no established definition of BAU, the resulting analysis is uninformative and can be gamed to result in the preferred outcome of the project proponent. With regard to energy use, rather then measure BAU with respect to current (2008) Title 24 standards, the EIR adds a per capita emissions component by including increased population growth. This is not a reduction from a current baseline. Further confusing matters, the EIR also seems to compare the project with the "California average." The "California average," which presumably encompasses past development 14 constructed under less stringent energy standards, is not BAU, which would examine the emissions from a project built under today's minimum standads. With regard to vehicle emissions, the EIR compares vehicle emissions with a purported "community performance goal." This is not BAU, but a performance objective that has not been analyzed in the CEQA context.

In addition, marginal reductions from BAU would improperly allow carbon-intensive projects with high emission levels to avoid feasible mitigation below 29 percent. Using BAU reductions as a threshold would allow any project, no matter how large, to only reduce greenhouse gases 29 percent below BAU. For example, a project that would generate over 1 million tons of CO_2 eq emissions would only have to reduce its emissions 15 by 29 percent to approximately 710,000 tons. This type of threshold will interfere with real progress on emissions reductions. For example, projects are now beginning to look to on-site and off-site measures to be carbon neutral. With the EIR's approach 71 percent of new emissions will be allowed and a critical opportunity to achieve additional reductions would have been lost.

b. *Reducing emissions to 29 percent below "BAU" is insufficient to declare project impacts are less than significant*

Even assuming BAU was a legitimate metric from which to determine significance, from a business-as-usual perspective, a 29 percent BAU threshold allows 71 percent of emissions from all new development to be released into the atmosphere. Substantial increases in emissions are clearly contrary to scientific evidence, which has concluded that "the net addition of CO_2 to the atmosphere from human activities must be decreased to nearly zero" to achieve "atmospheric carbon dioxide levels that lead to climate stabilization."[14] Indeed, as determined by CAPCOA, a 90 percent reduction from business-as-usual, *effective immediately*, is necessary to meet the emission reduction 16 targets set by Executive Order S-3-05 (CAPCOA 2008 at 33 (emphasis added).) A 50 percent reduction from business-as-usual will prohibit California from reaching the goals of Executive Order S-3-05 even if existing emissions were 100 percent controlled (CAPCOA 2008 at 33-34). According to CAPCOA, a 28-33 percent business-as-usual emission reduction—as proposed in the EIR—has "low" emission reduction effectiveness (CAPCOA 2008). It is difficult to conceive how the environmental objective of climate

[14] *See* Matthews H.D. & Caldeira, K., *Stabilizing the Climate Requires Near-Zero Emissions*, 35 GEOPHYSICAL RESEARCH LETTERS L04705 (2008) (finding that "the net addition of CO_2 to the atmosphere from human activities must be decreased to nearly zero" to achieve "atmospheric carbon dioxide levels that lead to climate stabilization.")

stabilization, which requires an 80 percent reduction of greenhouse gas emissions from 1990 levels by 2050, can be achieved if new projects continue to add 71 percent of business-as-usual emissions, or over 300,000 tons of additional emissions into an atmosphere already dangerously overly saturated with greenhouse gas emissions. *See* 16
Communities for Better Env't v. California Resources Agency, 103 Cal.App.4th 98, 120 (2002) ("the greater the existing environmental problems are, the lower the threshold for treating a project's contribution to cumulative impacts as significant.").

c. The EIR does not demonstrate that the project would be 29 percent below BAU

The project's energy usage is not 29 percent below current requirements. As noted above, the project would do no more than comply with the Title 24 requirements in force when the Project is built. The project therefore cannot legitimately be said to be 29 17
percent below BAU. To mask this deficiency, the EIR cites to CEC reports which forecasts per unit consumption of energy that accounts for less efficient structures built under earlier energy standards. Similarly, the EIR claims that mobile and water-use related sources are both at least 24 percent better than the California average. Not only is this fail to reach the 29 percent below target, but "the California average" is not BAU. 18
BAU is measured by the requirements in existence today, not a performance average that accounts for all California development subject to historically less stringent standards.

With regard to VMT, the EIR does not define BAU, but rather a "smart growth" suburban goal. First, there does not appear to be any legitimate basis for the assumption that BAU should be measured in the context of suburban development. This would place 19
a lesser burden on projects with remote locations and require infill projects with substantially less VMTs to have the same level of reductions as projects far from public transit. Second, in its draft threshold, the Air Resources Board set significance criteria for residential transportation at 14,000 VMT/hh-yr. (Air Resources Board, Staff Proposal on Greenhouse Gas Thresholds of Significance under CEQA (Dec. 9, 2008).) Even with 20
its understated estimate and erroneous assumptions, the VMTs generated by the Project are significantly higher than what ARB estimated would be needed for a project to claim impacts are less than significant.

3. Consistency with recommended mitigation programs is not determinative to the significance of project impacts

The EIR's discussion of purported consistency with mitigation measures recommended by the California Attorney General's Office and the Climate Action Team is irrelevant to the determination of the significance of project impacts. Neither of these documents is "a previously approved plan or mitigation program which provides specific requirements that will avoid or substantially lessen the cumulative problem … within the 21
geographic area where the project is located" or "specific in law or adopted by the public agency with jurisdiction over the affected resources through a public review process to implement, interpret, or make specific the law enforced or administered by the public agency." Guidelines § 15064(h)(3). Accordingly, they cannot legitimately be relied upon

to conclude the Project's greenhouse gas emission are not a cumulative impact. *See also* Resources Agency, *Initial Statement of Reasons for Regulatory Action, Proposed Amendments to the State CEQA Guidelines Addressing Analysis and Mitigation of Greenhouse Gas Emissions Pursuant to SB 97* (July 2009) at 13 ("consistency with early 21
action items would have little relevance for a residential subdivision project. Likewise, consistency with plans that are purely aspirational (i.e., those that include only unenforceable goals without mandatory reduction measures) … may not achieve the level of protection necessary to give rise to [§ 15064(h)(3)'s] presumption.").

Because the EIR fails to acknowledge the significance of project impacts, it cannot rely on a handful of mitigation measures to claim all feasible mitigation measures and alternatives have been adopted. The significance determination is what triggers the 22
obligation to analyze and adopt *all* feasible mitigation and alternatives that would avoid or substantially lessen project impacts, not just measures of the project proponent's choosing. Pub. Res. Code § 21002.

In any event, the mitigation measures proposed in the EIR are largely illusory, deferred, and do little to reduce the substantial carbon footprint of the Project. As already 23
noted, because the Project would be required to comply with 2008 Title 24 standards, claims of additional efficiency beyond 2005 Title 24 standards are misleading. GCC 3 and GCC 4 are of dubious effectiveness because they allow the project proponent to purchase carbon offsets from sources of questionable efficacy.[15] Indeed, in recognition of the increased certainty and verifiability associated with on-site mitigation, SCAQMD 24
prefers on-site mitigation of GHG emissions over the use of offsets. (SCAQMD Interim GHG Threshold at 3-16.) Accordingly, GCC 3 and 4 should be revised to require installation of on-site solar systems, rather than purport to achieve an equivalent reduction through the purchase of offsets.

D. There is a Fair Argument the Project Emissions Are Significant

The failure to immediately and significantly reduce emissions from existing levels will result in devastating consequences for the economy, public health, natural resources, and the environment. Based on the scientific and factual data, thresholds that are not highly effective at reducing emissions are inadequate in the face of the profound threats posed by global warming. Moreover, CEQA requires that a lead agency must "still consider any fair argument that a certain environmental effect may be significant" even 25
where a project complies with a regulatory threshold. *Protect the Historic Amador Waterways v. Amador Water Agency*, 116 Cal. App. 4th 1099, 1109 (2004). Because there is a fair argument that application of a threshold with limited effectiveness at reducing emissions would still result in environmental effects, reliance on a threshold that is not highly effective at reducing greenhouse gas emissions or is inconsistent with

[15] *See, e.g.*, GAO, *Carbon Offsets: The U.S. Voluntary Market is Growing, but Quality Assurance Poses Challenges for Market Participants*, GAO-09-1048 (Aug. 2008) at 35 ("Economic analyses of offsets acknowledge difficulties in their use, including baseline determination, additionality, permanence, double-counting, and verification and monitoring. If these criteria are more likely to be satisfied by internal reductions from regulated sources than by offsets, the use of offsets may result in greater emissions.").

mandated emission reductions leaves projects open to legal challenge under the fair 25
argument standard.

Under an analysis by the California Air Pollution Control Officer's Association ("CAPCOA"), the only two thresholds that are highly effective at reducing emissions and highly consistent with AB 32 and Executive Order S-3-05 are a threshold of zero or a quantitative threshold designed to capture 90 percent or more of likely future 26
discretionary projects (a 900-ton CO_2 Eq threshold).[16] A 40,000 – 50,000 ton project would have low consistency with AB 32 and Executive Order S-3-05. (Id.) Here, even with its understated estimate, the Project would result in well over 300,000 tons of greenhouse gas emissions.

II. The Project's Impact on Global Warming is also Significant Under NEPA

The U.S. Army Corps of Engineers ("USACE") refuses to acknowledge the significance of the Project's GHG contribution under NEPA on the grounds that there are no adopted GHG significance thresholds. (EIR at 8.0-29). USACE's failure to find that the Project's GHG emissions are a significant impact is fundamentally flawed. Neither NEPA, CEQA guidelines, nor USACE NEPA Regulations require quantitative thresholds of significance in order to discuss the environmental impacts of a proposed project. The Ninth Circuit in *Center for Biological Diversity v. National Highway Traffic Safety Administration* recognized the legal necessity of evaluating the cumulative significance of GHG emissions under NEPA, despite the absence of a quantitative threshold, stating "[t]he impact of greenhouse gas emissions on climate change is precisely the kind of cumulative impacts analysis that NEPA requires agencies to conduct."[17] "Thus, the fact that climate change is largely a global phenomenon that includes actions that are outside 27
of [the agency's] control . . . does not release the agency from the duty of assessing the effects of *its* actions on global warming within the context of other actions that also affect global warming. The cumulative impacts regulation specifically provides that the agency must assess the impact of the action when added to other past, present, and reasonably foreseeable future actions *regardless of what agency (Federal or non-Federal) or person undertakes such other actions.*"[18]

In addition, "it is reasonable to anticipate a cumulatively significant impact on the environment" from increased GHG emissions.[19] The EIR recognizes that there will be an "appreciable impact on global climate change" resulting from a Project's emission combined with other anthropogenic GHG sources.[20] Therefore, the failure to acknowledge the indisputable significance of the Project's GHG emissions violates NEPA because the EIR misrepresents the environmental impact of the proposed actions.[21]

---

[16] CAPCOA, *CEQA & Climate Change* at 56-57 (Jan. 2008).
[17] 508 F.3d 508, 550 (9th Cir. 2007) (holding an EA inadequate for inadequate cumulative impacts analysis).
[18] *Id.* (internal citations and quotations omitted; emphasis in original).
[19] CEQ Reg. 40 C.F.R. § 1508.27(7)
[20] DEIS/R at ES-22.
[21] 42 U.S.C. § 4332 (C)

III. DEIR Should Be Redrafted and Recirculated.

CEQA requires recirculation of a revised draft EIR "[w]hen significant new information is added to the environmental impact report" after public review and comment on the earlier draft DEIR. Pub. Res. Code § 21092.1. This includes the situation where, as here, "[t]he draft EIR was so fundamentally and basically inadequate and conclusory in nature that meaningful public review and comment were precluded." Guidelines § 15088.5(b)(4). The opportunity for meaningful public review of significant new information is essential "to test, assess, and evaluate the data and make an informed judgment as to the validity of the conclusions to be drawn there from." *Sutter Sensible Planning, Inc. v. Sutter County Board of Supervisors*, 122 Cal.App.3d 813, 822 (1981); *City of San Jose v. Great Oaks Water Co.*, 192 Cal.App.3d 1005, 1017 (1987). An agency cannot simply release a draft report "that hedges on important environmental 28
issues while deferring a more detailed analysis to the final [EIR] that is insulated from public review." *Mountain Lion Coalition v. California Fish and Game Comm'n*, 214 Cal.App.3d 1043, 1053 (1989).

In order to cure the panoply of defects identified in this letter, including the failure to recognize the significance of the Project's greenhouse gas emissions, the County will have to obtain substantial new information to adequately assess the proposed Project's environmental impacts, and to identify effective mitigation capable of alleviating the Project's significant impacts. CEQA requires that the public have a meaningful opportunity to review and comment upon this significant new information in the form of a recirculated draft EIR.

Thank you for considering these comments. If you have any questions, please contact Matt Vespa, mvespa@biologicaldiversity.org, (415) 436-9682 x309.

Please ensure that we are notified of any future action on this Project.

Sincerely,

Matthew Vespa
Senior Attorney

Enc: The following references are included in the accompanying CD for your review and inclusion in the administrative record.

ENCLOSED REFERENCES

Exhibit A - ARB Preliminary Draft Staff Proposal, Recommended Approaches for Setting Interim Significance Thresholds for Greenhouse Gases under the CEQA, Oct. 24, 2008

Exhibit B - ARB, Presentation Slides, Staff Proposal on Greenhouse Gas Thresholds of Significance under CEQA, Potential Performance Standards and Measures (Dec. 2008)

Exhibit C - CAPCOA, *CEQA & Climate Change* (Jan. 2008).

Exhibit D - EDAW, *Seattle New Building Energy Efficiency Policy Analysis*, *Energy Code Case Study – Title 24* (Nov. 2008).

Exhibit E - GAO, *Carbon Offsets: The U.S. Voluntary Market is Growing, but Quality Assurance Poses Challenges for Market Participants*, GAO-09-1048 (Aug. 2008)

Exhibit F - S. Gupta et al., *Policies, Instruments and Co-operative Arrangements, in* CLIMATE CHANGE 2007: MITIGATION, CONTRIBUTION OF WORKING GROUP III TO THE FOURTH ASSESSMENT REPORT OF THE INTERNATIONAL PANEL ON CLIMATE CHANGE 776 (2007).

Exhibit G - Matthews H.D. & Caldeira, K., *Stabilizing the Climate Requires Near-Zero Emissions*, 35 GEOPHYSICAL RESEARCH LETTERS L04705 (2008) (finding that "the net addition of CO_2 to the atmosphere from human activities must be decreased to nearly zero" to achieve "atmospheric carbon dioxide levels that lead to climate stabilization.")

Exhibit H - SCAQMD, Draft Guidance Document – Interim CEQA Greenhouse Gas (GHG) Significance (Oct. 2008)

From: Allen, Aaron O SPL [Aaron.O.Allen@usace.army.mil]
Sent: Tuesday, August 25, 2009 4:10 PM
To: Matt Carpenter; Sam Rojas
Subject: FW: Comments on Newhall Ranch DEIS/R

Attachments: CBD EHL Newhall DEIR Comments FINAL.pdf

FYI

-----Original Message-----
From: Matt Vespa [mailto:mvespa@biologicaldiversity.org]
Sent: Tuesday, August 25, 2009 3:51 PM
To: newhallranch@dfg.ca.gov; Allen, Aaron O SPL
Cc: gostodas1@yahoo.com
Subject: Comments on Newhall Ranch DEIS/R

Attached are comments from the Center for Biological Diversity and Endangered Habitats League on the Newhall Ranch Management and Development Plan EIS/EIR.

Dennis, a hard copy of our letter will also be sent to you via certified mail that includes a CD of attached exhibits. Please ensure that the letter and exhibits are part of the administrative record for this project.

Thanks you and please let me know if you have any questions,

Matt

Matthew D. Vespa

Senior Attorney

Center for Biological Diversity

351 California Street, Suite 600

San Francisco, CA 94104

Phone: (415) 436-9682 x 309

Fax: (415) 436-9683

http://www.biologicaldiversity.org

Please consider the impact on the environment before printing this e-mail.

California Air Resources Board

Preliminary Draft Staff Proposal

Recommended Approaches for Setting Interim Significance Thresholds for Greenhouse Gases under the California Environmental Quality Act

Released: October 24, 2008

[page intentionally blank]

DOCUMENT AVAILABILITY

Electronic copies of this document and related materials can be found at: http://www.arb.ca.gov/cc/localgov/ceqa/ceqa.htm. Alternatively, paper copies may be obtained from the Board's Public Information Office, 1001 I Street, 1st Floor, Visitors and Environmental Services Center, Sacramento, California, 95814, (916) 322-2990.

For individuals with sensory disabilities, this document is available in Braille, large print, audiocassette or computer disk. Please contact ARB's Disability Coordinator at (916) 323-4916 by voice or through the California Relay Services at 711, to place your request for disability services. If you are a person with limited English and would like to request interpreter services, please contact ARB's Bilingual Manager at (916) 323-7053.

DISCLAIMER

This preliminary draft proposal has been reviewed by the staff of the Air Resources Board and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Air Resources Board, nor does mention of trade names or commercial products constitute endorsement or recommendation of use.

ARB CONTACTS

Mr. Kurt Karperos, Chief
Air Quality and Transportation Planning Branch
Planning and Technical Support Division

Mr. Douglas Ito, Manager
SIP and Local Government Strategies Section
Planning and Technical Support Division

Air Resources Board
P.O. Box 2815
Sacramento, California 95812

Website: http://www.arb.ca.gov/cc/localgov/ceqa/ceqa.htm

ARB STAFF PROJECT TEAM

Jeannie Blakeslee, Lezlie Kimura, Leslie Krinsk, Esq.,
Kyriacos Kyriacou and Jamesine Rogers

Reviewed and approved for distribution by: Lynn M. Terry, Deputy Executive Officer

TABLE OF CONTENTS

[page intentionally blank]

INTRODUCTION

Climate change is one of the most serious environmental problems facing the world, the United States, and California today. In this State, climate change already is impacting our coastlines, water supplies, agriculture, and public health, and putting millions of acres of forested land at increased risk of fire. These adverse effects will only increase in number and intensity if we do not promptly and substantially reduce pollution of the atmosphere with greenhouse gases (GHGs).

California law provides that climate change is an environmental effect subject to the California Environmental Quality Act (CEQA).[1] Lead agencies therefore are obligated to determine whether a project's climate change-related effects may be significant, requiring preparation of an Environmental Impact Report,[2] and to impose feasible mitigation to substantially lessen any significant effects.[3] Determining significance, however, can be a challenging task. Accordingly, the Governor's Office of Planning and Research in its June 2008 Technical Advisory, "CEQA and Climate Change,"[4] asked the Air Resources Board (ARB) to make recommendations for GHG-related thresholds of significance – identifiable benchmarks or standards that assist lead agencies in the significance determination.[5]

With this Staff Proposal, ARB staff is taking the first step toward developing recommended statewide interim thresholds of significance for GHGs that may be adopted by local agencies for their own use. The task that ARB staff is undertaking is, however, a limited one. Staff will not attempt to address every type of project that may be subject to CEQA, but instead will focus on common project types that, collectively, are responsible for substantial GHG emissions – specifically, industrial, residential, and commercial projects.[6] ARB staff believes that thresholds in these important sectors will advance our climate objectives, streamline project review, and encourage consistency and uniformity in the CEQA analysis of GHG emissions throughout the State.

Staff intends to make its final recommendations on thresholds in early 2009, in order to harmonize with OPR's timeline for issuing draft CEQA guidelines addressing GHG emissions[7] and to provide much needed guidance to lead agencies in the near term.

Public, stakeholder, and local lead agency participation is essential to the success of this project. ARB staff believes that the comment and feedback it receives, along with

---

[1] Senate Bill 97, Public Resources Code, § 21083.05.
[2] California Code of Regulations, tit. 14, § 15064, subd. (f)(1).
[3] Id., § 15021, subd. (a)(2).
[4] See: http://opr.ca.gov/download.php?dl=ceqa/pdfs/june08-ceqa.pdf
[5] Id., § 15064.7, subd. (a).
[6] The collective greenhouse gas emissions from the industrial, residential and commercial sectors, together with the transportation sector, represent approximately 80% of the statewide greenhouse gas emissions inventory in 2004.
[7] See Senate Bill 97, Public Resources Code § 21083.05 (providing that draft guidelines are due June 1, 2009).

additional data and analyses, can form a body of evidence that lead agencies may rely on in adopting thresholds of significance consistent with ARB staff's recommendations.

Because the schedule is expedited, staff's recommendations must necessarily be interim and subject to review and revision as more information becomes available.[8]

BACKGROUND

Significance Under CEQA

A significant effect on the environment means a substantial, or potentially substantial, change in the environment caused directly or indirectly by the project.[9] The incremental effect of a project can be significant when it is cumulatively considerable – that is, when the effect is added to that of other past, present, and reasonably foreseeable probable future projects that also contribute to the problem.[10]

To streamline and facilitate consistency in the significance determination, the CEQA Guidelines[11] encourage agencies "to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects."[12] A threshold of significance is an identifiable quantitative, qualitative or performance level that marks the division between an impact that is significant and one that is not. A threshold of significance gives rise to a presumption, which can be rebutted by evidence that the threshold should not apply to a particular project.

Thresholds of significance must be supported by "substantial evidence." This does not mean that there is one best threshold. In CEQA, substantial evidence "means enough relevant information and reasonable inferences from this information that a fair argument can be made to support a conclusion, even though other conclusions might also be reached."[13]

Climate Change and GHG Thresholds of Significance

"The capacity of the environment is limited, and it is the intent of the Legislature that the government of the state take immediate steps to identify any critical thresholds for the health and safety of the people of the state and take all coordinated actions necessary to prevent such thresholds being reached."[14] But where should a threshold of significance be set for GHG emissions and climate change? This question can be answered only after considering the nature of the environmental problem.

---

[8] ARB staff intends to monitor the implementation of thresholds that are adopted as a result of this process for effectiveness. In the same time frame as the update of the AB 32 Scoping Plan, staff intends to revisit its recommendations and to modify them if necessary.
[9] California Code of Regulations, title 14, §§ 15064, subd. (d), 15382.
[10] *Id.*, § 15355, subd. (b).
[11] Id., § 15000, et. seq.
[12] *Id.*, § 15064.7, subd. (a).
[13] *Id.*, § 15384, subd. (a).
[14] Public Resources Code, § 21000, subd. (d).

There is a scientific consensus that human activities, chief among them the burning of fossil fuels, profoundly affect the world's climate by increasing the atmospheric concentration of GHG beyond natural levels. Contributing additional GHG pollution to the atmosphere leads to higher global average temperatures, changes to climate, and adverse environmental impacts here in California and around the world.[15] Climate change, caused by "collectively significant projects taking place over a period of time[,]"[16] is a quintessential cumulative impact.

The experts tell us that an additional increase in global average temperatures of just 2 degrees Celsius (3.6 degrees Fahrenheit) is very likely dangerous.[17] With a 2 degree Celsius increase, disastrous effects become likely, including more extreme and more frequent severe weather, more wildfires, greater frequency of droughts and floods, rapid and higher sea level rise, and increased habitat destruction and extinctions.[18] These environmental effects will undoubtedly lead to serious economic, political, and national security disruptions.

In order to reduce the risk of dangerous climate change, we must stabilize atmospheric levels of GHGes at approximately 450 parts per million (ppm) by mid-century.[19] We are fast approaching this limit. Since the beginning of the industrial era, atmospheric concentrations of carbon dioxide, the primary GHG, have climbed to their highest point in the last half-million years, increasing from just under 300 ppm at the turn of the last century, to over 380 ppm today, and rising at about 2 ppm per year.[20]

In response to the challenge of climate change, California has taken a leadership role by committing to reduce its GHG emissions to 1990 levels by 2020 (about a thirty percent reduction in business-as-usual emissions in 2020) and to eighty percent below 1990 levels by 2050.[21] The latter target is consistent with the scientific consensus of the reductions needed to stabilize atmospheric levels of GHGs at 450 ppm by mid-century. Assembly Bill 32, the Global Warming Solutions Act of 2006, codifies the 2020 reduction

---

[15] There is a large body of authoritative sources on the causes and current and projected impacts of climate change. An extended discussion of climate change is beyond the scope of this Staff Proposal. For additional information, ARB recommends the Fourth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) and, in particular, the IPCC's "Frequently Asked Questions," available at: http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-faqs.pdf and the 2006 California Climate Action Team's Report to the Governor and Legislature, available at: http://www.climatechange.ca.gov/climate_action_team/reports/index.html.

[16] See California Code of Regulations, tit. 14, § 15355, subd. (b).

[17] See IPCC 4th Assessment Report, Working Group II, Summary for Policymakers, Figure 2, available at: http://www.ipcc.ch/graphics/graphics/ar4-wg2/jpg/spm2.jpg (chart showing global impacts at various temperature increases); California Climate Change Center, Our Changing Climate: Assessing the Risks to California (2008) at p. 15, available at http://www.energy.ca.gov/2006publications/CEC-500-2006-077/CEC-500-2006-077.PDF (chart showing impacts in California at various temperature increases.)

[18] *Id.*

[19] See IPCC 4th Assessment Report, Working Group III, Summary for Policymakers at p. 17, available at http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-spm.pdf.

[20] IPPC 4th Assessment Report, Working Group I, Figure FAQ 2.1, available at: http://www.ipcc.ch/graphics/graphics/ar4-wg1/jpg/faq-2-1-fig-1.jpg.

[21] Executive Order S-03-05

target and charges ARB with development of a Scoping Plan to map out how the State will achieve this target, including regulatory, voluntary, and market-based mechanisms beginning in 2012.[22]

There is strong need, however, to aggressively address GHG emissions right now. The pollution we contribute to the atmosphere today will continue to have climate impacts for years, decades, and, in some cases, millennia to come. And the longer we delay in addressing the problem, the more we risk being unable to meet our climate objective. CEQA provides a mechanism that is independent of AB 32 through which lead agencies can begin immediately to reduce the climate change-related impacts of the projects that come before them.

What Type of Threshold is Appropriate?

Some have suggested that because of the need for urgent action and the uncertainty of the precise "tipping point" for dangerous climate change, any contribution of GHGs to the atmosphere may be significant – a so-called "zero threshold."

ARB staff believes that for the project types under consideration, non-zero thresholds can be supported by substantial evidence. ARB staff believes that zero thresholds are not mandated in light of the fact that (1) some level of emissions in the near term and at mid-century is still consistent with climate stabilization and (2) current and anticipated regulations and programs apart from CEQA (e.g., AB 32, the Pavley vehicle regulations, the Renewable Portfolio Standard, the California Solar Initiative, and the commitment to net-zero-energy buildings by 2020 (residential) and 2030 (commercial)) will proliferate and increasingly will reduce the GHG contributions of past, present, and future projects.

But any non-zero threshold must be sufficiently stringent to make substantial contributions to reducing the State's GHG emissions peak, to causing that peak to occur sooner, and to putting California on track to meet its interim (2020) and long-term (2050) emissions reduction targets. ARB staff believes that the preliminary interim approaches outlined in this Staff Proposal are consistent with these objectives.

RECOMMENDED THRESHOLDS – CONCEPTUAL APPROACH

ARB staff believes that different GHG thresholds of significance may apply to projects in different sectors. Two primary reasons that sector-specific thresholds are appropriate are: (1) some sectors contribute more substantially to the problem, and therefore should have a greater obligation for emissions reductions, and, (2) looking forward, there are differing levels of emissions reductions expected from different sectors in order to meet California's climate objectives. We also believe that different types of thresholds **–** quantitative, qualitative, and performance-based **–** can apply to different sectors under the premise that the sectors can and must be treated separately given the state of the science and data. A sector-specific approach is consistent with ARB's

[22] Health and Safety Code, § 38500, et. seq.

Proposed Scoping Plan. Consequently, the Staff Proposal takes different, although harmonious, approaches to setting thresholds for different sectors.

The attached flowcharts describe ARB staff's preliminary interim threshold concepts for two important sectors: industrial projects (**Attachment A**) and residential and commercial projects (**Attachment B**). The objective is to develop thresholds for projects in these sectors that will result in a substantial portion of the GHG emissions from new projects being subject to CEQA's mitigation requirement, consistent with a lead agency's obligation to "avoid or minimize environmental damage where feasible."[23] ARB staff is working on a proposal for an interim approach for thresholds for transportation projects and large dairies. Electricity generation is another sector where clarity is needed in the near term. The California Energy Commission (CEC) recently began a public process for identifying an approach for assessing the significance of GHG emissions from power plant projects. CEC staff anticipates concluding that work in Spring 2009.[24]

ARB staff's proposed recommendations for GHG thresholds address projects for which local agencies are typically the CEQA lead agency. In addition to the CEC, other State agencies also serve as lead agencies under CEQA. ARB is coordinating with these State agencies on their approaches to thresholds of significance.

[23] California Code of Regulations, title 14, § 15021.
[24] The CEC adopted an Order Instituting Informational Proceeding on October 8, 2008 to address GHG emissions in power plant licensing cases: http://www.energy.ca.gov/ghg_powerplants/notices/2008-10-06_PROPOSED_GHG_CEQA_OII.PDF.

REQUEST FOR PUBLIC COMMENT

ARB staff believes that the concepts in this Staff Proposal can be further developed into interim thresholds of significance. However, staff recognizes that additional analyses and data are needed to fill in some of the blanks, and to understand how the thresholds will operate in the real world.

Comments on all aspects of the Staff Proposal are encouraged. In particular, ARB seeks the active participation of local lead agencies. Staff has identified a few questions to solicit public comment, but this list is not exhaustive.

- Will the recommended approaches have any unintended consequences, for example, encouraging the piecemealing of projects?

- As set out in the attachments to the Staff Proposal, staff proposes to define certain performance standards (*e.g.*, for energy efficiency) by referencing or compiling lists from existing local, State or national standards. For some sub-sources of GHG emissions (*e.g.*, construction, transportation, waste), ARB staff has not identified reference standards. How should the performance standards for these sub-sources be defined?

- Are any of the industrial, residential, or commercial project types eligible for categorical exemptions likely to contribute more significantly to climate change than staff's preliminary analysis indicates?

- For residential and commercial projects, staff has proposed that the GHG emissions of some projects that meet GHG performance standards might under some circumstances still be considered cumulatively considerable and therefore significant. What types of projects might still have significant climate change-related impacts?

ATTACHMENT A
Preliminary Draft Proposal for Industrial Projects

1. The project is exempt under existing statutory or categorical exemptions.

No

2. (a) The project meets both of the below minimum performance standards, or includes equivalent mitigation measures:

Construction
- Meets an interim ARB performance standard for construction-related emissions.

Transportation
- Meets an interim ARB performance standard for transportation.

<u>AND</u>

(b) The project, with mitigation, will emit no more than ~7,000 metric tons CO_2e/yr from non-transportation-related GHG sources (which addresses ~90% of industrial sector GHG emissions). Includes:
- Combustion-related components/equipment;
- Process losses (fugitive, working, evaporative, etc.);
- Purchased electricity; and
- Water usage and wastewater discharge

No

3. Project will have significant GHG impacts. An EIR must be prepared and all feasible GHG mitigation measures implemented.

Yes

Yes

Yes

Presumption of less than significant impacts related to climate change

Presumption of significant impacts related to climate change

[page intentionally blank]

Preliminary Draft Proposal for Industrial Projects

Introduction

CEQA guidelines provide that thresholds of significance can be qualitative, quantitative, or in the form of performance standards. ARB staff's objective is to develop a threshold of significance that will result in the vast majority (~90% statewide) of the greenhouse gas (GHG) emissions from new industrial projects being subject to CEQA's requirement to impose feasible mitigation. ARB staff believes this can be accomplished with a threshold that allows small projects to be considered insignificant. ARB staff used existing data for the industrial sector to derive a proposed hybrid threshold. The threshold consists of a quantitative threshold of 7,000 metric tons of CO2 equivalent per year (MTCO2e/year) for operational emissions (excluding transportation), and performance standards for construction and transportation emissions.

The goal of this effort is to provide for the mitigation of GHG emissions from industrial projects on a statewide level. Over time, implementation of AB 32 will reduce or mitigate GHG emissions from industrial sources. Once such requirements are in place, they could become the performance standard for industrial projects for CEQA purposes. ARB staff intends to pursue this approach in conjunction with development of the regulatory requirements for industrial sources in the Proposed AB 32 Scoping Plan. Staff is proposing the use of a quantitative significance threshold at least until such time that performance standards, such AB 32 regulatory requirements, are in place to ensure mitigation of significant impacts of GHG emissions from projects in the industrial sector.

The performance standards are largely self explanatory and similar to the approaches proposed for residential and commercial projects. The method for deriving the quantitative aspect of the threshold warrants further explanation.

Technical foundation for proposed quantitative aspect of the threshold

Based on the available data, ARB staff found that for the industrial sector, small projects – defined as the portion of new projects that, when viewed collectively, were responsible for only a relatively small amount of emissions – could be allowed to proceed without requiring additional mitigation under CEQA. The question for ARB staff was what line divides these small projects from the rest of the projects that should undergo mitigation to achieve the larger environmental objective.

ARB decided to construct a representative small project and to estimate that project's expected emissions. First, ARB considered the common sub-sources of GHG emissions in the industrial sector. The four main broad emission categories and their approximate statewide contribution to GHG emissions from industrial facilities other than power plants are:

Category	MMTCO2e/year	Percent (%)
Combustion processes	70	63 %
Process Losses (evaporative, fugitive, working, etc.)	15	13 %
Purchased Electricity	18	17 %
Water Use and Wastewater Treatment	7	7 %

As the table indicates, GHG emissions from industrial sources are dominated by combustion emissions. To ensure that significant industrial emissions would be captured by the proposed threshold, ARB staff evaluated industrial boilers because they are a very common piece of equipment, are essential in many energy-intensive industries, and are a top contributor to industrial combustion emissions.

A recent comprehensive survey of industrial boilers by Oak Ridge National Laboratory[25] found that boilers with an input capacity of 10 MMBtu/hr or greater correspond to 93 percent of total industrial boiler input capacity. Based on this data, ARB staff used a natural gas boiler input capacity benchmark of 10 MMBtu/hr which equates to emissions of 4,660 MTCO2e/yr. This capacity benchmark defines a significant combustion source.

As shown in the above table, combustion processes account for 63 percent of the statewide GHG emissions from industrial facilities. Process losses, purchased electricity, and water use and water treatment account for the remaining 27 percent of emissions. Staff applied these proportions to the benchmark combustion emissions estimate (4,660 MTCO2e/yr). The result is an overall emissions estimate of approximately 7,000 MTCO2e/yr for a representative small project that accounts for the four main categories in the table above.

Based on the available data, staff believes that the 7,000 MTCO2e/year benchmark can be used to effectively mitigate industrial projects with significant GHG emissions.

[25] Characterization of the U.S. Industrial/Commercial Boiler Population, Energy, and Environmental Analysis, Inc. submitted to Oak Ridge National Laboratory, available at:: http://ww.eea-inc.com/natgas_reports/BoilersFinal.pdf.

ATTACHMENT B
Preliminary Draft Proposal for Residential and Commercial Projects

1. The project is exempt under existing statutory or categorical exemptions.

Yes

No

2. The project complies with a previously approved plan that addresses GHG emissions, satisfies (15064(h)(3)), and has all of the following attributes:

- Meets a community level GHG target consistent with the statewide emissions limit in AB 32 and, where the plan will apply beyond 2020, Executive Order S-3-05;
- Is consistent with a transportation-related GHG reduction target adopted by ARB pursuant to SB 375.
- Includes a GHG inventory and mechanisms to regularly monitor and evaluate emissions;
- Includes specific, enforceable GHG requirements;
- Incorporates mechanisms that allow the plan to be revised in order to meet targets; and
- Has a certified final CEQA document (see 15152(f)).

Yes

No

3. (a) The project meets all of the below minimum performance standards, or includes equivalent mitigation measures.

Construction
- Meets an interim ARB performance standard for construction-related emissions;

Operations
- Meets an energy use performance standard defined as CEC's Tier II Energy Efficiency goal;
- Meets an interim ARB performance standard for water use;
- Meets an interim ARB performance standard for waste;
- Meets an interim ARB performance standard for transportation;

<u>AND</u>

(b) The project, with performance standards or equivalent mitigation, will emit no more than X metric tons CO2e/yr (criteria to be developed).

Yes

No

4. Project will have significant GHG impacts. An EIR must be prepared and all feasible GHG mitigation measures implemented.

Yes

Presumption of less than significant impacts related to climate change

Presumption of significant impacts related to climate change

[page intentionally blank]

Preliminary Draft Proposal for Residential and Commercial Projects

Introduction

CEQA guidelines provide that thresholds of significance can be qualitative, quantitative, or in the form of performance standards. ARB staff's objective is to develop a threshold for residential and commercial projects that will substantially reduce the greenhouse gas (GHG) emissions from new projects and streamline the permitting of carbon-efficient projects. To achieve this, staff's preliminary recommendation is to develop a threshold based on clear and stringent performance standards.

Performance standards will address the five major emission sub-sources for the sector: energy use, transportation, water use, waste, and construction. For the energy use performance standard, staff recommends reliance on the California Energy Commission's (CEC) Tier II Energy Efficiency standards for solar energy incentive programs. These standards are consistent with what is needed to meet the state's goal of zero net energy buildings and are continuously updated to reflect energy efficiency best practices. For the remaining sub-sources (water, waste, etc.), staff intends to compile benchmark performance standards as part of its final threshold recommendation. Projects may alternatively incorporate mitigation equivalent to these performance standards.

Staff recognizes that a substantial body of measures to address GHG emissions exists through programs like LEED, GreenPoint Rated, and the California Green Building Code. As work on performance standards moves forward, staff intends to make use of these projects.

In addition, staff proposes that a presumption of non-significance apply only to projects whose total net emissions, after meeting the performance standards or equivalent, are below a specified level. Staff proposes to develop this emissions level as part of its final threshold recommendation.

Discussion of Flow Chart

Box 1: In general, categorical exemptions will continue to apply.

Based on its preliminary analysis, ARB staff believes that projects described in CEQA's categorical and statutory exemption provisions (Articles 18 and 19 of the California Code of Regulations, title 14) will not interfere with achieving the objective to minimize emissions from new projects in this sector. GHG emissions from residential and commercial projects that are described in the categorical exemption language appear to be relatively small from a GHG perspective. For example, staff's preliminary analysis indicates that emissions from a project qualifying for the statutory infill project exemption (Cal. Code Regs., tit. 14, § 15195) will emit approximately 1,600 metric tons (MT)CO2e/yr. Staff believes such infill projects represent some of the largest projects described in the exemption provisions. ARB staff expects to provide additional analyses to support a lead agency's determination that the GHG impact of these project types is less than significant. Staff invites the public and stakeholders to provide further evidence on the application of categorical exemptions to residential and commercial projects.

Box 2: If GHGs are adequately addressed at the programmatic level, the impact of certain individual projects can be found to be insignificant.

As OPR noted in its June 2008 Technical Advisory:

> CEQA can be a more effective tool for greenhouse gas emissions analysis and mitigation if it is supported and supplemented by sound development policies and practices that will reduce greenhouse gas emissions on a broad planning scale and that can provide the basis for a programmatic approach to project-specific CEQA analysis and mitigation…. For local government lead agencies, adoption of general plan policies and certification of general plan EIRs that analyze broad jurisdiction-wide impacts of greenhouse gas emissions can be part of an effective strategy for addressing cumulative impacts and for streamlining later project-specific CEQA reviews.

ARB staff encourages local agencies to take advantage of a programmatic approach to address climate change, consistent with existing law.

If a project complies with the requirements of a previously adopted GHG emission reduction plan or mitigation program that satisfies California Code of Regulations, title 14, section 15064(h)(3), and includes the attributes specified in that provision and Box 2, the lead agency may determine that the project's GHG impacts are less than significant with no further analysis required. Examples of plans that may satisfy this provision include Climate Action Plans incorporated into General Plans that have inventories, an emissions target, suites of specific and enforceable measures to reach that target, monitoring and reporting, and mechanisms to revise the plan to stay on target. Moreover, a prior EIR that "adequately addressed" climate change may be used for tiering purposes. (See Cal. Code Regs. tit. 14, § 15152.)

Box 3: Projects that meet performance standards, or include equivalent mitigation, can be found to be insignificant.

The threshold incorporates performance standards requiring carbon efficiency for each major sub-source of emissions from projects in these sectors. Provided they are set at a sufficiently stringent level, performance standards will dramatically reduce GHG emissions and promote a transition toward zero and low emission projects. In most cases, ARB staff expects that performance standards will need to reach beyond current State mandates by a substantial amount, given that GHG emission reduction goals have not yet been adequately incorporated into State programs. Staff anticipates that performance standards will become more stringent over time.

ARB staff has identified the California Energy Commission's Tier II Energy Efficiency goals as an appropriate performance standard for energy use. Under State law, the CEC is required to establish eligibility criteria, conditions for incentives, and rating standards to qualify for ratepayer-funded solar energy system incentives in California. As part of this effort, the CEC establishes energy efficiency standards for homes and commercial structures, and requires new buildings to exceed current building standards by meeting Tier Energy Efficiency goals. CEC's Tier II Energy Efficiency goals will continue to be updated to achieve energy efficiency best practices, and are consistent with what is needed to meet the California Public Utilities Commission Strategic Plan goals of zero net energy buildings. Currently, the CEC's proposed guidelines for the solar energy incentive program recommend a Tier II goal for residential and commercial projects of a 30 percent reduction in building combined space heating, cooling, and water heating energy compared to the 2008 Title 24 Standards.[26]

For the remaining sub-sources, staff intends to compile benchmark performance standards as part of its final threshold recommendation. ARB staff believes that existing progressive green building standards provide a starting point for performance standards for transportation, water use, waste, and construction-related emissions. Existing green building rating systems like LEED, GreenPoint Rated, the California Green Building Code, and others, contain examples of measures that are likely to result in substantial GHG emission reductions from residential and commercial projects. The key to this approach will be identifying effective GHG reduction measures within these systems. ARB staff would like input from the public and stakeholders on appropriate performance standards for these sub-sources. Performance standards that already exist and have been proven to be effective – at the local, State, national or international level – are preferable.

Under staff's proposed approach, lead agencies would be allowed to find that a project's mitigation is "equivalent" to identified performance standards, thereby allowing for cost-effective and innovative approaches to reducing GHG emissions.

Staff believes that under some circumstances, projects that meet performance standards or include equivalent mitigation measures will have impacts that may still be cumulatively considerable and therefore significant. For this reason, staff recommends that, in addition to meeting performance standards or including

[26] Guidelines for California's Solar Electric Incentive Program Pursuant to Senate Bill 1 - SECOND EDITION - Draft Guidelines can be found at: http://www.energy.ca.gov/2008publications/CEC-300-2008-007/CEC-300-2008-007-D.PDF

equivalent mitigation measures, a project must also emit no more than “X” MTCO2e/yr. Criteria for determining this emissions level have yet to be defined. ARB requests public and stakeholder input on what types of projects might still have significant climate change-related impacts.

Box 4: Presumption of significant impacts.

If a project cannot meet the requirements in the previous boxes, it should be presumed to have significant impacts related to climate change. The lead agency must then prepare an EIR, or other appropriate document, and implement all feasible GHG mitigation measures.

California Air Resources Board

Staff Proposal on Greenhouse Gas Thresholds of Significance under CEQA

Potential Performance Standards and Measures

December 9, 2008

Background

- AB 32 & Executive Order S-03-05
- SB 97
  - OPR tasked with updating CEQA guidelines for GHGs by early 2009
  - OPR asked ARB to recommend a method for setting GHG-related significance thresholds
- October release of preliminary draft proposal for interim thresholds

2

Overview - Preliminary Draft Proposal

- Residential and Commercial Projects
  - Performance standards for construction, energy, water, waste and transportation
  - Upper limit on project emissions
- Industrial Projects
  - Quantitative standard of 7,000 MTCO2e/yr for operational emissions
  - Performance standard for construction

3

Process Highlights

- Focus today on performance standards for residential and commercial projects
- Staff working on overall framework in response to comments
- December 19 release of next draft proposal
  - Framework, thresholds and application analysis
- Third workshop early January
- Board meeting January 22, 2009

4

Context

- Global, cumulative pollutant
- Project-by-project CEQA approach
- Distinct AB 32 and CEQA statutes
- Lead agencies implement CEQA

5

ARB Staff's Overall Approach

- Stringent non-zero thresholds
- Apply sector-by-sector approach
- Encourage lead agencies to include lifecycle emissions where appropriate
- ARB recommendation is interim
- Lead agencies retain existing authority on thresholds

6

Residential and Commercial Projects

7

Developing Performance Standards and Measures

8

Sources

- Staff surveyed performance standards and best management practices in:
  - Green building rating systems
  - California Green Building Code
  - Incentive programs
  - CEQA exemption in SB375

9

Green Building Rating Systems

- Leadership in Energy and Environmental Design:
  - New Construction - Homes
  - Existing Buildings - Schools
  - Neighborhood Development
- Collaborative for High Performance Schools
- California Green Builder Program
- Green Point Rated Single and Multifamily Homes

10

Incentive Programs

- Federal Transit Administration
  - New Starts Program
- CA Housing and Community Development
  - Transit Oriented Development Housing Program
- CA Energy Commission
  - SB 1 Solar Electric Incentive Programs

11

Application of Performance Standards and Measures

- Project would meet all interim performance standards for:
  - Energy - Water
  - Waste - Construction
  - Transportation
- Project with mitigation may demonstrate an equivalent level of GHG emission reductions

12

Potential Performance Standards and Measures

13

Construction

- Provide alternative transportation mode options or incentives for workers to and from worksite on days that construction requires 200 or more workers; AND
- Recycle and/or salvage at least 75% of non-hazardous construction and demolition debris by weight (residential) or by weight or volume (commercial); AND

Potential Performance Standards and Measures

14

Construction, cont.

- Use recycled materials for at least 20% of construction materials
  - Based on cost for building materials
  - Based on volume for roadway, parking lot, sidewalk and curb materials
  - Recycled materials may include: salvaged, reused, and recycled content materials

Energy

- Meet CEC's voluntary Tier II Energy Efficiency standards in effect at time building construction begins
  - Source: Standards to qualify for solar energy incentive programs
  - Currently 30% reduction in combined space heating, cooling and water heating energy compared to 2008 Title 24 Standards

Water

- Reduce indoor potable water use by at least 20%
- Reduce outdoor potable water use for landscape irrigation by at least 50%

Benchmark for comparison: water use levels projected by application of methodology in California Green Building Code, Section 603.2 (for indoor) and 604.2 (for outdoor)

Waste

- Where local recycling and/or composting programs exist:
  - Design facilities and structures to encourage participation in program; AND
  - Install adequate, accessible recycling and composting receptacles in common or public areas; AND
  - Provide easy access to central recycling and composting receptacles or collections areas

Residential Transportation

- Demonstrate that average vehicle miles traveled per household per year (VMT/hh-yr) is projected not to exceed 14,000 VMT/hh-yr
- Represents carbon-efficient, compact development with close proximity to transit and variety of services

Commercial Transportation

- Meet the following proximity and design elements:
  - ½ mile of residential zone or neighborhood with average density of at least 10du/net acre; AND
  - ½ mile of at least 10 neighborhood services; AND
  - Pedestrian access between project and services; AND

Commercial Transportation, cont.

- Institute comprehensive transportation demand management (TDM) program to reduce employee trips by at least 20%

Analysis of Representative Projects

- Impacts on all sub-sources, except waste
- Six residential projects
  - Single and multifamily, some with local serving retail and transit, density of 3-38 units/acre
  - Size: 45 - 14,000 dwelling units
- Six commercial projects
  - Distribution center, business park, discount superstore, medical office, office tower, school
  - Size: 100,000 – 5,000,000 sq ft

Emission Reductions by Project

- Application of performance standards and measures resulted in emission reductions of:
  - Residential: 20 – 50%
  - Commercial: 7 – 15%

23

Next Steps

Schedule

Dec 9:	Performance standards/measures and initial results
Dec 16:	Comments due on draft performance standards/measures
Dec 19:	Updated Draft Recommendation
Jan 6:	3rd Public Workshop
	Comments due on updated Draft
Jan 12:	Draft Recommendation for Board
Jan 22:	ARB Board Meeting

Contacts

Project Website:

http://www.arb.ca.gov/cc/localgov/ceqa/ceqa.htm

Online Comments:

http://www.arb.ca.gov/cc/localgov/ceqa/ceqacomm.htm

CAPCOA

CALIFORNIA
AIR
POLLUTION
CONTROL
OFFICERS
ASSOCIATION

CEQA & Climate Change

Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act

January 2008

Disclaimer

The California Air Pollution Control Officers Association (CAPCOA) has prepared this white paper consideration of evaluating and addressing greenhouse gas emissions under the California Environmental Quality Act (CEQA) to provide a common platform of information and tools to support local governments.

This paper is intended as a resource, not a guidance document. It is not intended, and should not be interpreted, to dictate the manner in which an air district or lead agency chooses to address greenhouse gas emissions in the context of its review of projects under CEQA.

This paper has been prepared at a time when California law has been recently amended by the Global Warming Solutions Act of 2006 (AB 32), and the full programmatic implications of this new law are not yet fully understood. There is also pending litigation in various state and federal courts pertaining to the issue of greenhouse gas emissions. Further, there is active federal legislation on the subject of climate change, and international agreements are being negotiated. Many legal and policy questions remain unsettled, including the requirements of CEQA in the context of greenhouse gas emissions. This paper is provided as a resource for local policy and decision makers to enable them to make the best decisions they can in the face of incomplete information during a period of change.

Finally, this white paper reviews requirements and discusses policy options, but it is not intended to provide legal advice and should not be construed as such. Questions of legal interpretation, particularly in the context of CEQA and other laws, or requests for advice should be directed to the agency's legal counsel.

Acknowledgements

This white paper benefited from the hard work and creative insights of many people. CAPCOA appreciates the efforts of all who contributed their time and energy to the project. In particular, the Association thanks the following individuals:

Principal Authors

Greg Tholen, BAAQMD
Dave Vintze, BAAQMD
Jean Getchell, MBUAPCD
Matt Jones, YSAQMD
Larry Robinson, SMAQMD
Ron Tan, SBCAPCD

Editor

Barbara Lee, NSAPCD

Reviewers

CAPCOA Climate Protection Committee

Barbara Lee (NSCAPCD), Chair

Larry Allen, SLOCPCD
Bobbie Bratz, SBAPCD
Karen Brooks, SLOCAPCD
Chris Brown, MCAQMD
Tom Christofk, PCAPCD
Jorge DeGuzman, SMAQMD
Mat Ehrhardt, YSAQMD
Jean Getchell, MBUAPCD
Larry Greene, SMAQMD
Henry Hilken, BAAQMD
Alan Hobbs, PCAPCD
Jim Jester, SMAQMD
Dave Jones, KCAPCD
Tom Jordan, SJVUAPCD
Tom Murphy, SBAPCD
Don Price, VCAPCD
Jean Roggenkamp, BAAQMD
Ana Sandoval, BAAQMD
Amy Taketomo, MBUAPCD
Tim Taylor, SMAQMD
Mike Villegas, VCAPCD
David Vintze, BAAQMD
Dave Warner, SJVUAPCD
Jill Whynot, SCAQMD
John Yu, CAPCOA
Mel Zeldin, CAPCOA

CAPCOA Planning Managers:
CEQA & Climate Change Subcommittee

Dave Vintze (BAAQMD), Chair
Greg Tholen (BAAQMD), Project Manager

Charles Anderson, SMAQMD
Aeron Arlin Genet, SLOCAPCD
Jean Getchell, MBUAPCD
Melissa Guise, SLOCAPCD
Matt Jones, YSAQMD
Barbara Lee, NSCAPCD
Ryan Murano, NSAQMD
Tom Murphy, SBCAPCD
Susan Nakamura, SCAQMD
Larry Robinson, SMAQMD
Jean Roggenkamp, BAAQMD
Ana Sandoval, BAAQMD
Ron Tan, SBCAPCD
Brigette Tollstrup, SMAQMD
Jill Whynot, SCAQMD

External Reviewers

James Goldstene, CARB
Annmarie Mora, CARB
Terri Roberts, OPR

Proofing & Layout

Jake Toolson, CAPCOA
John Yu, CAPCOA

Contract Support

Jones & Stokes, Sacramento, CA *(analysis of non-zero threshold approaches)*
EDAW, Inc., Sacramento, CA *(review of analytical methods and mitigation strategies)*.

Table of Contents

List of Figures

List of Tables

List of Acronyms and Abbreviations

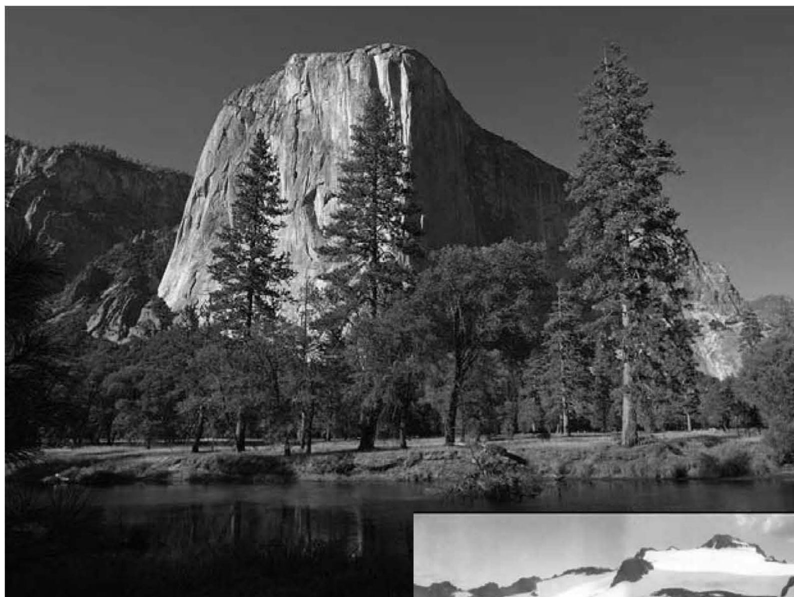
Acronym/ Abbreviation	Meaning
AB 32	Assembly Bill 32 Global Warming Solutions Act of 2006
AG	Attorney General
ARB	Air Resources Board
ASTM	American Society of Testing and Material
BAAQMD	Bay Area Air Quality Management District
BAU	Business as Usual
BEES	Building for Environmental and Economic Sustainability
Calfire	California Fire
Caltrans	California Department of Transportation
CAP	Criteria Air Pollutants
CAPCOA	California Air Pollution Control Officers Association
CARB	California Air Resource Board
CAT	Climate Action Team
CCAP	Center for Clean Air Policy
CCAR	California Climate Action Registry
CDFA	California Department of Food and Agriculture
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CF	Connectivity Factor
CH_4	Methane
CIWMB	California Integrated Waste Management Board
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CNG	Compressed Natural Gas
CPUC	California Public Utilities Commission
CUFR	California Urban Forestry
DGS	Department of General Services
DOE	U.S. Department of Energy
DOF	Department of Finance
DPF	Diesel Particulate Filter
DWR	Department of Water Resources
E85	85% Ethanol
EEA	Massachusetts Executive Office of Energy and Environmental Affairs
EERE	Energy Efficiency and Renewable Energy
EIR	Environmental Impact Report
EOE	Encyclopedia of Earth
EPA	U.S. Environmental Protection Agency
ETC	Edmonton Trolley Coalition
EV	Electric Vehicles
FAR	Floor Area Ratio

GHG	Greenhouse Gas
GGEP	Greenhouse Gas Emissions Policy
GGRP	Greenhouse Gas Reduction Plan
GP	General Plan
GWP	Global Warming Potential
IGCC	Integrated Gasification Combined Cycle
IOU	Investor Owned Utility
IPCC	International Panel on Climate Change
IT	Information Technology
ITE	Institute of Transportation Engineers
J&S	Jones & Stokes
km	Kilometer
LandGem	Landfill Gas Emissions Model
LEED	Leadership in Energy and Environmental Design
LNG	Liquefied Natural Gas
MBUAPCD	Monterey Bay Unified Air Pollution Control District
MEPA	Massachusetts Environmental Policy Act
MND	Mitigated Negative Declaration
MMT CO_2e	Million Metric Tons Carbon Dioxide Equivalent
MW	Megawatts
N_2O	Nitrous Oxide
NACAA	National Association Clean Air Agencies
ND	Negative Declaration
NEV	Neighborhood Electric Vehicle
NIST	National Institute of Standards and Technology
NO_X	Oxides of Nitrogen
NREL	National Renewable Energy Laboratory
NSCAPCD	Northern Sonoma County Air Pollution Control District
NSR	New Source Review
OPR	State Office of Planning and Research
PFC	Perfluorocarbon
PG&E	Pacific Gas & Electric
POU	Publicly Owned Utility
PM	Particulate Mater
RoadMod	Road Construction Emissions Model
ROG	Reactive Organic Gas
RPS	Renewable Portfolio Standards
RTP	Regional Transportation Plan
S-3-05	Executive Order S-3-05
SB	Senate Bill
SBCAPCD	Santa Barbara County Air Pollution Control District
SCAQMD	South Coast Air Quality Management District
SCM	Sustainable Communities Model
SIP	State Implementation Plan
SJVAPCD	San Joaquin Valley Unified Air Pollution Control District
SLOCAPCD	San Luis Obispo County Air Pollution Control District

SMAQMD	Sacramento Metropolitan Air Quality Management District
SMUD	Sacramento Municipal Utilities District
SO_X	Sulfur Oxides
SP	Service Population
SRI	Solar Reflectance Index
SWP	State Water Project
TAC	Toxic Air Contaminants
TBD	To Be Determined
TDM	Transportation Demand Management
TMA	Transportation Management Association
THC	Total Hydrocarbon
UC	University of California
ULEV	Ultra Low Emission Vehicle
UNFCCC	United Nations Framework Convention on Climate Change
URBEMIS	Urban Emissions Model
USGBC	U.S. Green Building Council
VMT	Vehicle Miles Traveled
VTPI	Victoria Transit Policy
YSAQMD	Yolo-Solano Air Quality Management District

Introduction

The California Environmental Quality Act (CEQA) requires that public agencies refrain from approving projects with significant adverse environmental impacts if there are feasible alternatives or mitigation measures that can substantially reduce or avoid those impacts. There is growing concern about greenhouse gas emissions[1] (GHG) and recognition of their significant adverse impacts on the world's climate and on our environment. In its most recent reports, the International Panel on Climate Change (IPCC) has called the evidence for this "unequivocal." In California, the passage of the Global Warming Solutions Act of 2006 (AB 32) recognizes the serious threat to the "economic well-being, public health, natural resources, and the environment of California" resulting from global warming. In light of our current understanding of these impacts, public agencies approving projects subject to the CEQA are facing increasing pressure to identify and address potential significant impacts due to GHG emissions. Entities acting as lead agencies in the CEQA process are looking for guidance on how to adequately address the potential climate change impacts in meeting their CEQA obligations.



Air districts have traditionally provided guidance to local lead agencies on evaluating and addressing air pollution impacts from projects subject to CEQA. Recognizing the need for a common platform of information and tools to support decision makers as they establish policies and programs for GHG and CEQA, the California Air Pollution Control Officers Association has prepared a white paper reviewing policy choices, analytical tools, and mitigation strategies.

This paper is intended to serve as a resource for public agencies as they establish agency procedures for reviewing GHG emissions from projects under CEQA. It considers the application of thresholds and offers three alternative programmatic approaches toward

[1] Throughout this paper GHG, CO_2, CO_2e, are used interchangeably and refer generally to greenhouse gases but do not necessarily include all greenhouse gases unless otherwise specified.

determining whether GHG emissions are significant. The paper also evaluates tools and methodologies for estimating impacts, and summarizes mitigation measures. It has been prepared with the understanding that the programs, regulations, policies, and procedures established by the California Air Resources Board (CARB) and other agencies to reduce GHG emissions may ultimately result in a different approach under CEQA than the strategies considered here. The paper is intended to provide a common platform for public agencies to ensure that GHG emissions are appropriately considered and addressed under CEQA while those programs are being developed.

Examples of Other Approaches

Many states, counties, and cities have developed policies and regulations concerning greenhouse gas emissions that seek to require or promote reductions in GHG emissions through standards for vehicle emissions, fuels, electricity production/renewables, building efficiency, and other means. A few have developed guidance and are currently considering formally requiring or recommending the analysis of greenhouse gas emissions for development projects during their associated environmental processes. Key work in this area includes:

- Massachusetts Office of Energy and Environmental Affairs Greenhouse Gas Emissions Policy;
- King County, Washington, Executive Order on the Evaluation of Climate Change Impacts through the State Environmental Policy Act;
- Sacramento AQMD interim policy on addressing climate change in CEQA documents; and
- Mendocino AQMD updated guidelines for use during preparation of air quality impacts in Environmental Impact Reports (EIRs) or mitigated negative declarations.

The following paper evaluates options for lead agencies to ensure that GHG emissions are appropriately addressed as part of analyses under CEQA. It considers the use of significance thresholds, tools and methodologies for analyzing GHG emissions, and measures and strategies to avoid, reduce, or mitigate impacts.

Greenhouse Gas Significance Criteria

This white paper discusses three basic options air districts and lead agencies can pursue when contemplating the issues of CEQA thresholds for greenhouse gas emissions. This paper explores each path and discusses the benefits and disbenefits of each. The three basic paths are:

- No significance threshold for GHG emissions;

- GHG emissions threshold set at zero; or

- GHG threshold set at a non-zero level.

Each has inherent advantages and disadvantages. Air districts and lead agencies may believe the state or national government should take the lead in identifying significance thresholds to address this global impact. Alternatively, the agency may believe it is premature or speculative to determine a clear level at which a threshold should be set. On the other hand, air districts or lead agencies may believe that every GHG emission should be scrutinized and mitigated or offset due to the cumulative nature of this impact. Setting the threshold at zero will place all discretionary projects under the CEQA microscope. Finally, an air district or lead agency may believe that some projects will not benefit from a full environmental impact report (EIR), and may believe a threshold at some level above zero is needed.

This paper explores the basis and implications of setting no threshold, setting a threshold at zero and two primary approaches for those who may choose to consider a non-zero threshold. The first approach is grounded in statute (AB 32) and executive order (EO S-3-05) and explores four possible options under this scenario. The options under this approach are variations of ways to achieve the 2020 goals of AB 32 from new development, which is estimated to be about a 30 percent reduction from business as usual.

The second approach explores a tiered threshold option. Within this option, seven variations are discussed. The concepts explored here offer both quantitative and qualitative approaches to setting a threshold as well as different metrics by which tier cut-points can be set. Variations range from setting the first tier cut-point at zero to second-tier cut-points set at defined emission levels or based on the size of a project. It should be noted that some applications of the tiered threshold approach may require inclusion in a General Plan or adoption of enabling regulations or ordinances to render them fully effective and enforceable.

Greenhouse Gas Analytical Methodologies

The white paper evaluates various analytical methods and modeling tools that can be applied to estimate the greenhouse gas emissions from different project types subject to CEQA. In addition, the suitability of the methods and tools to characterize accurately a project's emissions is discussed and the paper provides recommendations for the most appropriate methodologies and tools currently available.

The suggested methodologies are applied to residential, commercial, specific plan and general plan scenarios where GHG emissions are estimated for each example. This chapter also discusses estimating emissions from solid waste facilities, a wastewater treatment plant, construction, and air district rules and plans.

Another methodology, a service population metric, that would measure a project's overall GHG efficiency to determine if a project is more efficient than the existing statewide average for per capita GHG emissions is explored. This methodology may be more directly correlated to a project's ability to help achieve objectives outlined in AB 32, although it relies on establishment of an efficiency-based significance threshold. The subcommittee believes this methodology may eventually be appropriate to evaluate the long-term GHG emissions from a project in the context of meeting AB 32 goals. However, this methodology will need further work and is not considered viable for the interim guidance presented in this white paper.

Greenhouse Gas Mitigation Measures

Common practice in environmental protection is first to avoid, then to minimize, and finally to compensate for impacts. When an impact cannot be mitigated on-site, off-site mitigation can be effectively implemented in several resource areas, either in the form of offsetting the same impact or preserving the resource elsewhere in the region.

This white paper describes and evaluates currently available mitigation measures based on their economic, technological and logistical feasibility, and emission reduction effectiveness. The potential for secondary impacts to air quality are also identified for each measure. A summary of current rules and regulations affecting greenhouse gas emissions and climate change is also provided.

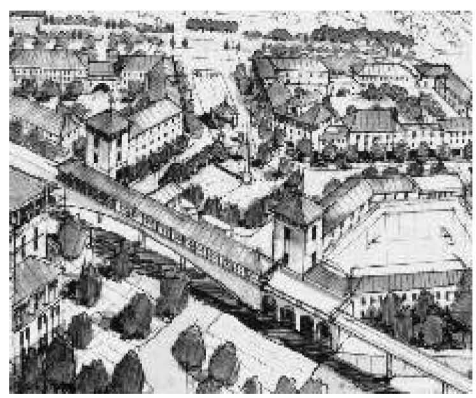
Reductions from transportation related measures (e.g., bicycle, pedestrian, transit, and parking) are explored as a single comprehensive approach to land use. Design measures that focus on enhancing alternative transportation are discussed. Mitigation measures are identified for transportation, land use/building design, mixed-use development, energy efficiency, education/social awareness and construction.

Chapter 1: Introduction

Purpose

CEQA requires the avoidance or mitigation of significant adverse environmental impacts where there are feasible alternatives available. The contribution of GHG to climate change has been documented in the scientific community. The California Global Warming Solutions Act of 2006 (AB 32) mandates significant reductions in greenhouse gases (GHG); passage of that law has highlighted the need to consider the impacts of GHG emissions from projects that fall under the jurisdiction of the California Environmental Quality Act (CEQA). Because we have only recently come to fully recognize the potential for significant environmental impacts from GHG, most public agencies have not yet established policies and procedures to consider them under CEQA. As a result, there is great need for information and other resources to assist public agencies as they develop their programs.

Air districts have historically provided guidance to local governments on the evaluation of air pollutants under CEQA. As local concern about climate change and GHG has increased, local governments have requested guidance on incorporating analysis of these impacts into local CEQA review. The California Air Pollution Control Officers Association (CAPCOA), in coordination with the CARB, the Governor's Office of Planning and Research (OPR) and two environmental consulting firms, has harnessed the collective expertise to evaluate approaches to analyzing GHG in CEQA. The purpose of this white paper is to provide a common platform of information and tools to address climate change in CEQA analyses, including the evaluation and mitigation of GHG emissions from proposed projects and identifying significance threshold options.

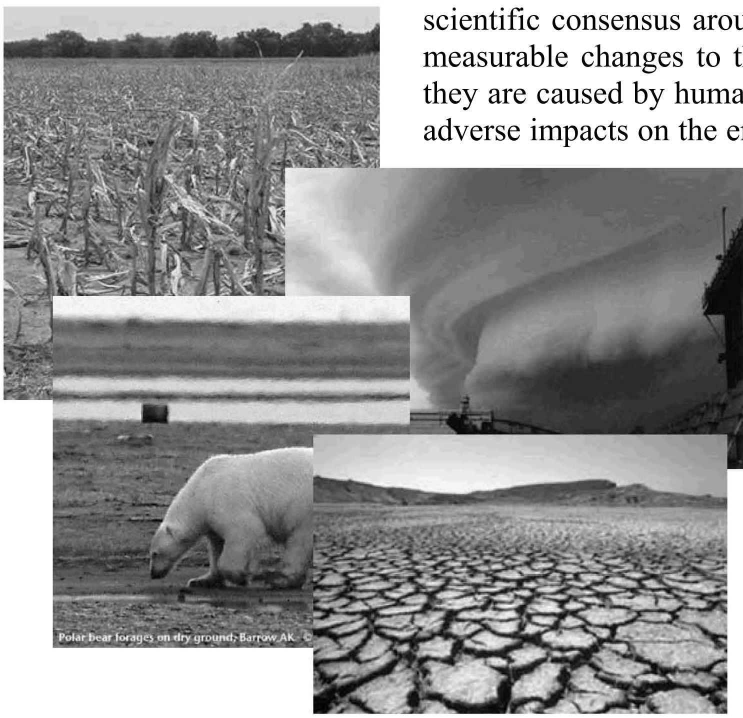


CEQA requires public agencies to ensure that potentially significant adverse environmental effects of discretionary projects are fully characterized, and avoided or mitigated where there are feasible alternatives to do so. Lead agencies have struggled with how best to identify and characterize the magnitude of the adverse effects that individual projects have on the global-scale phenomenon of climate change, even more so since Governor Schwarzenegger signed Executive Order S-3-05 and the state Legislature enacted The Global Warming Solutions Act of 2006 (AB 32). There is now a resounding call to establish procedures to analyze and mitigate greenhouse gas (GHG) emissions. The lack of established thresholds does not relieve lead agencies of their responsibility to analyze and mitigate significant impacts, so many of these agencies are seeking guidance from state and local air quality agencies. This white paper addresses issues inherent in establishing CEQA thresholds, evaluates tools, catalogues mitigation measures and provides air districts and lead agencies with options for incorporating climate change into their programs.

Background

National and International Efforts

International and Federal legislation have been enacted to deal with climate change issues. The Montreal Protocol was originally signed in 1987 and substantially amended in 1990 and 1992. In 1988, the United Nations and the World Meteorological Organization established the IPCC to assess the scientific, technical and socioeconomic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts, and options for adaptation and mitigation. The most recent reports of the IPCC have emphasized the scientific consensus around the evidence that real and measurable changes to the climate are occurring, that they are caused by human activity, and that significant adverse impacts on the environment, the economy, and human health and welfare are unavoidable.



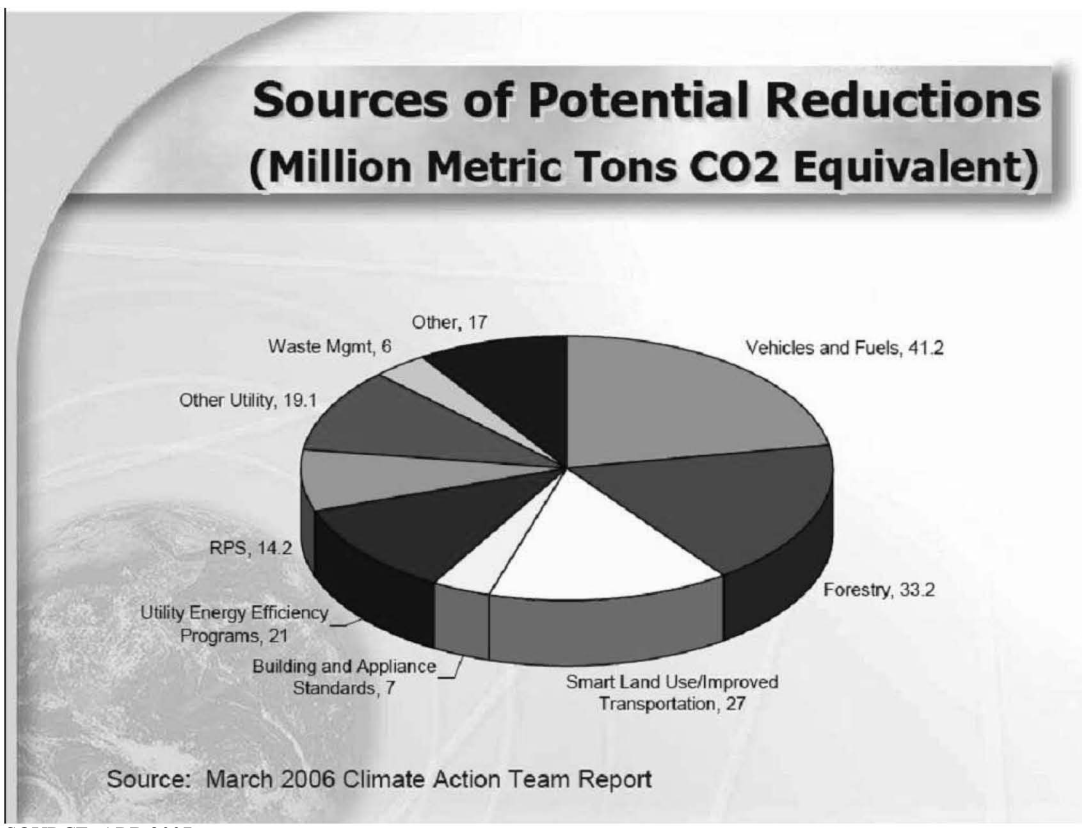
In October 1993, President Clinton announced his Climate Change Action Plan, which had a goal to return greenhouse gas emissions to 1990 levels by the year 2000. This was to be accomplished through 50 initiatives that relied on innovative voluntary partnerships between the private sector and government aimed at producing cost-effective reductions in greenhouse gas emissions. On March 21, 1994, the United States joined a number of countries around the world in signing the United Nations Framework Convention on Climate Change (UNFCCC). Under the Convention, governments agreed to gather and share information on greenhouse gas emissions, national policies, and best practices; launch national strategies for addressing greenhouse gas emissions and adapting to expected impacts, including the provision of financial and technological support to developing countries; and cooperate in preparing for adaptation to the impacts of climate change.

These efforts have been largely policy oriented. In addition to the national and international efforts described above, many local jurisdictions have adopted climate change policies and programs. However, thus far little has been done to assess the significance of the affects new development projects may have on climate change.

Executive Order S-3-05

On June 1, 2005, Governor Schwarzenegger issued Executive Order S-3-05 (S-3-05). It included the following GHG emission reduction targets: by 2010, reduce GHG emissions to 2000 levels; by 2020, reduce GHG emissions to 1990 levels; by 2050, reduce GHG emissions to 80 percent below 1990 levels. To meet the targets, the Governor directed the Secretary of the California Environmental Protection Agency to coordinate with the Secretary of the Business, Transportation and Housing Agency, Secretary of the Department of Food and Agriculture, Secretary of the Resources Agency, Chairperson of the CARB, Chairperson of the Energy Commission and President of the Public Utilities Commission on development of a Climate Action Plan.

The Secretary of CalEPA leads a Climate Action Team (CAT) made up of representatives from the agencies listed above to implement global warming emission reduction programs identified in the Climate Action Plan and report on the progress made toward meeting the statewide greenhouse gas targets that were established in the Executive Order.



SOURCE: ARB 2007

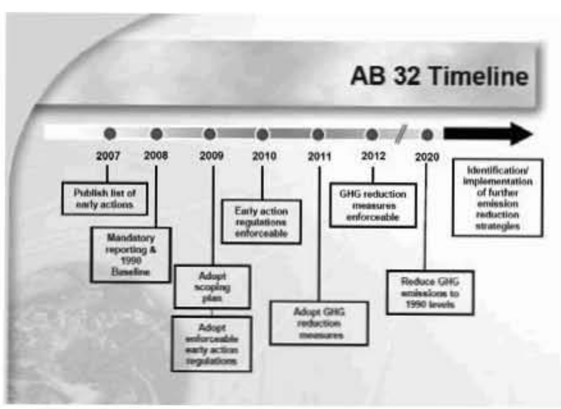
In accord with the requirements of the Executive Order, the first report to the Governor and the Legislature was released in March 2006 and will be issued bi-annually thereafter. The CAT Report to the Governor contains recommendations and strategies to help ensure the targets in Executive Order S-3-05 are met.

California Global Warming Solutions Act of 2006 (AB 32)

In 2006, the California State Legislature adopted the California Global Warming Solutions Act of 2006. AB 32 establishes a cap on statewide greenhouse gas emissions and sets forth the regulatory framework to achieve the corresponding reduction in statewide emissions levels. AB 32 charges the California Air Resources Board (CARB), the state agency charged with regulating statewide air quality, with implementation of the act. Under AB 32, greenhouse gases are defined as: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

The regulatory steps laid out in AB 32 require CARB to: adopt early action measures to reduce GHGs; to establish a statewide greenhouse gas emissions cap for 2020 based on 1990 emissions; to adopt mandatory reporting rules for significant source of greenhouse gases; and to adopt a scoping plan indicating how emission reductions will be achieved via regulations, market mechanisms and other actions; and to adopt the regulations needed to achieve the maximum technologically feasible and cost-effective reductions in greenhouse gases.

AB 32 requires that by January 1, 2008, the State Board shall determine what the statewide greenhouse gas emissions inventory was in 1990, and approve a statewide greenhouse gas emissions limit that is equivalent to that level, to be achieved by 2020. While the level of 1990 GHG emissions has not yet been approved, CARB's most recent emission inventory indicates that California had annual emissions of 436 million metric tons of carbon dioxide equivalent (MMT CO_2e) in 1990 and 497 MMT CO_2e in 2004.



SOURCE: ARB 2007

The regulatory timeline laid out in AB 32 requires that by July 1, 2007, CARB adopt a list of discrete early action measures, or regulations, to be adopted and implemented by January 1, 2010. These actions will form part of the State's comprehensive plan for achieving greenhouse gas emission reductions. In June 2007, CARB adopted three discrete early action measures. These three new proposed regulations meet the definition of "discrete early action greenhouse gas reduction measures," which include the following: a low carbon fuel standard; reduction of HFC-134a emissions from non-professional servicing of motor vehicle air conditioning systems; and improved landfill methane capture. CARB estimates that by 2020, the reductions from those three discrete early action measures would be approximately 13-26 MMT CO_2e.

CARB evaluated over 100 possible measures identified by the CAT for inclusion in the list of discrete early action measures. On October 25, 2007 CARB gave final approval to the list of Early Action Measures, which includes nine discrete measures and 35 additional measures, all of which are to be enforceable by January 1, 2010. AB 32 requires that by January 1, 2009, CARB adopt a scoping plan indicating how emission reductions will be achieved via regulations, market mechanisms and other actions.

Senate Bill 97

Senate Bill (SB) 97, signed in August 2007, acknowledges that climate change is an important environmental issue that requires analysis under CEQA. This bill directs the OPR to prepare, develop, and transmit to the Resources Agency guidelines for the feasible mitigation of GHG emissions or the effects of GHG emissions, by July 1, 2009. The Resources Agency is required to certify or adopt those guidelines by January 1, 2010. This bill also protects projects funded by the Highway Safety, Traffic Reduction, Air Quality and Port Security Bond Act of 2006, or the Disaster Preparedness and Flood Protection Bond Act of 2006 (Proposition 1B or 1E) from claims of inadequate analysis of GHG as a legitimate cause of action. This latter provision will be repealed on January 1, 2010. Thus, this "protection" is highly limited to a handful of projects and for a short time period.

The Role of Air Districts in the CEQA Process

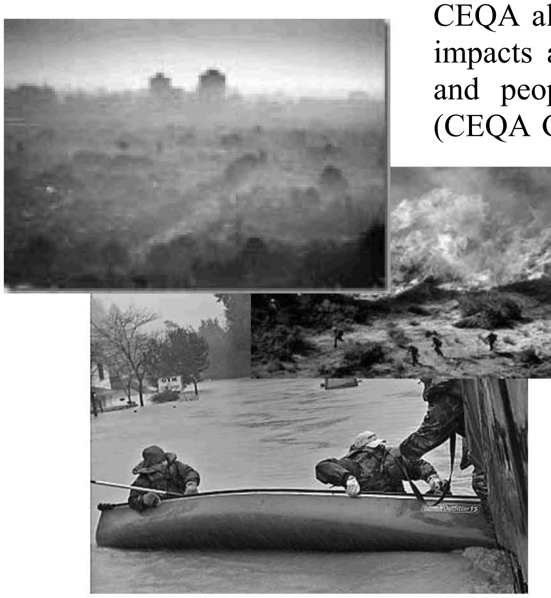
Air districts assume one of three roles in the CEQA process. They may be lead agencies when they are adopting regulations and air quality plans. In some instances, they can also be a lead agency when approving permits to construct or operate for applicants subject to district rules. However, in many cases where an air district permit is involved, another agency has broader permitting authority over the project and assumes the role of lead agency. In these situations, the air district becomes what is referred to as a responsible agency under CEQA. When CEQA documents are prepared for projects that do not involve discretionary approval of a district regulation, plan or permit, the air district may assume the role of a concerned or commenting agency. In this role, it is typical for air districts to comment on CEQA documents where there may be air quality-related adverse impacts, such as projects that may create significant contributions to existing violations of ambient standards, cause a violation of an ambient standard or create an exposure to toxic air contaminants or odors. In some cases, the air district may also act in an "advisory" capacity to a lead agency early on in its review of an application for a proposed development project.

A few air districts in California began developing significance thresholds for use in CEQA analyses in the late 1980's and early 1990's. By the mid-1990's most air districts had developed CEQA thresholds for air quality analyses. Many of the districts have included in their guidance the analysis of rule development and permits that may be subject to CEQA.

What is Not Addressed in this Paper

Impacts of Climate Change to a Project

The focus of this paper is addressing adverse impacts to climate change and the ability to meet statewide GHG reduction goals caused by proposed new land development projects. CEQA also requires an assessment of significant adverse impacts a project might cause by bringing development and people into an area affected by climate change (CEQA Guidelines §15126.2). For example, an area that experiences higher average temperatures due to climate change may expose new development to more frequent exceedances and higher levels of ozone concentrations. Alternatively, a rise in sea level brought on by climate change may inundate new development locating in a low-lying area. The methodologies, mitigation and threshold approaches discussed in this paper do not specifically address the potential adverse impacts resulting from climate change that may affect a project.



Impacts from Construction Activity

Although construction activity has been addressed in the analytical methodologies and mitigation chapters, this paper does not discuss whether any of the threshold approaches adequately addresses impacts from construction activity. More study is needed to make this assessment or to develop separate thresholds for construction activity. The focus of this paper is the long-term adverse operational impacts of land use development.

Introduction

Any analysis of environmental impacts under CEQA includes an assessment of the nature and extent of each impact expected to result from the project to determine whether the impact will be treated as significant or less than significant. CEQA gives lead agencies discretion whether to classify a particular environmental impact as significant. "The determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved," ref: CEQA Guidelines §15064(b) ("Guidelines"). Ultimately, formulation of a standard of significance requires the lead agency to make a policy judgment about where the line should be drawn distinguishing adverse impacts it considers significant from those that are not deemed significant. This judgment must, however, be based on scientific information and other factual data to the extent possible (Guidelines §15064(b)).

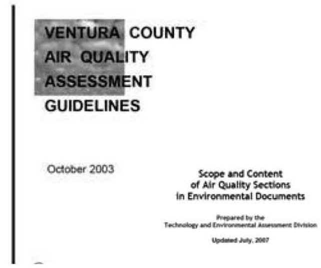
CEQA does not require that agencies establish thresholds of significance. Guidelines §15064.7(a) encourages each public agency "…to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects. A threshold of significance is an identifiable quantitative, qualitative or performance level of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant by the agency and compliance with which normally means the effect will be determined to be less than significant."

Once such thresholds are established, an impact that complies with the applicable threshold will "normally" be found insignificant and an impact that does not comply with the applicable threshold will "normally" be found significant.

Additionally, Guidelines §15064.7(b) requires that if thresholds of significance are adopted for general use as part of the lead agency's environmental review process they must be adopted by ordinance, resolution, rule or regulation, and developed through a public review process and be supported by substantial evidence.

While many public agencies adopt regulatory standards as thresholds, the standards do not substitute for a public agency's use of careful judgment in determining significance. They also do not replace the legal standard for significance (i.e., if there is a fair argument, based on substantial evidence in light of the whole record that the project may have a significant effect, the effect should be considered significant) (Guidelines §15064(f)(1). Also see *Communities for a Better Environment v. California Resource Agency* 103 Cal. App. 4th 98 (2002)). In other words, the adoption of a regulatory standard does not create an irrebuttable presumption that impacts below the regulatory standard are less than significant.

Summary of CEQA Thresholds at Air Districts



This section briefly summarizes the evolution of air district CEQA significance thresholds. Ventura County APCD, in 1980, was the first air district in California that formally adopted CEQA significance thresholds. Their first CEQA assessment document contained impact thresholds based on project type: residential, nonresidential, and government. Then, as now, the District's primary CEQA thresholds applied only to ROG and NO_x. The 1980 Guidelines did not address other air pollutants.

Santa Barbara County APCD and the Bay Area AQMD adopted thresholds in 1985. The South Coast AQMD recommended regional air quality thresholds in 1987 for CO, SO_2, NO_2, particulates, ROG, and lead. Most of the other California air districts adopted CEQA guidance and thresholds during the 1990's. Air districts have updated their thresholds and guidelines several times since they were first published.

Originally, most districts that established CEQA thresholds focused on criteria pollutants for which the district was nonattainment and the thresholds only addressed project level impacts. Updates during the 1990's began to add additional air quality impacts such as odors, toxic air contaminants and construction. Several air districts also developed thresholds for General Plans that relied on an assessment of the plan consistency with the district's air quality plans. A consistency analysis involves comparing the project's land use to that of the general plan and the population and employment increase to the forecasts underlying the assumptions used to develop the air quality plan.

Most air district thresholds for CEQA are based on the threshold for review under the New Source Review (NSR). The NSR threshold level is set by district rule and is different depending on the nonattainment classification of the air district. Areas with a less severe classification have a higher NSR trigger level while the most polluted areas have the lowest NSR trigger level. Some districts, such as Ventura County APCD, have significantly lower CEQA thresholds that are not tied to the NSR requirements. In Ventura, one set of CEQA thresholds is 25 pounds per day for all regions of Ventura County, except the Ojai Valley. The second set of CEQA thresholds was set at 5 pounds per day for the Ojai Valley.

The Sacramento Metropolitan AQMD bases its thresholds for ozone precursors on the projected land use share of emission reductions needed for attainment. The emission reductions needed to reach attainment are based on commitments made in the state implementation plan (SIP) prepared for the federal clean air act.

CEQA Considerations in Setting Thresholds

Public agencies use significance thresholds to disclose to their constituents how they plan on evaluating and characterizing the severity of various environmental impacts that could be associated with discretionary projects that they review. Significance thresholds are also used to help identify the level of mitigation needed to reduce a potentially significant impact to a less than significant level and to determine what type of an environmental document should be prepared for a project; primarily a negative declaration, mitigated negative declaration or an environmental impact report.

While public agencies are not required to develop significance thresholds, if they decide to develop them, they are required to adopt them by ordinance, resolution, rule or regulation through a public process. A lead agency is not restrained from adopting any significance threshold it sees as appropriate, as long as it is based on substantial evidence. CEQA Guidelines §15064.7 encourages public agencies to develop and publish significance thresholds that are identifiable, quantitative, qualitative or performance level that the agency uses in the determination of the significance of environmental effects. The courts have ruled that a "threshold of significance" for a given environmental effect is simply that level at which the lead agency finds the effects of the project to be significant.

Before an agency determines its course with regard to climate change and CEQA, it must be made clear that a threshold, or the absence of one, will not relieve a lead agency from having to prepare an EIR or legal challenges to the adequacy of an analysis leading to a conclusion, or lack of a conclusion, of significance under CEQA. CEQA has generally favored the preparation of an EIR where there is any substantial evidence to support a fair argument that a significant adverse environmental impact may occur due to a proposed project. This paper explores three alternative approaches to thresholds, including a no threshold option, a zero threshold option and a non-zero threshold option.

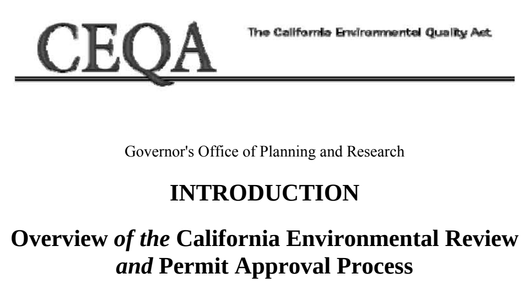
Fair Argument Considerations

Under the CEQA fair argument standard, an EIR must be prepared whenever it can be fairly argued, based on substantial evidence in the administrative record, that a project may have a significant adverse effect on the environment. "Substantial evidence" comprises "enough relevant information and reasonable inferences from this information that a fair argument can be made to support a conclusion, even though other conclusions might also be reached." (Guidelines §15384) This means that if factual information is presented to the public agency that there is a reasonable possibility the project could have a significant effect on the environment, an EIR is required even if the public agency has information to the contrary (Guidelines §15064 (f)).

The courts have held that the fair argument standard "establishes a low threshold for initial preparation of an EIR, which reflects a preference for resolving doubts in favor of environmental review." (*Santa Teresa Citizen Action Group v. City of San Jose* [2003] 114 Cal.App.4th 689) Although the determination of whether a fair argument exists is made by the public agency, that determination is subject to judicial scrutiny when challenged in litigation. When the question is whether an EIR should have been prepared, the court will review the administrative record for factual evidence supporting a fair argument.

The fair argument standard essentially empowers project opponents to force preparation of an EIR by introducing factual evidence into the record that asserts that the project may have a significant effect on the environment. This evidence does not need to be conclusive regarding the potential significant effect.

In 1998, the Resources Agency amended the State CEQA Guidelines to encourage the use of thresholds of significance. Guidelines §15064 (h) provided that when a project's impacts did not exceed adopted standards, the impacts were to be considered less than significant. The section went on to describe the types of adopted standards that were to be considered thresholds. Guidelines § 15064.7 provided that agencies may adopt thresholds of significance to guide their determinations of significance. Both of these sections were challenged when environmental groups sued the Resources Agency in 2000 over the amendments. The trial court concluded that §15064.7 was proper, if it was applied in the context of the fair argument standard.


CEQA The California Environmental Quality Act

Governor's Office of Planning and Research

INTRODUCTION

Overview *of the* California Environmental Review *and* Permit Approval Process

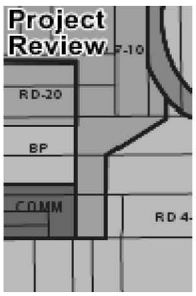
At the appellate court level, §15064(h) was invalidated.[2] Establishing a presumption that meeting an adopted standard would avoid significant impacts was "inconsistent with controlling CEQA law governing the fair argument approach." The Court of Appeal explained that requiring agencies to comply with a regulatory standard "relieves the agency of a duty it would have under the fair argument approach to look at evidence beyond the regulatory standard, or in contravention of the standard, in deciding whether an EIR must be prepared. Under the fair argument approach, any substantial evidence supporting a fair argument that a project may have a significant environmental effect would trigger the preparation of an EIR." (*Communities for a Better Environment v. California Resources Agency* [2002] 103 Cal.App.4th 98)

[2] Prior §15064(h) has been removed from the State CEQA Guidelines. Current §15064(h) discusses cumulative impacts.

In summary, CEQA law does not require a lead agency to establish significance thresholds for GHG. CEQA guidelines encourage the development of thresholds, but the absence of an adopted threshold does not relieve the agency from the obligation to determine significance.

Defensibility of CEQA Analyses

The basic purposes of CEQA, as set out in the State CEQA Guidelines, include: (1) informing decision makers and the public about the significant environmental effects of proposed projects; (2) identifying ways to reduce or avoid those impacts; (3) requiring the implementation of feasible mitigation measures or alternatives that would reduce or avoid those impacts; and (4) requiring public agencies to disclose their reasons for approving any project that would have significant and unavoidable impacts (Guidelines §15002). CEQA is enforced through civil litigation over procedure (i.e., did the public agency follow the correct CEQA procedures?) and adequacy (i.e., has the potential for impacts been disclosed, analyzed, and mitigated to the extent feasible?).



The California Supreme Court has held that CEQA is "to be interpreted in such manner as to afford the fullest possible protection to the environment within the reasonable scope of the statutory language." (*Friends of Mammoth v. Board of Supervisors* [1972] 8 Cal.3d 247, 259) Within that context, the role of the courts is to weigh the facts in each case and apply their judgment. Although the court may rule on the adequacy of the CEQA work, the court is not empowered to act in the place of the public agency to approve or deny the project for which the CEQA document was prepared. Further, the court's review is limited to the evidence contained in the administrative record that was before the public agency when it acted on the project.

Putting aside the issue of CEQA procedure, the defensibility of a CEQA analysis rests on the following concerns:

- whether the public agency has sufficiently analyzed the environmental consequences to enable decision makers to make an intelligent decision;

- whether the conclusions of the public agency are supported by substantial evidence in the administrative record; and

- whether the agency has made a good faith effort at the full disclosure of significant effects.

CEQA analyses need not be perfect or exhaustive -- the depth and breadth of the analysis is limited to what is "reasonably feasible." (Guidelines §15151) At the same time, the analysis "must include detail sufficient to enable those who did not participate in its preparation to understand and to consider meaningfully the issues raised by the proposed project." (Laurel Heights Improvement Assn. v. Regents of University of California (1988) 47 Cal.3d 376)

By itself, establishment of a GHG threshold will not insulate individual CEQA analyses from challenge. Defensibility depends upon the adequacy of the analysis prepared by the lead agency and the process followed. However, the threshold can help to define the boundaries of what is a reasonable analysis by establishing when an analysis will be required and the basic scope of that analysis. The threshold would attempt to define the point at which an analysis will be required and when a level of impact becomes significant, requiring preparation of an EIR. If the threshold includes recommendations for the method or methods of analysis, it can establish the minimum level of analysis to address this issue.

Considerations in Setting Thresholds for Stationary Source Projects

In many respects, the analysis of GHG emissions from stationary sources is much more straightforward than the analysis of land use patterns, forecasted energy consumption, and emissions from mobile sources. The reason is that, for the most part, the latter analyses depend largely on predictive models with myriad inputs and have a wider range of error. Emissions from stationary sources involve a greater reliance on mass and energy balance calculations and direct measurements of emissions from the same or similar sources. Energy demand is more directly tied to production, and even associated mobile source emissions will likely fall within narrower predictive windows.

Implementing CEQA Without a Threshold

A lead agency is not required to establish significance thresholds for GHG emissions from stationary sources. The lead agency may find that it needs more information or experience evaluating GHG from these types of projects to determine an appropriate significance threshold. As with other project types, the lead agency could conduct a project specific analysis to determine whether an environmental impact report is needed and to determine the level of mitigation that is appropriate. The agency might also rely on thresholds established for criteria pollutants as a screening method, and analyze GHG emissions (and require mitigation) from projects with emissions above the criteria pollutant thresholds. Over time, the agency could amass information and experience with specific project categories that would support establishing explicit thresholds. The lead agency may also choose to base local CEQA thresholds on state guidelines or on the category-specific reduction targets established by ARB in its scoping plan for implementing AB32. Resource constraints and other considerations associated with implementing CEQA without GHG thresholds for stationary sources would be similar to those outlined for other types of projects (see Chapter 5 – No Threshold Option).

Implementing CEQA with Threshold of Zero

A lead agency may find that any increase in GHG emissions is potentially significant under CEQA. The resources and other considerations for implementing a threshold of zero for stationary sources are the same as those outlined for other types of projects (see Chapter 6 – Zero Threshold Option).

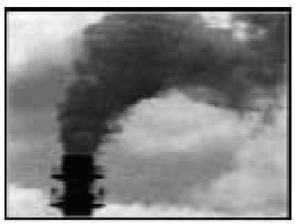
Implementing CEQA with a Non-Zero Threshold

A lead agency may identify one or more non-zero thresholds for significance of emissions of GHG from stationary sources. The agency could elect to rely on existing thresholds for reviewing new or modified stationary sources of GHG, if the state or local air district has established any. The agency could also apply the threshold(s) established for non-stationary sources to GHG emissions from stationary sources. Significance thresholds could also be established by ordinance, rule, or policy for a given category of stationary sources; this approach is especially conducive to a tiered threshold approach. For example, the agency could establish significance and mitigation tiers for stationary compression-ignition diesel-fueled generators. Under such an approach, the project proponent could be first required to use a lower GHG-emitting power source if feasible, and if not, to apply mitigation based on the size of the generator and other defined considerations, such as hours of operation. Certain classes of generators could be found to be insignificant under CEQA (e.g., those used for emergency stand-by power only, with a limit on the annual hours of use). As with non-stationary projects, the goal of establishing non-zero thresholds is to maximize environmental protection, while minimizing resources used. Resource and other considerations outlined for non-stationary projects are applicable here (see Chapter 7 – Non-Zero Threshold Options).

Implementing CEQA with Different Thresholds for Stationary and Non-stationary Projects

Although a lead agency may apply the same thresholds to stationary and non-stationary projects, it is not required to do so. There are, in fact, some important distinctions between the two types of projects that could support applying different thresholds. The lead agency should consider the methods used to estimate emissions. Are the estimates a "best/worst reasonable scenario" or are they based on theoretical maximum operation? How accurate are the estimates (are they based on models, simulations, emission factors, source test data, manufacturer specifications, etc.)? To what extent could emissions be reduced through regulations after the project is constructed if they were found to be greater than originally expected (i.e., is it possible to retrofit emissions control technology onto the source(s) of GHG at a later date, how long is the expected project life, etc.)? Are there emission limits or emissions control regulations (such as New Source Review) that provide certainty that emissions will be mitigated? Generally, stationary source emissions are based on maximum emissions (theoretical or allowed under law or regulation), are more accurate, and are more amenable to retrofit at a later time than non-stationary source emissions. It is also more likely that category specific rules or some form of NSR will apply to stationary sources than non-stationary projects. Notwithstanding, it is almost always more effective and cost-efficient to apply emission reduction technology at the design phase of a project. There are, therefore, a number of considerations that need to be evaluated and weighed before establishing thresholds – and which may support different thresholds for stationary and non-stationary projects. Furthermore, the considerations may change over time as new regulations are established and as emissions estimation techniques and control technology evolves.

Direct GHG Emissions from Stationary Sources



The main focus of this paper has been the consideration of projects that do not, in the main, involve stationary sources of air pollution, because stationary source projects are generally a smaller percentage of the projects seen by most local land use agencies. That said, some discussion of stationary sources is warranted. As the broader program for regulating GHG from these sources is developed, the strategies for addressing them under CEQA will likely become more refined.

The primary focus of analysis of stationary source emissions has traditionally been those pollutants that are directly emitted by the source, whether through a stack or as fugitive releases (such as leaks). CAPCOA conducted a simplified analysis of permitting activity to estimate the number of stationary source projects with potentially significant emissions of greenhouse gases that might be seen over the course of a year. This analysis looked only at stationary combustion sources (such as boilers and generators), and only considered direct emissions. A lead agency under CEQA may see a different profile of projects than the data provided here suggest, depending on what other resources are affected by projects. In addition, air districts review like-kind replacements of equipment to ensure the new equipment meets current standards, but such actions might not constitute a project for many land use agencies or other media regulators. The data does provide a useful benchmark, however, for lead agencies to assess the order of magnitude of potential stationary source projects. A similar analysis is included for non-stationary projects in Chapter 7.

Table 1: Analysis of GHG Emissions from Stationary Combustion Equipment Permits[3]

	BAAQMD	SMAQMD	SJVUAPCD	SCAQMD
Total Applications for Year	1499	778	1535	1179
Affected at threshold of:				
900 metric tons/year	26	43	63	108
10,000 metric tons/year	7	5	26	8
25,000 metric tons/year	3	1	11	4

[3] District data varies based on specific local regulations and methodologies.

Emissions from Energy Use

In addition to the direct emissions of GHG from stationary projects, CEQA will likely need to consider the project's projected energy use. This could include an analysis of opportunities for energy efficiency, onsite clean power generation (e.g., heat/energy recovery, co-generation, geothermal, solar, or wind), and the use of dedicated power contracts as compared to the portfolio of generally available power. In some industries, water use and conservation may provide substantial GHG emissions reductions, so the CEQA analysis should consider alternatives that reduce water consumption and wastewater discharge. The stationary project may also have the opportunity to use raw or feedstock materials that have a smaller GHG footprint; material substitution should be evaluated where information is available to do so.

Emissions from Associated Mobile Sources

The stationary project will also include emissions from associated mobile sources. These will include three basic components: emissions from employee trips, emissions from delivery of raw or feedstock materials, and emissions from product transport. Employee trips can be evaluated using trip estimation as is done for non-stationary projects, and mitigations would include such measures as providing access to and incentives for use of public transportation, accessibility for bicycle and pedestrian modes of transport, employer supported car or vanpools (including policies such as guaranteed rides home, etc). Upstream and downstream emissions related to goods movement can also be estimated with available models. The evaluation will need to determine the extent of the transport chain that should be included (to ensure that all emissions in the chain have been evaluated and mitigated, but to avoid double counting). Mitigations could include direct actions by operators who own their own fleet, or could be implemented through contractual arrangements with independent carriers; again, the evaluation will need to consider how far up and down the chain mitigation is feasible and can be reasonably required.

Comparing Emissions Changes Across Pollutant Categories

The potential exists for certain GHG reduction measures to increase emissions of criteria and toxic pollutants known to cause or aggravate respiratory, cardiovascular, and other health problems. For instance, GHG reduction efforts such as alternative fuels and methane digesters may create significant levels of increased pollutants that are detrimental to the health of the nearby population (e.g.; particulate matter, ozone precursors, toxic air contaminants). Such considerations should be included in any CEQA analysis of a project's environmental impacts. While there are many win-win strategies that can reduce both GHG and criteria/toxic pollutant emissions, when faced with situations that involve tradeoffs between the two, the more immediate public health concerns that may arise from an increase in criteria or toxic pollutant emissions should take precedence. GHG emission reductions could be achieved offsite through other mitigation programs.

Introduction

Under state law, it is the purview of each lead agency to determine what, if any, significance thresholds will be established to guide its review of projects under CEQA. While the state does provide guidelines for implementing CEQA, the guidelines have left the decision of whether to establish thresholds (and if so, at what level) to individual lead agencies. Frequently, lead agencies consult with resource-specific agencies (such as air districts) for assistance in determining what constitutes a significant impact on that specific resource.

With the passage of AB 32, the ARB has broad authority to regulate GHG emissions as necessary to meet the emission reduction goals of the statute. This may include authority to establish emission reduction requirements for new land use projects, and may also enable them to recommend statewide thresholds for GHG under CEQA.

In developing this white paper, CAPCOA recognizes that, as the GHG reduction program evolves over time, GHG thresholds and other policies and procedures for CEQA may undergo significant revision, and that uniform statewide thresholds and procedures may be established. This paper is intended to serve as a resource for public agencies until such time that statewide guidance is established, recognizing that decisions will need to be made about GHG emissions from projects before such guidance is available. This paper is not, however, uniform statewide guidance. As stated before, it outlines several possible approaches without endorsing any one over the others.

Some air districts may choose to use this paper to support their establishment of guidance for GHG under CEQA, including thresholds. This paper does not, nor should it be construed to require a district to implement any of the approaches evaluated here. Decisions about whether to provide formal local guidance on CEQA for projects with GHG emissions, including the question of thresholds, will be made by individual district boards.

Each of the 35 air districts operates independently and has its own set of regulations and programs to address the emissions from stationary, area and mobile sources, consistent with state and federal laws, regulations, and guidelines. The independence of the districts allows specific air quality problems to be addressed on a local level. In addition, districts have also established local CEQA thresholds of significance for criteria pollutants – also to address the specific air quality problems relative to that particular district.

The overall goal of air district thresholds is to achieve and maintain health based air quality standards within their respective air basins and to reduce transport of emissions to other air basins. In establishing recommended thresholds, air districts consider the existing emission inventory of criteria pollutants and the amount of emission reductions needed to attain and maintain ambient air quality standards.

However, unlike criteria pollutants where individual districts are characterized by varying levels of pollutant concentrations and source types, greenhouse gases (GHG) and their attendant climate change ramifications are a global problem and, therefore, may suggest a uniform approach to solutions that ensure both progress and equity.

Under SB97, the Office of Planning and Research is directed to prepare, develop, and transmit to the Resources Agency guidelines for the feasible mitigation of GHG emissions or the effects of GHG emissions through CEQA by July 1, 2009. Those guidelines may recommend thresholds. As stated, this paper is intended to provide a common platform of information and tools to support local decision makers until such time that statewide guidance or requirements are promulgated.

Local Ability to Promulgate District-Specific GHG Thresholds

One of the primary reasons behind the creation of air districts in California is the recognition that some regions within the state face more critical air pollution problems than others and, as has often been pointed out – one size does not fit all. For example, a “Serious” federal nonattainment district would need greater emission reductions than a district already in attainment – and, therefore, the more “serious” district would set its criteria pollutant CEQA thresholds of significance much lower than the air district already in attainment.

The action of GHGs is global in nature, rather than local or regional (or even statewide or national). Ultimately there may be a program that is global, or at least national in scope. That said, actions taken by a state, region, or local government can contribute to the solution of the global problem. Local governments are not barred from developing and implementing programs to address GHGs. In the context of California and CEQA, lead agencies have the primary responsibility and authority to determine the significance of a project’s impacts.

Further, air districts have primary authority under state law for "control of air pollution from all sources, other than emissions from motor vehicles." (H&SC §40000) The term air contaminant or "air pollutant" is defined extremely broadly, to mean "any discharge, release, or other propagation into the atmosphere" and includes, but is not limited to, soot, carbon, fumes, gases, particulate matter, etc. Greenhouse gases and other global warming pollutants such as black carbon would certainly be included in this definition, just as the U.S. Supreme Court held in Massachusetts v. EPA that greenhouse gases were air pollutants under the federal Clean Air Act. Therefore, air districts have the primary authority to regulate global warming pollutants from nonvehicular sources. AB 32 does not change this result. Although it gives wide responsibility to CARB to regulate greenhouse gases from all sources, including nonvehicular sources, it does not preempt the districts. AB 32 specifically states That "nothing in this division shall limit or expand the existing authority of any district..."(H&SC § 38594). Thus, districts and CARB retain concurrent authority over nonvehicular source greenhouse gas emissions.

Introduction

The CEQA statutes do not require an air district or any lead agency to establish significance thresholds under CEQA for any pollutant. While there are considerations that support the establishment of thresholds (which are discussed in other sections of this document), there is no obligation to do so.

An air district or other lead agency may elect not to establish significance thresholds for a number of reasons. The agency may believe that the global nature of the climate change problem necessitates a statewide or national framework for consideration of environmental impacts. SB 97 directs OPR to develop "guidelines for the mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions by July 1, 2009," and directs the California Resources Agency to certify and adopt the guidelines by June 30, 2010.

An agency may also believe there is insufficient information to support selecting one specific threshold over another. As described earlier, air districts have historically set CEQA thresholds for air pollutants in the context of the local clean air plan, or (in the case of toxic air pollutants) within the framework of a rule or policy that manages risks and exposures due to toxic pollutants. There is no current framework that would similarly manage impacts of greenhouse gas pollutants, although the CARB is directed to establish one by June 30, 2009, pursuant to AB 32. A local agency may decide to defer any consideration of thresholds until this framework is in place.

Finally, an agency may believe that the significance of a given project should be assessed on a case-by-case basis in the context of the project at the time it comes forward.

Implementing CEQA Without Significance Thresholds for GHG

The absence of a threshold does not in any way relieve agencies of their obligations to address GHG emissions from projects under CEQA. The implications of not having a threshold are different depending on the role the agency has under CEQA – whether it is acting in an advisory capacity, as a responsible agency, or as a lead agency.

Implications of No Thresholds for an Agency Acting in an Advisory Capacity

Air districts typically act in an advisory capacity to local governments in establishing the framework for environmental review of air pollution impacts under CEQA. This may include recommendations regarding significance thresholds, analytical tools to assess emissions and impacts, and mitigations for potentially significant impacts. Although districts will also address some of these issues on a project-specific basis as responsible agencies, they may provide general guidance to local governments on these issues that are program wide, and these are advisory (unless they have been established by regulation).

An air district that has not established significance thresholds for GHG will not provide guidance to local governments on this issue. This does not prevent the local government from establishing thresholds under its own authority. One possible result of this would be the establishment of different thresholds by cities and counties within the air district. Alternatively, the air district could advise local governments not to set thresholds and those jurisdictions may follow the air district's guidance.

It is important to note here (as has been clearly stated by the Attorney General in comments and filings) that lack of a threshold does *not* mean lack of significance. An agency may argue lack of significance for any project, but that argument would have to be carried forth on a case-by-case, project specific basis. By extension then, a decision not to establish thresholds for GHG is likely to result in a greater workload for responsible and lead agencies as they consider individual projects under CEQA.

Implications of No Thresholds for a Responsible Agency

If there are no established thresholds of significance, the significance of each project will have to be determined during the course of review. The responsible agency (e.g., the air district) will review each project referred by the lead agency. The review may be qualitative or quantitative in nature. A qualitative review would discuss the nature of GHG emissions expected and their potential effect on climate change as the district understands it. It could also include a discussion of the relative merits of alternative scenarios. A quantitative analysis would evaluate, to the extent possible, the expected GHG emissions; it would also need to evaluate their potential effect on climate change and might include corresponding analysis of alternatives. The air district, as a responsible agency, may also identify mitigation measures for the project.

The lack of established thresholds will make the determination of significance more resource intensive for each project. The district may defer to the lead agency to make this determination, however the district may be obligated, as a responsible agency, to evaluate the analysis and determination.

Implications of No Thresholds for a Lead Agency

The main impact of not having significance thresholds will be on the primary evaluation of projects by the lead agency. Without significance thresholds, the agency will have to conduct some level of analysis of every project to determine whether an environmental impact report is needed. There are three fundamental approaches to the case-by-case analysis of significance, including presumptions of significance or insignificance, or no presumption:

1. The agency can begin with a presumption of significance and the analysis would be used to support a case-specific finding of no significance. This is similar to establishing a threshold of zero, except that here, the "threshold" is rebuttable. This approach may result in a large number of projects proceeding to preparation of an environmental impact report. Because of the attendant costs, project proponents may challenge the determination of significance, although formal challenge is less likely than attempts to influence the determination.

2. The agency can begin with a presumption of insignificance, and the analysis would be used to support a case-specific finding of significance. A presumption of insignificance could be based on the perspective that it would be speculative to attempt to identify the significance of GHG emissions from a project relative to climate change on a global scale. This approach might reduce the number of projects proceeding to preparation of environmental impact reports. It is likely to have greater success with smaller projects than larger ones, and a presumption of *insignificance* may be more likely to be challenged by project opponents.

3. It is not necessary for the lead agency to have any presumption either way. The agency could approach each project from a *tabula rasa* perspective, and have the determination of significance more broadly tied to the specific context of the project; this approach is likely to be resource intensive, and creates the greatest uncertainty for project proponents. To the extent that it results in a lead agency approving similar projects based on different determinations of significance for GHG emissions, it may be more vulnerable to challenge from either proponents or opponents of the project. Alternatively, in the absence of either thresholds or presumptions, the lead agency could use each determination of significance to build its approach in the same way that subsequent judgments define the law.

Relevant Citations

The full text of relevant citations is in Appendix A.

Public Resources Code – §21082.2, Significant Effect on Environment; Determination; Environmental Impact Report Preparation.

State CEQA Guidelines – §15064, Determining the Significance of the Environmental Effects Caused by a Project.

Introduction

If an air district or lead agency determines that any degree of project-related increase in GHG emissions would contribute considerably to climate change and therefore would be a significant impact, it could adopt a zero-emission threshold to identify projects that would need to reduce their emissions. A lead agency may determine that a zero-emission threshold is justified even if other experts may disagree. A lead agency is not prevented from adopting any significance threshold it sees as appropriate, as long as it is based on substantial evidence.

If the zero threshold option is chosen, all projects subject to CEQA would be required to quantify and mitigate their GHG emissions, regardless of the size of the project or the availability of GHG reduction measures available to reduce the project's emissions. Projects that could not meet the zero-emission threshold would be required to prepare environmental impact reports to disclose the unmitigable significant impact, and develop the justification for a statement of overriding consideration to be adopted by the lead agency.

Implementing CEQA With a Zero Threshold for GHG

The scientific community overwhelmingly agrees that the earth's climate is becoming warmer, and that human activity is playing a role in climate change. Unlike other environmental impacts, climate change is a global phenomenon in that all GHG emissions generated throughout the earth contribute to it. Consequently, both large and small GHG generators cause the impact. While it may be true that many GHG sources are individually too small to make any noticeable difference to climate change, it is also true that the countless small sources around the globe combine to produce a very substantial portion of total GHG emissions.

A zero threshold approach is based on a belief that, 1) all GHG emissions contribute to global climate change and could be considered significant, and 2) not controlling emissions from smaller sources would be neglecting a major portion of the GHG inventory.

CEQA explicitly gives lead agencies the authority to choose thresholds of significance. CEQA defers to lead agency discretion when choosing thresholds. Consequently, a zero-emission threshold has merits.

The CEQA review process for evaluating a project's impact on global climate change under the zero threshold option would involve several components. Air quality sections would be written by lead agencies to include discussions on climate change in CEQA documents, GHG emissions would be calculated, and a determination of significance would be made. The local air districts would review and comment on the climate change discussions in environmental documents. Lead agencies may then revise final EIRs to accommodate air district comments. More than likely, mitigation measures will be specified for the project, and a mitigation monitoring program will need to be put in place to ensure that these measures are being implemented.

Since CEQA requires mitigation to a less than significant level, it is conceivable that many projects subjected to a zero threshold could only be deemed less than significant with offsite reductions or the opportunity to purchase greenhouse gas emission reduction credits. GHG emission reduction credits are becoming more readily available however the quality of the credits varies considerably. High quality credits are generated by actions or projects that have clearly demonstrated emission reductions that are real, permanent, verifiable, enforceable, and not otherwise required by law or regulation. When the pre- or post-project emissions are not well quantified or cannot be independently confirmed, they are considered to be of lesser quality. Similarly, if the reductions are temporary in nature, they are also considered to be poor quality. Adoption of a zero threshold should consider the near-term availability and the quality of potential offsets.

There are also environmental justice concerns about the effects of using offsite mitigations or emission reduction credits to offset, or mitigate, the impacts of a new project. Although GHGs are global pollutants, some of them are emitted with co-pollutants that have significant near-source or regional impacts. Any time that increases in emissions at a specific site will be mitigated at a remote location or using emission reduction credits, the agency evaluating the project should ensure that it does not create disproportionate impacts.

The Climate Registry

California Climate Action Registry

Administrative Considerations

If electing to pursue a zero threshold, an air district or lead agency should consider the administrative costs and the environmental review system capacity. Some projects that previously would have qualified for an exemption could require further substantial analysis, including preparation of a Negative Declaration (ND), a Mitigated Negative Declaration (MND) or an EIR. Moreover, the trade-offs between the volume of projects requiring review and the quality of consideration given to reviews should be considered. It may also be useful to consider whether meaningful mitigation can be achieved from smaller projects.

Consideration of Exemptions from CEQA

A practical concern about identifying GHG emissions as a broad cumulative impact is whether the zero threshold option will preclude a lead agency from approving a large set of otherwise qualified projects utilizing a Categorical Exemption, ND, or MND. The results could be a substantial increase in the number of EIR's. This is a valid and challenging concern, particularly for any threshold approach that is based on a zero threshold for net GHG emission increases.

CEQA has specified exceptions to the use of a categorical exception. Specifically, CEQA Guidelines §15300.2 includes the following exceptions:

"(b) Cumulative Impact. All exemptions for these classes are inapplicable when the cumulative impact of successive projects of the same type in the same place, over time is significant."

(c) Significant Effect. A categorical exemption shall not be used for an activity where there is a reasonable possibility that the activity will have a significant effect on the environment due to unusual circumstances."

These CEQA Guidelines sections could be argued to mean that any net increase in GHG emissions would preclude the use of a categorical exemption. However, as described below, if the following can be shown, then the exceptions above could be argued not to apply:

(1) Cumulative local, regional and/or state GHG emissions are being reduced or will be reduced by adopted, funded, and feasible measures in order to meet broader state targets.

(2) Mandatory state or local GHG reduction measures would apply to the project's emissions such that broader GHG reduction goals would still be met and the project contributions would not be cumulatively considerable.

(3) Project GHG emissions are below an adopted significance threshold designed to take into account the cumulative nature of GHG emissions.

A similar argument could be made relative to the use of a ND (provided no additional mitigation (beyond existing mandates) is required to control GHG emissions) and to the use of a MND instead of an EIR. However, due to the "fair argument" standard, which is discussed in Chapter 3, caution is recommended in use of a ND or MND unless all three elements above can be fully supported through substantial evidence and there is no substantial evidence to the contrary. Establishing a significance threshold of zero is likely to preclude the use of a categorical exemption.

Relevant Citations

The full text of relevant citations is in Appendix A.

Public Resources Code – §21004, Mitigating or Avoiding a Significant Effect; Powers of Public Agency.

State CEQA Guidelines – §15064, Determining the Significance of the Environmental Effects Caused by a Project.

State CEQA Guidelines – §15130, Discussion of Cumulative Impacts.

State CEQA Guidelines – §15064.7, Thresholds of Significance.

Introduction

A non-zero threshold could minimize the resources spent reviewing environmental analyses that do not result in real GHG reductions or to prevent the environmental review system from being overwhelmed. The practical advantages of considering non-zero thresholds for GHG significance determinations can fit into the concept regarding whether the project's GHG emissions represent a "considerable contribution to the cumulative impact" and therefore warrant analysis.

Specifying a non-zero threshold could be construed as setting a *de minimis* value for a cumulative impact. In effect, this would be indicating that there are certain GHG emission sources that are so small that they would not contribute substantially to the global GHG budget. This could be interpreted as allowing public agencies to approve certain projects without requiring any mitigation of their GHG. Any threshold framework should include a proper context to address the *de minimis* issue. However, the CEQA Guidelines recognize that there may be a point where a project's contribution, although above zero, would not be a *considerable contribution* to the cumulative impact and, therefore, not trigger the need for a significance determination.

GHG emissions from all sources are under the purview of CARB and as such may eventually be "regulated" no matter how small. Virtually all projects will result in some direct or indirect release of GHG. However, a decision by CARB to regulate a class of sources does not necessarily mean that an individual source in that class would constitute a project with significant GHG impacts under CEQA. For example, CARB has established criteria pollutant emission standards for automobiles, but the purchase and use of a single new car is not considered a project with significant impacts under CEQA. At the same time, it is important to note that it is likely that all meaningful sources of emissions, no matter how small are likely to be considered for regulation under AB 32. It is expected that projects will have to achieve some level of GHG reduction to comply with CARB's regulations meant to implement AB 32. As such all projects will have to play a part in reducing our GHG emissions budget and no project, however small, is truly being considered *de minimis* under CARB's regulations.

This chapter evaluates a range of conceptual approaches toward developing GHG significance criteria. The air districts retained the services of J&S an environmental consulting, firm to assist with the development of a Statute and Executive Order-based threshold (Approach 1) and a tiered threshold (Approach 2) based on a prescribed list of tasks and deliverables. Time and financial constraints limited the scope and depth of this analysis, however, the work presented here may be useful in developing interim guidance while AB 32 is being implemented. J&S recognized that approaches other than those described here could be used.

As directed, J&S explored some overarching issues, such as:

- what constitutes "new" emissions?

- how should "baseline emissions" be established?
- what is cumulatively "considerable" under CEQA?
- what is "business as usual" ? and
- should an analysis include "life-cycle" emissions?

The answers to these issues were key to evaluating each of the threshold concepts.

Approach 1 – Statute and Executive Order Approach

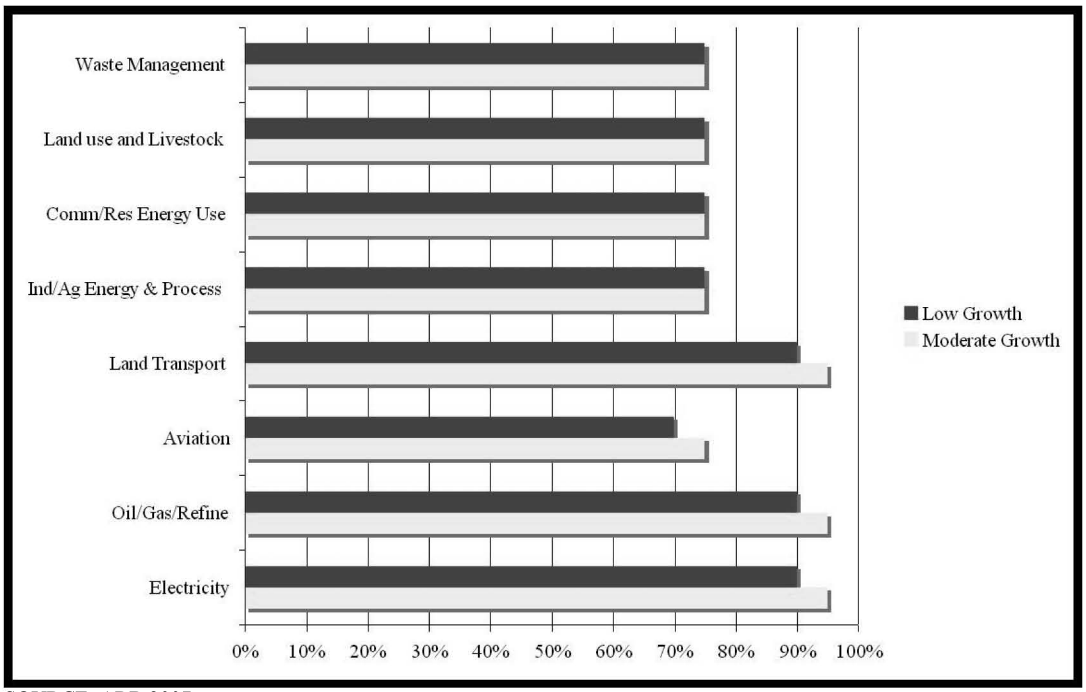
Thresholds could be grounded in existing mandates and their associated GHG emission reduction targets. A project would be required to meet the targets, or reduce GHG emissions to the targets, to be considered less than significant.

AB 32 and S-3-05 target the reduction of statewide emissions. It should be made clear that AB 32 and S-3-05 do not specify that the emissions reductions should be achieved through uniform reduction by geographic location or by emission source characteristics. For example, it is conceivable, although unlikely, that AB 32 goals could be achieved by new regulations that only apply to urban areas or that only apply to the transportation and/or energy sector. However, this approach to evaluating GHG under CEQA is based on the presumption that a new project must at least be consistent with AB 32 GHG emission reduction mandates.

The goal of AB 32 and S-3-05 is the significant reduction of future GHG emissions in a state that is expected to rapidly grow in both population and economic output. As such, there will have to be a significant reduction in the per capita GHG output for these goals to be met. CEQA is generally used to slow or zero the impact of new emissions, leaving the reduction of existing emission sources to be addressed by other regulatory means. With these concepts in mind, four options were identified for statute/executive order-based GHG significance thresholds and are described below.

<u>Threshold 1.1: AB 32/S-3-05 Derived Uniform Percentage-Based Reduction.</u> AB 32 requires the state to reduce California-wide GHG emissions to 1990 levels by 2020. Reducing greenhouse gas emission levels from 2020 to 1990 levels could require a 28 to 33 percent reduction of business-as-usual GHG emissions depending on the methodology used to determine the future emission inventories. The exact percent reduction may change slightly once CARB finalizes its 1990 and 2020 inventory estimates. In this context, business-as-usual means the emissions that would have occurred in the absence of the mandated reductions. The details of the business-as-usual scenario are established by CARB in the assumptions it uses to project what the state's GHG emissions would have been in 2020, and the difference between that level and the level that existed in 1990 constitutes the reductions that must be achieved if the mandated goals are to be met.

This threshold approach would require a project to meet a percent reduction target based on the average reductions needed from the business-as-usual emission from all GHG sources. Using the 2020 target, this approach would require all discretionary projects to achieve a 33 percent reduction from projected business-as-usual emissions in order to be considered less than significant. A more restrictive approach would use the 2050 targets. S-3-05 seeks to reduce GHG emissions to 80 percent below 1990 levels by 2050. To reach the 2050 milestone would require an estimated 90 percent reduction (effective immediately) of business-as-usual emissions. Using this goal as the basis for a significance threshold may be more appropriate to address the long-term adverse impacts associated with global climate change. Note that AB 32 and S-3-05 set emission inventory goals at milestone years; it is unclear how California will progress to these goals in non-milestone years.



SOURCE: ARB 2007

Threshold 1.2: Uniform Percentage-Based (e.g.50%) Reduction for New Development. This threshold is based on a presumption that new development should contribute a greater percent reduction from business-as-usual because greater reductions can be achieved at lower cost from new projects than can be achieved from existing sources. This approach would establish that new development emit 50 percent less GHG emissions than business-as-usual development. This reduction rate is greater than the recommended reduction rate for meeting the Threshold 1.1 2020 target (33 percent) but is significantly less restrictive than the Threshold 1.1 2050 target reduction rate (90 percent). If a 50 percent GHG reduction were achieved from new development, existing emissions would have to be reduced by 25 to 30 percent in order to meet the 2020 emissions goal depending on the year used to determine the baseline inventory. Although this reduction goal is reasonable for achieving the 2020 goal, it would not be possible to reach the 2050 emissions target with this approach even if existing emissions were 100 percent controlled.

Threshold 1.3: Uniform Percentage-Based Reduction by Economic Sector. This threshold would use a discrete GHG reduction goal specific to the economic sector associated with the project. There would be specific reduction goals for each economic sector, such as residential, commercial, and industrial development. Specifying different reduction thresholds for each market sector allows selection of the best regulatory goal for each sector taking into account available control technology and costs. This approach would avoid over-regulating projects (i.e. requiring emissions to be controlled in excess of existing technology) or under-regulating projects (i.e. discouraging the use of available technology to control emissions in excess of regulations). This approach requires extensive information on the emission inventories and best available control technology for each economic sector. This data will be compiled as CARB develops its scoping plan under AB 32 and its implementing regulations; as a result, this approach will be more viable in the long term.

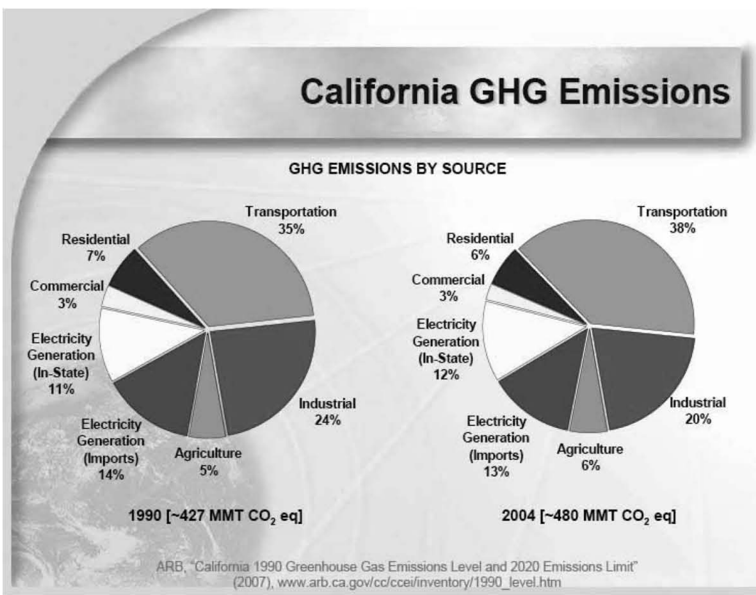
Threshold 1.4: Uniform Percentage-Based Reduction by Region. AB 32 and S-3-05 are written such that they apply to a geographic region (i.e. the entire state of California) rather than on a project or sector level. One could specify regions of the state such as the South Coast Air Basin, Sacramento Valley, or Bay Area which are required to plan (plans could be developed by regional governments, such as councils of governments) and demonstrate compliance with AB 32 and S-3-05 reduction goals at a regional level. To demonstrate that a project has less than significant emissions, one would have to show compliance with the appropriate regional GHG plan. Effectively this approach allows for analysis of GHG emissions at a landscape scale smaller than the state as a whole. Specifying regions in rough correlation to existing air basins or jurisdictional control allows for regional control of emissions and integration with regional emission reduction strategies for criteria and toxic air pollutants. Although differing GHG reduction controls for each region are possible, it is likely that all regions would be

required to achieve 1990 emission inventories by the year 2020 and 80 percent less emissions by 2050. Threshold 1.4 is considered viable long-term significance criteria that is unlikely to be used in the short term.

Implementing CEQA Thresholds Based on Emission Reduction Targets

Characterizing Baseline and Project Emissions

While the population and economy of California is expanding, all new projects can be considered to contribute new emissions. Furthermore, GHG impacts are exclusively cumulative impacts; there are no non-cumulative GHG emission impacts from a climate change perspective. "Business-as-usual" is the projection of GHG emissions at a future date based on current technologies and regulatory requirements in absence of other reductions. For example to determine the future emissions from a power plant for "business-as-usual" one would multiply the projected energy throughput by the current emission factor for that throughput. If adopted regulations (such as those that may be promulgated by CARB for AB 32) dictate that power plant emissions must be reduced at some time in the future, it is appropriate to consider these regulation standards as the new business-as-usual for a future date. In effect, business-as-usual will continue to evolve as regulations manifest. Note that "business-as-usual" defines the CEQA No Project conditions, but does not necessarily form the baseline under CEQA. For instance, it is common to subtract the future traffic with and without a project to determine the future cumulative contribution of a project on traffic conditions. However, existing conditions at the time of issuance of the notice of preparation is normally the baseline.



Establishing Emission Reduction Targets

One of the obvious drawbacks to using a uniform percent reduction approach to GHG control is that it is difficult to allow for changes in the 1990 and future emission inventories estimates. To determine what emission reductions are required for new projects one would have to know accurately the 1990 budget and efficacy of other GHG promulgated regulations as a function of time. Since CARB will not outline its regulation strategy for several more years, it is difficult to determine accurately what the new project reductions should be in the short term. Future updates to the 1990 inventory could necessitate changes in thresholds that are based on that inventory. It is important to note that it is difficult to create near term guidance for a uniform reduction threshold strategy since it would require considerable speculation regarding the implementation and effectiveness of forthcoming CARB regulations.

Of greater importance are the assumptions used to make the projected 2020 emission inventories. Projecting future inventories over the next 15-50 years involves substantial uncertainty. Furthermore, there are likely to be federal climate change regulations and possibly additional international GHG emission treaties in the near future. To avoid such speculation, this paper defines all future emission inventories as hypothetical business-as-usual projections.

This white paper is intended to support local decisions about CEQA and GHG in the near term. During this period, it is unlikely that a threshold based on emission reduction targets would need to be changed. However, it is possible that future inventory updates will show that targets developed on the current inventory were not stringent enough, or were more stringent than was actually needed.

Approach 2 – Tiered Approach

The goal of a tiered threshold is to maximize reduction predictability while minimizing administrative burden and costs. This would be accomplished by prescribing feasible mitigation measures based on project size and type, and reserving the detailed review of an EIR for those projects of greater size and complexity. This approach may require inclusion in a General Plan, or adoption of specific rules or ordinances in order to fully and effectively implement it.

A tiered CEQA significance threshold could establish different levels at which to determine if a project would have a significant impact. The tiers could be established based on the gross GHG emission estimates for a project or could be based on the physical size and characteristics of the project. This approach would then prescribe a set of GHG mitigation strategies that would have to be incorporated into the project in order for the project to be considered less than significant.

The framework for a tiered threshold would include the following:

- disclosure of GHG emissions for all projects;
- support for city/county/regional GHG emissions reduction planning;
- creation and use of a “green list” to promote the construction of projects that have desirable GHG emission characteristics;
- a list of mitigation measures;

- a decision tree approach to tiering; and

- quantitative or qualitative thresholds.

Decision-Tree Approach to Tiering

CEQA guidance that allows multiple methodologies to demonstrate GHG significance will facilitate the determination of significance for a broad range of projects/plans that would otherwise be difficult to address with a single non-compound methodology. Even though there could be multiple ways that a project can determine GHG significance using a decision-tree approach, only one methodology need be included in any single CEQA document prepared by the applicant. The presence of multiple methodologies to determine significance is designed to promote flexibility rather than create additional analysis overhead. Figure 1 shows a conceptual approach to significance determination using a tiered approach that shows the multiple routes to significance determination.

Figure 1 Detail Description

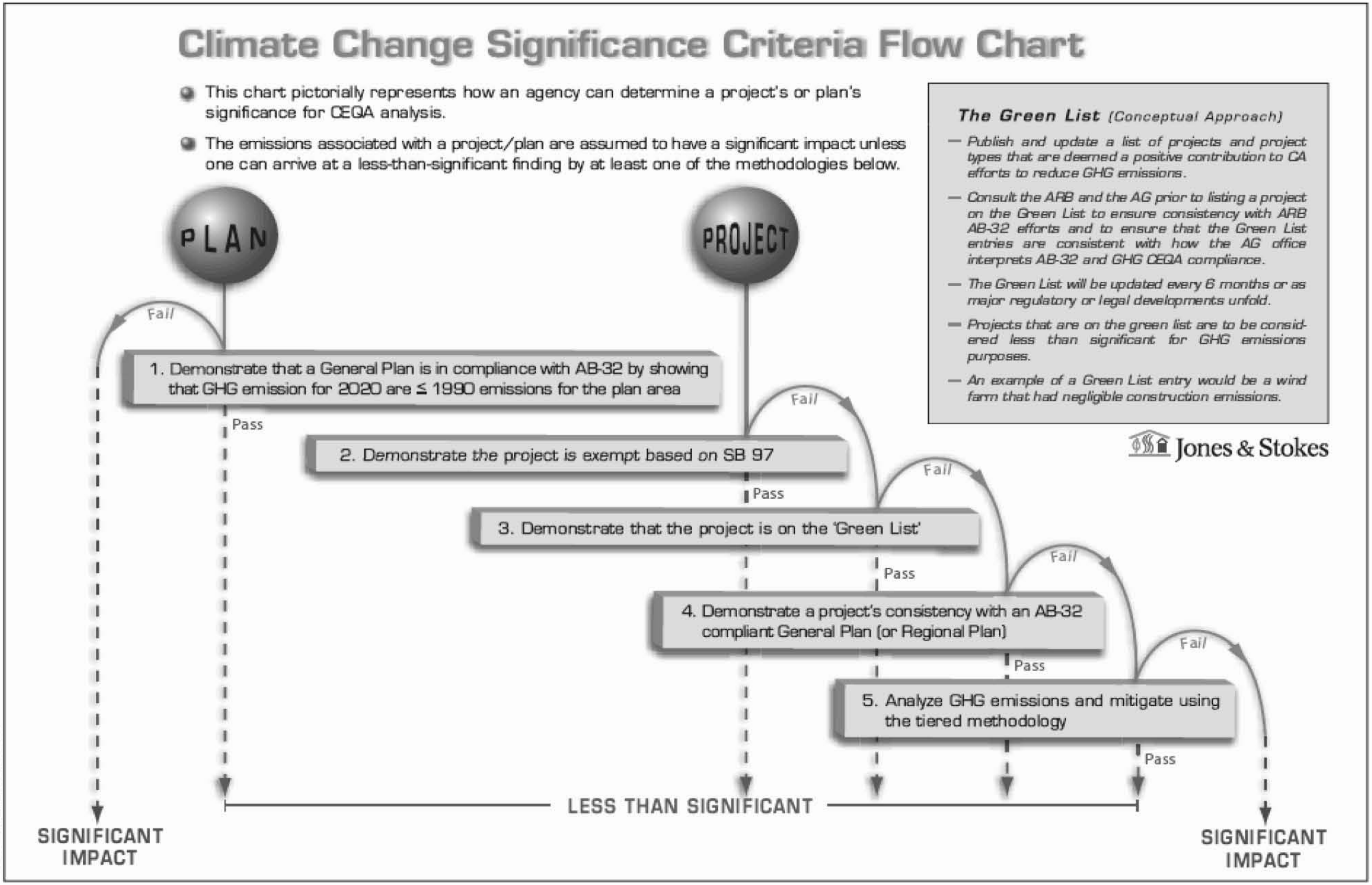
Figure 1 pictorially represents how an agency can determine a project's or plan's significance for CEQA analysis using the non-zero threshold methodology. The emissions associated with a project/plan are assumed to have a significant impact unless one can arrive at a less-than-significant finding by at least one of the methodologies below.

1. Demonstrate that a General Plan (GP) or Regional Plan is in Compliance with AB32

    - For most GPs or RPs this will require demonstration that projected 2020 emissions will be equal to or less than 1990 emissions.
    - GPs or RPs are expected to fully document 1990 and 2020 GHG emission inventories.
    - Projection of 2020 emissions is complicated by the fact that CARB is expected to promulgate emission reductions in the short term. Until explicit CARB regulations are in place, unmitigated GP 2020 emission inventories represent business-as-usual scenarios.
    - EIRs for GPs or RPs which demonstrate 2020 mitigated emissions are less than or equal to 1990 emissions are considered less than significant.

2. Demonstrate the Project is Exempt Based on SB 97

    - As specified in SB 97, projects that are funded under November 2006 Proposition 1B (Highway Safety, Traffic Reduction, Air Quality and Port Security Bond Act) and 1C (Disaster Preparedness and Flood Prevention Bond Act) may be exempt from analysis until January 1, 2010.



00802.07 GHG Emissions (rev 10/07)

Jones & Stokes

Figure 1
Climate Change Significance Criteria Flow Chart

- An exemption can be used in an ND, MND, or EIR to support a less than significant finding for GHG impacts.

3. Demonstrate that the Project is on the 'Green List'

- This list would include projects that are deemed a positive contribution to California efforts to reduce GHG emissions. If the project is of the type described on the Green List it is considered less than significant.
- If the Green List entry description requires mitigation for impacts other than GHG, this methodology can be used in MNDs or EIRs; if the Green List entry does not require mitigation this methodology can be used in NDs, MNDs, or EIRs.

4. Demonstrate a Project's Compliance with a General Plan

- If a project is consistent with an appropriate General Plan's Greenhouse Gas Reduction Plan (GGRP), a project can be declared less than significant.
- Note that at this time there are no known jurisdictions that have a GGRP that has been fully subject to CEQA review. While Marin County has adopted a forward-thinking GGRP and it is described in the most recent GP update, the associated EIR does not analyze the secondary environmental impacts of some of the GGRP measures such as tidal energy. While one can reference GGRPs that have not been reviewed fully in CEQA, to attempt to show a project's compliance with such a plan as evidence that the project's GHG emission contributions are less than significant may not be supported by substantial evidence that cumulative emissions are being fully addressed in the particular jurisdiction.
- Compliance with a CEQA-vetted GGRP can be cited as evidence for all CEQA documents (Categorical Exemption, ND, MND, and EIR).

5. Analyze GHG Emissions and Mitigate using the Tiered Methodology

- Guidance and mitigation methodology for various development projects (residential, commercial, industrial) are listed in the form of tiered thresholds. If a project incorporates the mitigation measures specified in the tiered threshold tables the project is considered less than significant.
- All project emissions are considered less than significant if they are less than the threshold(s).
- If the tiered approach requires mitigation, this methodology can be used in MNDs or EIRs; if the tiered approach does not require mitigation this methodology can be used in NDs, MNDs, or EIRs.

<u>The Green List</u>

- The Green List would be a list of projects and project types that are deemed a positive contribution to California's efforts to reduce GHG emissions.
- If this approach is followed, it is suggested that CARB and the Attorney General (AG) are consulted prior to listing a project on the Green List to ensure consistency with CARB AB 32 efforts and to ensure that the Green List entries are consistent with how the AG office interprets AB 32 and GHG CEQA compliance.
- The Green List should be updated every 6 months or as major regulatory or legal developments unfold.
- Projects that are on the Green List are to be considered less than significant for GHG emissions purposes.
- A tentative list of potential Green List entries is presented below. Actual Green List entries should be far more specific and cover a broad range of project types and mitigation approaches. The list below is merely a proof-of-concept for the actual Green List.

    1. Wind farm for the generation of wind-powered electricity
    2. Extension of transit lines to currently developed but underserved communities
    3. Development of high-density infill projects with easily accessible mass transit
    4. Small hydroelectric power plants at existing facilities that generate 5 mw or less (as defined in Class 28 Categorical Exemption)
    5. Cogeneration plants with a capacity of 50 mw or less at existing facilities (as defined in Class 29 Cat Exemption)
    6. Increase in bus service or conversion to bus rapid transit service along an existing bus line
    7. Projects with LEED "Platinum" rating
    8. Expansion of recycling facilities within existing urban areas
    9. Recycled water projects that reduce energy consumption related to water supplies that services existing development
    10. Development of bicycle, pedestrian, or zero emission transportation infrastructure to serve existing regions

There are also several options for tiering and thresholds, as shown in Table 2 below. One could establish strictly numeric emissions thresholds and require mitigation to below the specific threshold to make a finding of less than significant. One could establish narrative emissions threshold that are based on a broader context of multiple approaches to GHG reductions and a presumption that projects of sufficiently low GHG intensity are less than significant.

In Concept 2A, a zero threshold would be applied to projects and thus only projects that result in a reduction of GHG emissions compared to baseline emissions would be less than significant absent mitigation. All projects would require quantified inventories. All projects that result in a net increase of GHG emissions would be required to mitigate their emissions to zero through direct mitigation or through fees or offsets or the impacts

Table 2: Approach 2 Tiering Options

	Concept 2A Zero	Concept 2B Quantitative	Concept 2C Qualitative
Tier 1	Project results in a net reduction of GHG emissions *Less than Significant*	Project in compliance with an AB 32-compliant General/Regional Plan, on the Green List, or below Tier 2 threshold. Level 1 Reductions (Could include such measures as: bike parking, transit stops for planned route, Energy Star roofs, Energy Star appliances, Title 24, water use efficiency, etc.) *Less than Significant*	Project in compliance with an AB 32-compliant General/Regional Plan, on the Green List, or below Tier 2 threshold. Level 1 Reductions (See measures under 2B) *Less than Significant*
Tier 2	Project results in net increase of GHG emissions Mitigation to zero (including offsets) *Mitigated to Less than Significant*	Above Tier 2 threshold Level 2 Mitigation (Could include such measures as: Parking reduction beyond code, solar roofs, LEED Silver or Gold Certification, exceed Title 24 by 20%, TDM measures, etc.) *Mitigated to Less than Significant*	Above Tier 2 threshold Level 2 Mitigation (See measures under 2B) *Mitigated to Less than Significant*
Tier 3	Mitigation infeasible to reduce emissions to zero (e.g., cost of offsets infeasible for project or offsets not available) *Significant and Unavoidable*	Above Tier 2 threshold With Level 1, 2 Mitigation Level 3 Mitigation: (Could include such measures as: On-site renewable energy systems, LEED Platinum certification, Exceed Title 24 by 40%, required recycled water use for irrigation, zero waste/high recycling requirements, mandatory transit passes, offsets/carbon impact fees) *Mitigated to Less than Significant*	Above Tier 3 thresholds Quantify Emissions, Level 3 Mitigation (see measures under 2B), and Offsets for 90% of remainder *Significance and Unavoidable*

would be identified as significant and unavoidable. This could be highly problematic and could eliminate the ability to use categorical exemptions and negative declarations for a wide range of projects.

In Concepts 2B and 2C, the first tier of a tiered threshold includes projects that are within a jurisdiction with an adopted greenhouse gas reduction plan (GGRP) and General Plan/Regional Plan that is consistent with AB 32 (and in line with S-3-05), or are on the Green List, or are below the Tier 2 threshold. All Tier 1 projects would be required to implement mandatory reductions required due to other legal authority (Level 1 reductions) such as AB 32, Title 24, or local policies and ordinances. With Level 1 reduction measures, qualifying Tier 1 projects would be considered less than significant without being required to demonstrate mitigation to zero.

In Concept 2B, the Tier 2 threshold would be quantitative, and quantified inventories would be required. Several quantitative threshold options are discussed below. A more comprehensive set of Level 2 mitigation would be required. If the project's emissions still exceed the Tier 2 threshold, an even more aggressive set of Level 3 mitigation measures would be required including offsets (when feasible) to reduce emissions below the Tier 2 threshold.

In Concept 2C, there would be two thresholds, a lower Tier 2 threshold (the "low bar") and a higher Tier 3 threshold (the "high bar"). The Tier 2 threshold would be the significance threshold for the purposes of CEQA and would be qualitative in terms of units (number of dwelling units, square feet of commercial space, etc.) or a per capita ratio. Projects above the Tier 2 threshold would be required to implement the comprehensive set of Level 2 mitigation. Projects below the Tier 2 threshold would not be required to quantify emissions or reductions. The Tier 3 threshold would be a threshold to distinguish the larger set of projects for which quantification of emissions would be required. Level 3 mitigation would be required and the project would be required to purchase offsets (when feasible) in the amount of 90 percent of the net emissions after application of Level 1 reductions and Level 2 and 3 mitigation. A variant on Concept 2C would be to require mandatory Level 3 mitigation without quantification and offsets.

Approach 2 Threshold Options

Seven threshold options were developed for this approach. The set of options are framed to capture different levels of new development in the CEQA process and thus allow different levels of mitigation. Options range from a zero first-tier threshold (Threshold 2.1) up to a threshold for GHG that would be equivalent to the capture level (i.e., number of units) of the current criteria pollutant thresholds used by some air districts (Threshold 2.4). The decision-based implementation approach discussed above could be used for any of these options. Table 3 below compares the results of each of the approaches discussed here.

Threshold 2.1: Zero First Tier Tiered Threshold.

This option would employ the decision tree concept and set the first tier cut-point at zero. The second tier cut-point could be one of the qualitative or quantitative thresholds discussed below. First-tier projects would be required to implement a list of very feasible and readily available mitigation measures.

Threshold 2.2: Quantitative Threshold Based on Market Capture

A single quantitative threshold was developed in order to ensure capture of 90 percent or more of likely future discretionary developments. The objective was to set the emission threshold low enough to capture a substantial fraction of future residential and non-residential development that will be constructed to accommodate future statewide population and job growth, while setting the emission threshold high enough to exclude small development projects that will contribute a relatively small fraction of the cumulative statewide GHG emissions.

The quantitative threshold was created by using the following steps:

- Reviewing data from four diverse cities (Los Angeles in southern California and Pleasanton, Dublin, and Livermore in northern California) on pending applications for development.

- Determining the unit (dwelling unit or square feet) threshold that would capture approximately 90 percent of the residential units or office space in the pending application lists.

- Based on the data from the four cities, the thresholds selected were 50 residential units and 30,000 square feet of commercial space.

- The GHG emissions associated with 50 single-family residential units and 30,000 square feet of office were estimated and were found to be 900 metric tons and 800 metric tons, respectively. Given the variance on individual projects, a single threshold of 900 metric tons was selected for residential and office projects.

- A 900 metric ton threshold was also selected for non-office commercial projects and industrial projects to provide equivalency for different projects in other economic sectors.

- If this threshold is preferred, it is suggested that a more robust data set be examined to increase the representativeness of the selected thresholds. At a minimum, a diverse set of at least 20 cities and/or counties from throughout the state should be examined in order to support the market capture goals of this threshold. Further, an investigation of market capture may need to be conducted for different commercial project types and for industrial projects in order to examine whether multiple quantitative emissions thresholds or different thresholds should be developed.

The 900-ton threshold corresponds to 50 residential units, which corresponds to the 84^{th} percentile of projects in the City of Los Angeles, the 79^{th} percentile in the City of Pleasanton, the 50^{th} percentile in the City of Livermore and the 4^{th} percentile in the City of Dublin. This is suggestive that the GHG reduction burden will fall on larger projects that will be a relatively small portion of overall projects within more developed central cities (Los Angeles) and suburban areas of slow growth (Pleasanton) but would be the higher portion of projects within moderately (Livermore) or more rapidly developing areas (Dublin). These conclusions are suggestive but not conclusive due to the small sample size. The proposed threshold would exclude the smallest proposed developments from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA. While this would exclude perhaps 10 percent of new residential development, the capture of 90 percent of new residential development would establish a strong basis for demonstrating that cumulative reductions are being achieved across the state. It can certainly serve as an interim measure and could be revised if subsequent regulatory action by CARB shows that a different level or different approach altogether is called for.

The 900-ton threshold would correspond to office projects of approximately 35,000 square feet, retail projects of approximately 11,000 square feet, or supermarket space of approximately 6,300 square feet. 35,000 square feet would correspond to the 46th percentile of commercial projects in the City of Los Angeles, the 54th percentile in the City of Livermore, and the 35th percentile in the City of Dublin. However, the commercial data was not separated into office, retail, supermarket or other types, and thus the amount of capture for different commercial project types is not known. The proposed threshold would exclude smaller offices, small retail (like auto-parts stores), and small supermarkets (like convenience stores) from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA but would include many medium-scale retail and supermarket projects.

The industrial sector is less amenable to a unit-based approach given the diversity of projects within this sector. One option would be to adopt a quantitative GHG emissions threshold (900 tons) for industrial projects equivalent to that for the residential/commercial thresholds described above. Industrial emissions can result from both stationary and mobile sources. CARB estimates that their suggested reporting threshold for stationary sources of 25,000 metric tons accounts for more than 90 percent of the industrial sector GHG emissions (see Threshold 2.3 for 25,000 metric ton discussion). If the CARB rationale holds, then a 900 metric ton threshold would likely capture at least 90 percent (and likely more) of new industrial and manufacturing sources. If this approach is advanced, we suggest further examination of industrial project data to determine market capture.

This threshold would require the vast majority of new development emission sources to quantify their GHG emissions, apportion the forecast emissions to relevant source categories, and develop GHG mitigation measures to reduce their emissions.

<u>Threshold 2.3: CARB Reporting Threshold</u>

CARB has recently proposed to require mandatory reporting from cement plants, oil refineries, hydrogen plants, electric generating facilities and electric retail providers, cogeneration facilities, and stationary combustion sources emitting ≥ 25,000 MT CO_2e/yr. AB 32 requires CARB to adopt a regulation to require the mandatory reporting and verification of emissions. CARB issued a preliminary draft version of its proposed reporting requirements in August 2007 and estimates that it would capture 94 percent of the GHG emissions associated with stationary sources.

This threshold would use 25,000 metric tons per year of GHG as the CEQA significance level. CARB proposed to use the 25,000 metric tons/year value as a reporting threshold, not as a CEQA significance threshold that would be used to define mitigation requirements. CARB is proposing the reporting threshold to begin to compile a statewide emission inventory, applicable only for a limited category of sources (large industrial facilities using fossil fuel combustion).

A 25,000 metric ton significance threshold would correspond to the GHG emissions of approximately 1,400 residential units, 1 million square feet of office space, 300,000 square feet of retail, and 175,000 square feet of supermarket space. This threshold would capture far less than half of new residential or commercial development.

As noted above, CARB estimates the industrial-based criteria would account for greater than 90 percent of GHG emissions emanating from stationary sources. However, industrial and manufacturing projects can also include substantial GHG emissions from mobile sources that are associated with the transportation of materials and delivery of products. When all transportation-related emissions are included, it is unknown what portion of new industrial or manufacturing projects a 25,000-ton threshold would actually capture.

An alternative would be to use a potential threshold of 10,000 metric tons considered by the Market Advisory Committee for inclusion in a Greenhouse Gas Cap and Trade System in California. A 10,000 metric ton significance threshold would correspond to the GHG emissions of approximately 550 residential units, 400,000 square feet of office space, 120,000 square feet of retail, and 70,000 square feet of supermarket space. This threshold would capture roughly half of new residential or commercial development.

Threshold 2.4: Regulated Emissions Inventory Capture

Most California air districts have developed CEQA significance thresholds for NOx and ROG emissions to try to reduce emissions of ozone precursors from proposed sources that are not subject to NSR pre-construction air quality permitting. The historical management of ozone nonattainment issues in urbanized air districts is somewhat analogous to today's concerns with greenhouse gas emissions in that regional ozone concentrations are a cumulative air quality problem caused by relatively small amounts of NOx and ROG emissions from thousands of individual sources, none of which emits enough by themselves to cause elevated ozone concentrations. Those same conditions apply to global climate change where the environmental problem is caused by emissions from a countless number of individual sources, none of which is large enough by itself to cause the problem. Because establishment of NOx/ROG emissions CEQA significance thresholds has been a well-tested mechanism to ensure that individual projects address cumulative impacts and to force individual projects to reduce emissions under CEQA, this threshold presumes the analogy of NOx/ROG emission thresholds could be used to develop similar GHG thresholds.

The steps to develop a GHG emission threshold based on the NOx/ROG analogy were as follows:

- For each agency, define its NOx/ROG CEQA thresholds.
- For each agency, define the regional NOx/ROG emission inventory the agency is trying to regulate with its NOx/ROG thresholds.
- For each agency, calculate the percentage of the total emission inventory for NOx represented by that agency's CEQA emission threshold. That value represents the "minimum percentage of regulated inventory" for NOx.
- The current (2004) California-wide GHG emission inventory is 499 million metric tons per year of CO_2 equivalent (MMT CO_2e). Apply the typical "minimum percentage of regulated inventory" value to the statewide GHG inventory, to develop a range of analogous GHG CEQA thresholds.

The preceding methodology was applied to two different air quality districts: the Bay Area Air Quality Management District (BAAQMD), a mostly-urbanized agency within which most emissions are generated from urban areas; and the San Joaquin Valley Air Pollution Control District (SJVAPCD), which oversees emissions emanating in part from rural areas that are generated at dispersed agricultural sources and area sources. For example, in the Bay Area the NOx threshold is 15 tons/year. The total NOx inventory for 2006 was 192,000 tons/year (525 tons/day). The threshold represents 0.008 percent of the total NOx inventory. Applying that ratio to the total statewide GHG emissions inventory of 499 MMT CO_2e (2004) yields an equivalent GHG threshold of 39,000 MMT CO_2e.

The range of analogous CEQA GHG thresholds derived from those two agencies is tightly clustered, ranging from 39,000 to 46,000 tons/year. A 39,000 to 46,000 metric ton threshold would correspond to the GHG emissions of approximately 2,200 to 2,600 residential units, 1.5 to 1.8 million square feet of office space, 470,000 to 560,000 square feet of retail, and 275,000 to 320,000 square feet of supermarket space. This threshold would capture far less than half of new residential or commercial development. Similarly, this threshold would capture less of new industrial/manufacturing GHG emissions inventory than Thresholds 2.2 or 2.3.

Threshold 2.5: Unit-Based Thresholds Based on Market Capture

Unit thresholds were developed for residential and commercial developments in order to capture approximately 90 percent of future development. The objective was to set the unit thresholds low enough to capture a substantial fraction of future housing and commercial developments that will be constructed to accommodate future statewide population and job growth, while setting the unit thresholds high enough to exclude small development projects that will contribute a relatively small fraction of the cumulative statewide GHG emissions. Sector-based thresholds were created by using the same steps and data used to create Threshold 2.2- Quantitative Threshold Based on Market Capture above.

The distribution of pending application data suggests that the GHG reduction burden will fall on larger projects that will be a relatively small portion of overall projects within more developed central cities and suburban areas of slow growth but would be the higher portion of projects within moderately or rapidly developing areas. The proposed threshold would exclude the smallest proposed developments from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA. While this would exclude perhaps 10 percent of new residential development, the capture of 90 percent of new residential development would establish a strong basis for demonstrating that cumulative reductions are being achieved across the state. It can certainly serve as an interim measure and could be revised if subsequent regulatory action by CARB shows that a different level or different approach altogether is called for.

A similar rationale can be applied to the development of a commercial threshold. Threshold 2.5 would exclude many smaller businesses from potentially burdensome requirements to quantify and mitigate GHG emissions under CEQA. It should be noted that the GHG emissions of commercial projects vary substantially. For example, the carbon dioxide emissions associated with different commercial types were estimated as follows:

- 30,000 square-foot (SF) office = 800 metric tons/year CO_2
- 30,000 SF retail = 2,500 metric tons/year CO_2
- 30,000 SF supermarket = 4,300 metric tons/year CO_2

Thus, in order to assure appropriate market capture on an emissions inventory basis, it will be important to examine commercial project size by type, instead of in the aggregate (which has been done in this paper).

The industrial sector is less amenable to a unit-based approach given the diversity of projects within this sector. One option would be to use a quantitative threshold of 900 tons for industrial projects in order to provide for rough equivalency between different sectors. Industrial emissions can result from both stationary and mobile sources. However, if the CARB rationale for > 90 percent stationary source capture with a threshold of 25,000 metric tons holds, then a 900 metric ton threshold would likely capture at least 90 percent (and likely more) of new industrial sources. Further examination of unit-based industrial thresholds, such as the number of employees or manufacturing floor space or facility size, may provide support for a unit-based threshold based on market capture.

This threshold would require the vast majority of new development emission sources to quantify their GHG emissions, apportion the forecast emissions to relevant source categories, and develop GHG mitigation measures to reduce their emissions.

Threshold 2.6. Projects of Statewide, Regional, or Areawide Significance

For this threshold, a set of qualitative, tiered CEQA thresholds would be adopted based on the definitions of "projects with statewide, regional or areawide significance" under the Guidelines for California Environmental Quality Act, CCR Title 14, Division 6, Section 15206(b).

Project sizes defined under this guideline include the following:

- Proposed residential development of more than 500 dwelling units.
- Proposed shopping center or business establishment employing more than 1,000 persons or encompassing more than 500,000 square feet of floor space.
- Proposed commercial office building employing more than 1,000 persons or encompassing more than 250,000 square feet of floor space.
- Proposed hotel/motel development of more than 500 rooms.
- Proposed industrial, manufacturing or processing plant or industrial park planned to house more than 1,000 persons, or encompassing more than 600,000 square feet of floor space.

These thresholds would correspond to the GHG emissions of approximately 9,000 metric tons for residential projects, 13,000 metric tons for office projects, and 41,000 metric tons for retail projects. These thresholds would capture approximately half of new residential development and substantially less than half of new commercial development. It is unknown what portion of the new industrial or manufacturing GHG inventory would be captured by this approach.

Threshold 2.7 Efficiency-Based Thresholds

For this approach, thresholds would be based on measurements of efficiency. For planning efforts, the metric could be GHG emissions per capita or per job or some combination thereof. For projects, the metric could be GHG emission per housing unit or per square foot of commercial space. In theory, one could also develop metrics for GHG emissions per dollar of gross product to measure the efficiency of the economy.

This approach is attractive because it seeks to benchmark project GHG intensity against target levels of efficiency. The thresholds would need to be set such that there is reasonably foreseeable and sufficient reductions compared to business as usual to support meeting AB 32 and S-3-05 goals in time (in combination with command and control regulations). Because this approach would require substantial data and modeling to fully develop, this is a concept considered as a potential future threshold and not appropriate for interim guidance in the short term. Thus, it is not evaluated in the screening evaluation in the next section.

Table 3 compares the results for each of the approaches.

Table 3: Comparison of Approach 2 Tiered Threshold Options

Threshold	GHG Emission Threshold (metric tons/year)	Future Development Captured by GHG Threshold
2.1: Zero Threshold	0 tons/year	All
2.2: Quantitative Threshold Based on Market Capture	~900 tons/year	Residential development > 50 dwelling units Office space > 36,000 ft^2 Retail space >11,000 ft^2 Supermarkets >6.300 ft^2 small, medium, large industrial
2.3: CARB GHG Mandatory Reporting Threshold OR Potential Cap and Trade Entry Level	25,000 metric tons/year OR 10,000 metric tons/year	Residential development >1,400 dwelling units OR 550 dwelling units Office space >1 million ft^2 OR 400,000 ft^2 Retail space >300,000 ft^2 OR 120,000 ft^2 Supermarkets >175,000 ft^2 OR 70,000 ft^2 medium/larger industrial
2.4: Regulated Inventory Capture	40,000 – 50,000 metric tons/year	Residential development >2,200 to 2,600 dwelling units Office space >1.5 to 1.8 million ft^2 Retail space >470,000 to 560,000 ft^2 Supermarkets >270,000 to 320,000 ft^2 medium/larger industrial
2.5: Unit-Based Threshold Based on Market Capture	Not applicable.	Residential development >50 dwelling units Commercial space >50,000 ft^2 > small, medium, large industrial (with GHG emissions > 900 tonsCO2e)
2.6: Projects of Statewide, Regional, or Areawide Significance	Not applicable.	Residential development >500 dwelling units Office space >250,000 ft^2 Retail space >500,000 ft^2 Hotels >500 units Industrial project >1,000 employees Industrial project >40 acre or 650,000 ft^2
2.7: Efficiency-Based Thresholds	TBD tons/year/person TBD tons/year/unit	Depends on the efficiency measure selected.

Implementing CEQA With Tiered Thresholds

Several issues related to Approach 2 are addressed below:

1. *Some applications of this approach may need to be embodied in a duly approved General Plan, or in some other formal regulation or ordinance to be fully enforceable.* Because CEQA does not expressly provide that projects may be deemed insignificant based on implementation of a set of mitigations, this approach may need to be supported with specific and enforceable mechanisms adopted with due public process.

2. *How would this concept affect adoption of air district rules and regulations?* Proposed air district rules and regulations may be subject to CEQA like other projects and plans. Thus, if significance thresholds were adopted by an APCD or AQMD, then they could also apply to air district discretionary actions. If GHG emissions would be increased by a rule or regulation for another regulated pollutant, that would be a potential issue for review under CEQA.

3. *Mitigation measures may not be all-inclusive; better measures now or new future technology would make these measures obsolete.* The mandatory mitigation measures could be periodically updated to reflect current technology, feasibility, and efficiency.

4. *Total reduction may not be quantified or difficult to quantify.* CEQA only requires the adoption of feasible mitigation and thus the reduction effectiveness of required mitigation should not be in question. However, the precise reduction effectiveness may indeed be difficult to identify. As described above, if a quantitative threshold is selected as the measure of how much mitigation is mandated, then best available evidence will need to be used to estimate resultant GHG emissions with mitigation adoption. If a qualitative threshold is selected, then it may not be necessary to quantify reductions.

5. *Difficult to measure progress toward legislative program goals.* One could require reporting of project inventories to the Climate Action Registry, air district, or regional council of governments, or other suitable body. Collection of such data would allow estimates of the GHG intensity of new development over time, which could be used by CARB to monitor progress toward AB 32 goals.

6. *Measures may have adverse impacts on other programs.* The identification of mandatory mitigation will need to consider secondary environmental impacts, including those to air quality.

7. *Consideration of life-cycle emissions.* In many cases, only direct and indirect emissions may be addressed, rather than life-cycle emissions. A project applicant has traditionally been expected to only address emissions that are closely related and within the capacity of the project to control and/or influence. The long chain

8. of economic production resulting in materials manufacture, for example, involves numerous parties, each of which in turn is responsible for the GHG emissions associated with their particular activity. However, there are situations where a lead agency could reasonably determine that a larger set of upstream and downstream emissions should be considered because they are being caused by the project and feasible alternatives and mitigation measures may exist to lessen this impact.

Approach 2 Tiered Threshold with Mandatory Mitigation

As shown in Table 2, due to the cumulative nature of GHG emissions and climate change impacts, there could be a level of mandatory reductions and/or mitigation for all projects integrated into a tiered threshold approach. In order to meet AB 32 mandates by 2020 and S-3-05 goals, there will need to be adoption of GHG reduction measures across a large portion of the existing economy and new development. As such, in an effort to support a determination under CEQA that a project has a less than considerable contribution to significant cumulative GHG emissions, mitigation could be required on a progressively more comprehensive basis depending on the level of emissions.

- Level 1 Reductions – These reduction measures would apply to all projects and would only consist of AB 32 and other local/state mandates. They would be applied to a project from other legal authority (not CEQA). Level 1 reductions could include such measures as bike parking, transit stops for planned routes, Energy Star roofs, Energy Star appliances, Title 24 compliance, water use efficiency, and other measures. All measures would have to be mandated by CARB or local regulations and ordinances.

- Level 2 Mitigation – Projects that exceed the determined threshold would be required to first implement readily available technologies and methodologies with widespread availability. Level 2 Mitigation could include such measures as: parking reduction below code minimum levels, solar roofs, LEED Silver or Gold Certification, exceed Title 24 building standards by 20 percent, Traffic Demand Management (TDM) measures, and other requirements.

- Level 3 Mitigation - If necessary to reduce emissions to the thresholds, more extensive mitigation measures that represent the top tier of feasible efficiency design would also be required. Level 3 Mitigation could include such measures as: on-site renewable energy systems, LEED Platinum certification, exceed Title 24 building requirements by 40 percent, required recycled water use for irrigation, zero waste/high recycling requirements, mandatory transit pass provision, and other measures.

- Offset Mitigation – If, after adoption of all feasible on-site mitigation, the project is still found to exceed a Tier 2 quantitative threshold, or exceed a Tier 3 qualitative threshold, or if a project cannot feasibly implement the mandatory on-site mitigation, then purchases of offsets could be used for mitigation. In the case of a quantitative threshold, the amount of purchase would be to offset below the Tier 2 significance threshold. In the case of a qualitative threshold, the amount of purchase could be to offset GHG emissions overall to below the lowest equivalent GHG emissions among the Tier 2 qualitative thresholds. With Threshold 2.5, this would be approximately 900 tons of GHG emissions (corresponding to 50 residential units). With Threshold 2.6, this would be approximately 9,000 tons (corresponding to 500 residential units). Alternatively, one could require purchase of offsets in the amount of a set percentage (such as 90% or 50% for example) of the residual GHG emissions (after other mitigation). As discussed earlier, any decision to include or require the use of emission reduction credits (or offsets) must consider issues of availability, quality, and environmental justice.

Substantial Evidence Supporting Different Thresholds

If a project can be shown by substantial evidence not to increase GHG emissions relative to baseline emissions, then no fair argument will be available that the project contributes considerably to a significant cumulative climate change impact.

It is more challenging to show that a project that increases GHG emissions above baseline emissions does not contribute considerably to a significant cumulative climate change impact. It is critical therefore, to establish an appropriate cumulative context, in which, although an individual project may increase GHG emissions, broader efforts will result in net GHG reductions.

Approach 1-based thresholds that by default will require an equal level of GHG reductions from the existing economy (Thresholds 1.1, 1.3, and 1.4) may be less supportable in the short run (especially before 2012) than Approach 1.2 (which requires new development to be relatively more efficient than a retrofitted existing economy). This is because, prior to 2012, there will only be limited mandatory regulations implementing AB 32 that could address the existing economy in a truly systematic way that can be relied upon to demonstrate that overall GHG reduction goals can be achieved by 2020. Approach 1.2 will still rely on substantial reductions in the existing economy but to a lesser degree.

Approach 1-based thresholds that would spread the mitigation burden across a sector (Threshold 1.3) or across a region (Threshold 1.4) will allow for tradeoffs between projects or even between municipalities. In order to demonstrate that a sector or a region is achieving net reductions overall, there would need to be feasible, funded, and mandatory requirements in place promoting an overall reduction scheme, in order for a project to result in nominal net increased GHG emissions.

Approach 2-based thresholds that capture larger portions of the new development GHG inventory (Thresholds 2.2 and 2.5) would promote growth that results in a smaller increase in GHG emissions; they may therefore be more supportable than thresholds that do not and that have a greater reliance on reductions in the existing economy (Thresholds

2.3, 2.4, and 2.6), especially in the next three to five years. With an established cumulative context that demonstrates overall net reductions, all threshold approaches could be effective in ensuring growth and development that significantly mitigates GHG emissions growth in a manner that will allow the CARB to achieve the emission reductions necessary to meet AB 32 targets. In that respect, all of these thresholds are supported by substantial evidence.

Evaluation of Non-Zero Threshold Options

Overarching issues concerning threshold development are reviewed below. Where appropriate, different features or application of the two conceptual approaches and the various options for thresholds under each conceptual approach described above are analyzed. The screening evaluation is summarized in Tables 4 (Approach 1) and 5 (Approach 2). The summary tables rate each threshold for the issues discussed below based on the level of confidence (low, medium or high) ascribed by J&S. The confidence levels relate to whether a threshold could achieve a particular attribute, such as emission reduction effectiveness. For example, a low emission reduction effectiveness rating means the threshold is not expected to capture a relatively large portion of the new development inventory.

As described above, Threshold 2.7 is not included in this evaluation because the data to develop an efficiency-based threshold has not been reviewed at this time and because this threshold is not considered feasible as an interim approach until more detailed inventory information is available across the California economy.

What is the GHG Emissions Effectiveness of Different Thresholds?

Effectiveness was evaluated in terms of whether a threshold would capture a large portion of the GHG emissions inventory and thus require mitigation under CEQA to control such emissions within the larger framework of AB 32. In addition, effectiveness was also evaluated in terms of whether a threshold would require relatively more or less GHG emissions reductions from the existing economy verses new development. This is presumptive that gains from the existing economy (through retrofits, etc.) will be more difficult and inefficient relative to requirements for new development.

Approach 1-based thresholds that require equivalent reductions relative to business-as-usual (Thresholds 1.1, 1.3, and 1.4) for both the existing and new economy will be less effective than thresholds that support lower-GHG intensity new development (Approach 1.2). However, since Approach 1-based thresholds do not establish a quantitative threshold below which projects do not have to mitigate, the market capture for new development is complete.

Approach 2-based thresholds can be more or less effective at capturing substantial portions of the GHG inventory associated with new development depending on where the quantitative or qualitative thresholds are set. Lower thresholds will capture a broader range of projects and result in greater mitigation. Based on the review of project data for the select municipalities described in the Approach 2 section above, thresholds based on the CARB Reporting Threshold/Cap and Trade Entry Level (Threshold 2.4) or CEQA definitions of "Statewide, Regional or Areawide" projects (Threshold 2.6) will result in a limited capture of the GHG inventory. Lower quantitative or qualitative thresholds (Thresholds 2.1, 2.2 and 2.5) could result in capture of greater than 90 percent of new development.

Are the Different Thresholds Consistent with AB 32 and S-3-05?

Thresholds that require reductions compared to business-as-usual for all projects or for a large portion of new development would be consistent with regulatory mandates. In time, the required reductions will need to be adjusted from 2020 (AB 32) to 2050 (S-3-05) horizons, but conceptually broad identification of significance for projects would be consistent with both of these mandates. Thresholds that exclude a substantial portion of new development would likely not be consistent, unless it could be shown that other more effective means of GHG reductions have already been, or will be adopted, within a defined timeframe.

All Approach 1-based thresholds would be consistent with AB 32 and S-3-05 if it can be demonstrated that other regulations and programs are effective in achieving the necessary GHG reduction from the existing economy to meet the overall state goals.

Approach 2-based thresholds that include substantive parts of the new development GHG inventory (Thresholds 2.1, 2.2 and 2.5) will be more consistent with AB 32 and S-3-05 than those that do not (Thresholds 2.3, 2.4, and 2.6) unless it can be demonstrated that other regulations and programs are effective in achieving the necessary GHG reduction from the existing economy to meet the overall state goals.

What are the Uncertainties Associated with Different Thresholds?

All thresholds have medium to high uncertainties associated with them due to the uncertainty associated with the effectiveness of AB 32 implementation overall, the new character of GHG reduction strategies on a project basis, the immaturity of GHG reduction technologies or infrastructure (such as widespread biodiesel availability), and the uncertainty of GHG reduction effectiveness of certain technologies (such as scientific debate concerning the relative lifecycle GHG emissions of certain biofuels, for example).

In general, Approach 1-based thresholds have higher uncertainties than Approach 2 thresholds because they rely on a constantly changing definition of business-as-usual. Threshold 1.2, with its relatively smaller reliance on the existing economy for GHG reductions has relatively less uncertainty than other Approach 1 thresholds. Thresholds that spread mitigation more broadly (Thresholds 1.3 and 1.4) have less uncertainty by avoiding the need for every project to mitigate equally.

Approach 2 thresholds with lower quantitative (2.1 and 2.2) or qualitative (2.5) thresholds will have uncertainties associated with the ability to achieve GHG reductions from small to medium projects. Approach 2 thresholds with higher quantitative (2.3, 2.4) or qualitative (2.6) thresholds will have uncertainties associated with the ability to achieve relatively larger GHG reductions from the existing economy.

What are Other Advantages/Disadvantages of the Different Thresholds?

Thresholds with a single project metric (Thresholds 1.1, 1.2, 2.1, 2.2, 2.3, 2.4, 2.5, and 2.6) will be easier to apply to individual projects and more easily understood by project applicants and lead agencies broadly. Thresholds that spread mitigation across sectors (1.3) or regions (1.4), while simple in concept, will require adoption of more complicated cross-jurisdictional reduction plans or evaluation of broad sector-based trends in GHG intensity reduction over time. Approach 1 options would require all projects to quantify emissions in order to determine needed reductions relative to business-as-usual (which will change over time as described above). Concepts that are unit-based (Threshold 2.5 and 2.6) will not result in thresholds that have equal amount of GHG emissions, and thus equity issues may arise.

Table 4: Non-Zero Threshold Evaluation Matrix – Approach 1

Approach 1	**1.1**	**1.2**	**1.3**	**1.4**
	28% - 33% Reduction from BAU by 2020 by Project	**50% Reduction from BAU by 2020 by Project**	**28% - 33% Reduction by 2020 by Sector**	**28% - 33% Reduction by 2020 by Region**
GHG Emissions Reduction Effectiveness	**Low** - Captures all new projects but relies on a high level of reductions from the existing economy.	**Medium** - Captures all new projects and has a more realistic level of reductions from the existing economy.	**Low** - Captures all new projects but relies on a high level of reductions from the existing economy.	**Low** - Captures all new projects but relies on a high level of reductions from the existing economy.
Economic Feasibility	**Low** - Some projects will not be able to afford this level of reduction without effective market-based mechanisms like offsets.	**Low** - Some projects will not be able to afford this level of reduction without effective market-based mechanisms like offsets.	**Medium** - Sectors as a whole will be better able to achieve reductions than individual projects.	**Low** - Some regions and newly developed areas may not be able to afford this level of reduction without effective market-based mechanisms like offsets.
Technical Feasibility	**Medium** - Some projects will not be able to achieve this level of reduction without effective market-based mechanisms like offsets	**Low** - Relatively larger set of projects will not be able to achieve this level of reduction without effective market-based mechanisms like offsets	**High** - Some projects will not be able to achieve this level of reduction without effective market-based mechanisms like offsets	**Medium** - Some regions and newly developed areas may not be able to afford this level of reduction without effective market-based mechanisms like offsets.
Logistical Feasibility	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.	**Low** - Absent broader reductions strategies, each project may reinvent the wheel each time to achieve mandated reductions.
Consistency with AB-32 and S-03-05	**Medium** - Would require heavy reliance on command and control gains.	**High**	**Medium-High** - Would rely on command and control gains, but would allow sectoral flexibility.	**Medium-High** - Would rely on command and control gains, but would allow regional flexibility.
Cost Effectiveness	**Low** - Will require all types of projects to reduce the same regardless of the cost/ton of GHG reductions.	**Low** - Will require all types of projects to reduce the same regardless of the cost/ton of GHG reductions.	**Low/Medium** - Allows tradeoffs within sector between high and low cost reduction possibilities but not between sectors.	**Low/Medium** - Allows tradeoffs within region between high and low cost reduction possibilities, but not between regions.
Uncertainties	**High** - BAU changes over time. Ability to reduce GHG emissions from existing economy will take years to demonstrate. Ability to limit GHG emissions from other new development will take years to demonstrate.	**Medium/High** - BAU changes over time. Ability to limit GHG emissions from other new development will take years to demonstrate.	**High** - BAU changes over time. Ability to reduce GHG emissions from existing economy will take years to demonstrate. Ability to limit GHG emissions from other new development will take years to demonstrate.	**High** - BAU changes over time. Ability to reduce GHG emissions from existing economy will take years to demonstrate. Ability to limit GHG emissions from other new development will take years to demonstrate.
Other Advantages	Simple/easy to explain.	Simple/easy to explain.	Spreads mitigation broadly	Spreads mitigation broadly
Other Disadvantages	Requires all projects to quantify emissions.	Requires all projects to quantify emissions.	Requires all projects to quantify emissions.	Requires all projects to quantify emissions.

Table 5: Non-Zero Threshold Evaluation Matrix – Approach 2

Approach 2	2.1	2.2	2.3	2.4	2.5	2.6
	Zero Threshold	**Quantitative (900 tons)**	**Quantitative CARB Reporting Threshold/Cap and Trade (25,000 tons/ 10,000 tons)**	**Quantitative Regulated Inventory Capture (~40,000 - 50,000 tons)**	**Qualitative Unit-Based Thresholds**	**Statewide, Regional or Areawide (CEQA Guidelines 15206(b)).**
GHG Emissions Reduction Effectiveness	**High** - Captures all sources.	**High** - Market capture at >90%. Captures diverse sources.	**Medium** - Moderate market capture.	**Low** - Low market capture.	**High** - Market capture at ~90%. Captures diverse sources; excl. smallest proj.	**Medium** - Moderate market capture. Excludes small and med. projects.
Economic Feasibility	**Low** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**Medium** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**High** - Large projects have greater ability to absorb cost.	**High** - Large projects have greater ability to absorb cost.	**Medium** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**High** - Large projects have greater ability to absorb cost.
Technical Feasibility	**Low** - Early phases will be substantial change in BAU, esp. for smaller projects; may be infeasible to mitigate.	**Medium** - Early phases will be substantial change in BAU, esp. for smaller projects; may be inefficient to mitigate.	**High** - Greater opportunities for multiple reduction approaches.	**High** - Greater opportunities for multiple reduction approaches.	**Medium** - Early phases will be substantial change in BAU, particularly for smaller projects may be inefficient to mitigate.	**High** - Greater opportunities for multiple reduction approaches.
Logistical Feasibility	**Low** - Unless fee or offset basis,very difficult to mitigate all projects.	**Medium** - BMPs broadly written to allow diversity; new req. will take time to integrate into new dev.	**High** - Less mitigation.	**High** - Less mitigation.	**Medium** - BMPs broadly written to allow diversity; new req. will take time to integrate into new dev.	**High** - Less mitigation.
Consistency with AB-32 and S-03-05	**High** - Market capture.	**High** - Market capture at >90%.	**Low** - Would rely on command and control success heavily.	**Low** - Would rely on command and control success heavily.	**Medium** - Need to demonstrate adequate market capture over time.	**Low** - Would rely on command and control success heavily.
Cost Effectiveness	**Low** - Will result in inefficient mitigation approaches. Efficiency will improve in time.	**Medium** - Emphasis is on new dev., req. for mitigation will result in inefficient mitigation approaches in early phases. Efficiency will improve in time.	**Medium** - Relies on command and control reductions for existing economy more heavily. With focus on larger projects, eff. of mitigation for new dev. high.	**Medium** - Relies on command and control reductions for existing economy more heavily. With focus on larger projects, eff. of mitigation for new dev. high.	**Medium** - Emphasis is on new dev.; req. for mitigation will result in inefficient mitigation approaches in early phases. Efficiency will improve in time.	**Medium** - Relies on command and control reductions for existing economy more heavily. With focus on larger projects, eff. of mitigation for new dev. high.
Uncertainties	**High** - Time to adapt for res. and comm.. sectors. Ability to mitigate without market-based mechanism for smaller projects unlikely.	**Medium/High** - Time to adapt for res. and comm.. sectors. Ability to mitigate without market-based mechanism for smaller projects uncertain.	**High** - Gains from command and control likely longer to be realized.	**High** - Gains from command and control likely longer to be realized.	**Medium/High** - Time to adapt for res. and comm.. sectors. Ability to mitigate without market-based mechanism for smaller projects uncertain.	**High** - Gains from command and control likely longer to be realized.
Other Advantages	Single threshold.	Single threshold. BMPs can be updated. Greenlist can be updated.	Single threshold. Does not change CEQA processing for most projects. CARB inventory = project inv.. All projects treated same.	Single threshold. Does not change CEQA processing for most projects. Follows established SIP practice.	BMPs can be updated. Greenlist can be updated. Unit-Based thresholds can be updated.	Existing guideline. Does not change CEQA processing for most projects. Endorsed by Cal. Chapter of the APA.
Other Disadvantages	Requires all projects to quantify emissions.	Requires nearly all projects to quantify emissions.			Sectoral projects have different GHG emis. Only largest projects to quantify emis.	Sectoral projects have different GHG emissions.

Introduction

This chapter evaluates the availability of various analytical methods and modeling tools that can be applied to estimate the greenhouse gas emissions from different project types subject to CEQA. This chapter will also provide comments on the suitability of the methods and tools to accurately characterize a projects emissions and offer recommendations for the most favorable methodologies and tools available. Some sample projects will be run through the methodologies and modeling tools to demonstrate what a typical GHG analysis might look like for a lead agency to meet its CEQA obligations. The air districts retained the services of EDAW environmental consultants to assist with this effort.

Methodologies/Modeling Tools

There are wide varieties of discretionary projects that fall under the purview of CEQA. Projects can range from simple residential developments to complex expansions of petroleum refineries to land use or transportation planning documents. It is more probably than not, that a number of different methodologies would be required by any one project to estimate its direct and indirect GHG emissions. Table 10 contains a summary of numerous modeling tools that can be used to estimate GHG emissions associated with various emission sources for numerous types of project's subject to CEQA. The table also contains information about the models availability for public use, applicability, scope, data requirements and its advantages and disadvantages for estimating GHG emissions.

In general, there is currently not one model that is capable of estimating all of a project's direct and indirect GHG emissions. However, one of the models identified in Table 9 would probably be the most consistently used model to estimate a projects direct GHG emissions based on the majority of projects reviewed in the CEQA process. The Urban Emissions Model (URBEMIS) is designed to model emissions associated with development of urban land uses. URBEMIS attempts to summarize criteria air pollutants and CO_2 emissions that would occur during construction and operation of new development. URBEMIS is publicly available and already widely used by CEQA practitioners and air districts to evaluate criteria air pollutants emissions against air district-adopted significance thresholds. URBEMIS is developed and approved for statewide use by CARB. The administrative reasons for using URBEMIS are less important than the fact that this model would ensure consistency statewide in how CO_2 emissions are modeled and reported from various project types.

One of the shortfalls of URBEMIS is that the model does not contain emission factors for GHGs other than CO_2, except for methane (CH_4) from mobile-sources, which is converted to CO_2e. This may not be a major problem since CO_2 is the most important GHG from land development projects. Although the other GHGs have a higher global warming potential, a metric used to normalize other GHGs to CO_2e, they are emitted in far fewer quantities. URBEMIS does not calculate other GHG emissions associated with off-site waste disposal, wastewater treatment, emissions associated with goods and services consumed by the residents and workers supported by a project. Nor does URBEMIS calculate GHGs associated with consumption of energy produced off-site. (For that matter, URBEMIS does not report criteria air pollutant emissions from these sources either).

Importantly, URBEMIS does not fully account for interaction between land uses in its estimation of mobile source operational emissions. Vehicle trip rates are defaults derived from the Institute of Transportation Engineers trip generation manuals. The trip rates are widely used and are generally considered worst-case or conservative. URBEMIS does not reflect "internalization" of trips between land uses, or in other words, the concept that a residential trip and a commercial trip are quite possibly the same trip, and, thus, URBEMIS counts the trips separately. There are some internal correction settings that the modeler can select in URBEMIS to correct for "double counting"; however, a project-specific "double-counting correction" is often not available. URBEMIS does allow the user to overwrite the default trip rates and characteristics with more project-specific data from a traffic study prepared for a project.

Residential, Commercial, Mixed-Use Type Projects/ Specific Plans

<u>Direct Emissions</u>

URBEMIS can be used to conduct a project-specific model run and obtain CO_2e emissions for area and mobile sources from the project, and convert to metric tons CO_2e. When a project-specific traffic study is not available, the user should consult with their local air district for guidance. Many air district staff are experienced practitioners of URBEMIS and can advise the lead agency or the modeler on how to best tailor URBEMIS default input parameters to conduct a project-specific model run. When a traffic study has been prepared for the project, the user must overwrite default trip length and trip rates in URBEMIS to match the total number of trips and vehicle miles traveled (VMT) contained in the traffic study to successfully conduct a project-specific model run. URBEMIS is recommended as a calculation tool to combine the transportation study (if available) and EMFAC emission factors for mobile-sources. Use of a project-specific traffic study gets around the main shortfall of URBEMIS: the lack of trip internalization. URBEMIS also provides the added feature of quantifying direct area-source GHG emissions.

<u>Important steps for running URBEMIS</u>

1. Without a traffic study prepared for the project, the user should consult with the local air district for direction on which default options should be used in the modeling exercise. Some air districts have recommendations in the CEQA guidelines.

2. If a traffic study was prepared specifically for the project, the following information must be provided:

a. Total number of average daily vehicle trips *or* trip-generation rates by land use type per number of units; and,

b. Average VMT per residential *and* nonresidential trip.

c. The user overwrites the "Trip Rate (per day)" fields for each land use in URBEMIS such that the resultant "Total Trips" and the "Total VMT" match the number of total trips and total VMT contained in the traffic study.

d. Overwrite "Trip Length" fields for residential and nonresidential trips in UBEMIS with the project-specific lengths obtained form the traffic study.

3. Calculate results and obtain the CO_2 emissions from the URBEMIS output file (units of tons per year [TPY]).

Indirect Emissions

URBEMIS does estimate indirect emissions from landscape maintenance equipment, hot water heaters, etc. URBEMIS does not however, provide modeled emissions from indirect sources of emissions, such as those emissions that would occur off-site at utility providers associated with the project's energy demands. The California Climate Action Registry (CCAR) Protocol v.2.2 includes methodology, which could be used to quantify and disclose a project's increase in indirect GHG emissions from energy use. Some assumptions must be made for electrical demand per household or per square foot of commercial space, and would vary based on size, orientation, and various attributes of a given structure. An average rate of electrical consumption for residential uses is 7,000 kilowatt hours per year per household and 16,750 kilowatt hours per thousand square feet of commercial floor space. Commercial floor space includes offices, retail uses, warehouses, and schools. These values have been increasing steadily over the last 20 years. Energy consumption from residential uses has increased due to factors such as construction and occupation of larger homes, prices of electricity and natural gas, and increased personal income allowing residents to purchase more electronic appliances. Commercial energy consumption is linked to factors such as vacancy rates, population, and sales.

The modeler will look up the estimated energy consumption for the project's proposed land uses under year of project buildout, or use the values given in the previous paragraph for a general estimate. The CCAR Protocol contains emission factors for CO_2, CH_4, and nitrous oxide. The "CALI" region grid serves most of the State of California. If a user has information about a specific utility provider's contribution from renewable sources, the protocol contains methodology to reflect that, rather than relying on the statewide average grid. The incremental increase in energy production associated with project operation should be accounted for in the project's total GHG emissions for inclusion in the environmental document.

The incremental increase in energy production associated with project operation should be accounted for in the project's total GHG emissions, but it should be noted that these emissions would be closely controlled by stationary-source control-based regulations and additional regulations are expected under AB 32. However, in the interest of disclosing project-generated GHG emissions and mitigating to the extent feasible, the indirect emissions from off-site electricity generation can be easily calculated for inclusion in the environmental document.

Example Project Estimates for GHG Emissions

Residential Project

Project Attributes:

- 68 detached dwelling units
- 15.9 acres
- 179 residents
- 0 jobs
- Located in unincorporated Placer County (PCAPCD jurisdiction)
- Analysis year 2009

As shown in Table 6, the project's direct GHG emissions per service population (SP) would be approximately 8 metric tons CO_2e/SP/year.

Table 6: Residential Project Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	Metric Tons/Year CO_2e	Demographic Data	
Area-source emissions	251	Residents	179
Mobile-source emissions	1,044	Jobs	0
Indirect emissions (from CCAR Protocol)	174		
Total operational emissions	**1,469**	Service population	179
Operational emissions/SP	**8.2**		

Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population(see definition of service population below in discussion of Normalization/Service Population Metric).

Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

Commercial Project

Project Attributes:

- Free Standing Discount Superstore: 241 thousand square feet (ksf)
- 0 residents

- 400 jobs
- Located in the San Joaquin Valley Air Pollution Control District's (SJVAPCD) jurisdiction
- Analysis year 2009

Table 7: Commercial Project Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	Metric Tons/Year CO_2e	Demographic Data	
Area-source emissions	464	Residents	0
Mobile-source emissions	13,889	Jobs	400
Indirect emissions (from CCAR Protocol)	1,477		
Total operational emissions	**15,830**	Service population	400
Operational emissions/SP	**39.6**		

Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population (see definition of service population below in discussion of Normalization/Service Population Metric).

Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

Specific Plan

If used traditionally with default trip rates and lengths, rather than project-specific (Traffic Analysis Zone-specific) trip rates and lengths, URBEMIS does not work well for specific plan or general plan-sized projects with multiple land use types proposed. However, in all instances, projects of these sizes (several hundred or thousand acres) would be accompanied by a traffic study. Thus, for large planning-level projects, URBEMIS can be used as a calculation tool to easily obtain project-specific mobile-source emissions. The user should follow the steps discussed above; wherein he/she overwrites the default ITE trip rates for each land use type with that needed to make total VMT match that contained in the traffic study. The URBEMIS interface is a simple calculator to combine the traffic study and EMFAC emissions factors for mobile-source CO_2.

Project Attributes:

- 985 acres
- Total dwelling units: 5,634
- Commercial/Mixed Use: 429 ksf
- Educational: 2,565 ksf
- 14,648 residents
- 3,743 jobs
- Located in Sacramento County (SMAQMD jurisdiction)
- Analysis year 2009

Table 8: Specific Plan Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	Metric Tons/Year CO_2e	Demographic Data	
Area-source emissions	23,273	Residents	14,648
Mobile-source emissions	73,691	Jobs	3,743
Indirect emissions (from CCAR Protocol)	32,744		
Total operational emissions	**129,708**	Service population	18,391
Operational emissions/SP	**7.1**		

Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population (see definition of service population below in discussion of Normalization/Service Population Metric).

Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

The specific plan example, when compared to the residential or commercial examples, illustrates the benefit of a mixed-use development when you look at CO_2e emissions per resident or job (service population) metric (see definition of service population below in discussion of Normalization/Service Population Metric). Though this particular specific plan is not an example of a true jobs/housing balance, the trend is clear: accommodating residents and jobs in a project is more efficient than residents or jobs alone.

Stationary- and Area-Source Project Types

GHG emissions from stationary or area sources that require a permit to operate from the air district also contain both direct and indirect sources of emissions. Examples of these types of sources would be fossil fuel power plants, cement plants, landfills, wastewater treatment plants, gas stations, dry cleaners and industrial boilers. All air districts have established procedures and methodologies for projects subject to air district permits to calculate their regulated pollutants. It is anticipated that these same procedures and methodologies could be extended to estimate a permitted facility's GHG calculations. For stationary and area sources that do not require air district permits, the same methodologies used for permitted sources could be used in addition to URBEMIS and CCAR GRP to calculate GHG emissions from these facilities.

Wastewater Treatment Facilities

Direct GHG emissions associated with a proposed waste water treatment plant can be calculated using AP-42 emission factors from Chapter 4.3.5 Evaporative Loss Sources: Waste Water-Greenhouse Gases and the CCAR methodology. In general, most wastewater operations recover CH_4 for energy, or use a flare to convert the CH_4 to CO_2. There are many types of wastewater treatment processes and the potential for GHG emissions from different types of plants varies substantially. There is not one standard set of emission factors that could be used to quantify GHG emissions for a state "average" treatment plant. Thus, research will need to be conducted on a case-by-case basis to determine the "Fraction Anaerobically Digested" which is a function of the type of treatment process. Indirect emissions from these facilities can be calculated using the CCAR energy use protocols and URBEMIS model for transportation emissions.

Solid Waste Disposal Facilities

Air districts will have emission estimate methodologies established for methane emissions at permitted landfills. In addition, EPA's Landfill Gas Emissions Model (LandGem) and the CCAR methodology could also be used to quantify GHG emissions from landfill off gassing; however, this model requires substantial detail be input. The model uses a decomposition rate equation, where the rate of decay is dependent on the quantity of waste in place and the rate of change over time. This modeling tool is free to the public, but substantial project detail about the operation of the landfill is needed to run the model. Indirect emissions from these facilities can be calculated using the CCAR energy use protocols and URBEMIS model for transportation emissions.

Construction Emissions

GHG emissions would occur during project construction, over a finite time. In addition, a project could result in the loss of GHG sequestration opportunity due primarily to the vegetation removed for construction. URBEMIS should be used to quantify the mass of CO_2 that would occur during the construction of a project for land development projects. Some construction projects would occur over an extended period (up to 20–30 years on a planning horizon for general plan buildout, or 5–10 years to construct a dam, for example). OFFROAD emission factors are contained in URBEMIS for CO_2 emissions from construction equipment. For other types of construction projects, such as roadway construction projects or levee improvement projects, SMAQMD's spreadsheet modeling tool, the Road Construction Emissions Model (RoadMod), should be used. This tool is currently being updated to include CO_2 emissions factors from OFFROAD.

The full life-cycle of GHG emissions from construction activities is not accounted for in the modeling tools available, and the information needed to characterize GHG emissions from manufacture, transport, and end-of-life of construction materials would be speculative at the CEQA analysis level. The emissions disclosed will be from construction equipment and worker commutes during the duration of construction activities. Thus, the mass emissions in units of metric tons CO_2e/year should be reported in the environmental document as new emissions.

General Plans

In the short-term, URBEMIS can be used as a calculation tool to model GHG emissions from proposed general plans, but only if data from the traffic study is incorporated into model input. The same methodology applied above in the specific plan example applies to general plans. The CCAR GRP can be used to approximate indirect emissions from increased energy consumption associated with the proposed plan area. The same models and methodologies discussed previously for wastewater, water supply and solid waste would be used to estimate indirect emissions resulting from buildout of the general plan.

In the longer-term, more complex modeling tools are needed, which would integrate GHG emission sources from land use interaction, such as I-PLACE^{3}S or CTG Energetics' Sustainable Communities Custom Model attempt to do. These models are not currently available to the public and only have applicability in certain areas of the state. It is important that a tool with statewide applicability be used to allow for consistency in project treatment, consideration, and approval under CEQA.

Scenarios

At the general plan level, the baseline used for analyzing most environmental impacts of a general plan update is typically no different from the baseline for other projects. The baseline for most impacts represents the existing conditions, normally on the date the Notice of Preparation is released. Several comparative scenarios could be relevant, depending on the exact methodological approach and significance criteria used for GHG assessment:

- Existing Conditions. The GHG emissions associated with the existing, on-the-ground conditions within the planning area.

- 1990 conditions. The GHG emissions associated with the general plan area in 1990. This is relevant due to the state's AB 32 GHG emission reduction goals' benchmark year of 1990. The GHG-efficiency of 1990 development patterns could be compared to that of the general plan buildout.

- Buildout of the Existing General Plan. The GHG emissions associated with buildout of the existing general plan (without the subject update). This is the no project alternative for the purposes of general plan CEQA analysis.

- Buildout of the Updated General Plan. The GHG emissions associated with buildout of the general plan, as proposed as a part of the subject update. This would include analysis of any changes included as a part of the general plan update for the existing developed portions of the planning area. Many communities include redevelopment and revitalization strategies as a part of the general plan update. The general plan EIR can include assumptions regarding what level and type of land use change could be facilitated by infill and redevelopment. Many jurisdictions wish to provide future projects consistent with these land use change assumptions with some environmental review streamlining. In addition, many communities include transit expansions, pedestrian/bicycle pathway improvements, multi-modal facility construction, travel demand policies, energy efficiency policies, or other measures that could apply to the existing developed area, just as they may apply to any new growth areas. Such policies could affect the overall GHG emissions of the built out general plan area.

- Increment between Buildout of Updated General Plan and Existing General Plan Area. There are many important considerations associated with the characterization of the impact of the General Plan update. The actual GHG emissions impact could be described as the difference between buildout under the existing and proposed land use plan (No-Build Alternative). However, the courts have held that an EIR should also analyze the difference between the proposed General Plan and the existing environment (*Environmental Planning & Information Council v. County of El Dorado* (EPIC) (1982) 131 Cal.App.3d 350). At the General Plan level, over the course of buildout, some new land uses are introduced, which could potentially add operational GHG emissions and potentially remove existing sequestration potential. Some properties become vacant and are not redeveloped. Other properties become vacant and then are redeveloped. Communities cannot pretend to understand fully in advance each component of land use change. The programmatic document is the preferred method of environmental analysis. Through this programmatic framework, communities develop buildout assumptions as a part of the General Plan that are normally used as a basis of environmental analysis. For certain aspects of the impact analysis, it becomes important not just to understand how much "new stuff" could be accommodated under the updated General Plan, but also the altered interactions between both "new" and "existing" land uses within the planning area. As addressed elsewhere, there are tools available for use in understanding land use/transportation interactions at the General Plan level. Without the GHG targets established by AB 32, a simple mass comparison of existing conditions to General Plan buildout might be appropriate.

However, within the current legal context, the GHG efficiency of the updated General Plan becomes the focus of analysis. Some options in this regard include:

- Estimate the GHG emissions associated with all the land uses included within the planning area upon buildout of the General Plan using no project specific information (regional, countywide, or statewide defaults). Estimate GHG emissions using project specific information from the transportation engineer, transportation demand policies, community design elements, energy efficiency requirements, wastewater treatment and other public infrastructure design changes, and other components. Compare these two calculations. Is the second calculation reduced by the percent needed to meet AB 32 goals compared to the first calculation?

- Estimate the GHG emissions associated with the 1990 planning area and the per-capita or per-service population GHG associated with the 1990 planning area. (Many communities are establishing GHG inventories using different tools). Estimate the GHG emissions associated with buildout of the proposed General Plan update and the resulting per-capita or per-service population GHG emissions. Compare the two calculations. Is the General Plan buildout per-capita or per-service population level greater than the 1990 estimate?

Example General Plan Update: Proposed new growth area

Project Attributes:
- 10,050 single family dwelling units
- 652 multi-family dwelling units
- 136 acres parks
- 2,047 ksf commercial (regional shopping center)
- 2,113 ksf office
- 383 acres industrial park
- 31,293 new residents
- 4,945 new jobs
- Located in Stanislaus County (SJVAPCD jurisdiction)
- Analysis year 2025

Table 9: General Plan Example GHG Emissions Estimates

URBEMIS Output (Project Specific)	**Metric CO_2e**	**Tons/Year**	**Demographic Data**	
Construction emissions	12,083*		Residents	31,293
Area-source emissions	45,708			
Mobile-source emissions	263,954		Jobs	4,945
Indirect emissions (from CCAR Protocol)	78,385			
Total operational emissions	**388,046**		Service population	36,238
Operational emissions/SP	**10.7**			

* Approximately 241,656 metric tons CO_2e total at general plan buildout (assumes 20-year buildout period). Construction emissions were not included in total operational emissions.
Notes:
CO_2e = carbon dioxide equivalent; CCAR = California Climate Action Registry; SP = service population (see definition of service population below in discussion of Normalization/Service Population Metric).
Sources: EDAW 2007, ARB 2007b, CCAR 2007, CEC 2000

Due to the programmatic level of analysis that often occurs at the general plan level, and potential for many relevant GHG emission quantities, it could be preferable to use a qualitative approach. Such an analysis could address the presence of GHG-reducing policy language in the general plan.

Three possible tiers of approaches to addressing GHG mitigation strategies, either as general plan policy, general plan EIR mitigation measures, or both, include:

- Forward planning
- Project toolbox
- Defer to GHG reductions plan

The three basic approaches are described below.

1. Bring reduction strategies into the plan itself. The most effective way for local jurisdictions to achieve GHG emissions reductions in the medium- and long-term is through land use and transportation policies that are built directly into the community planning document. This involves creating land use diagrams and circulation diagrams, along with corresponding descriptive standards, that enable and encourage alternatives to travel and goods movement via cars and trucks. The land use and circulation diagrams provide a general framework for a community where people can conduct their everyday business without necessarily using their cars. The overall community layout expressed as a part of the land use and circulation diagrams is accompanied by a policy and regulatory scheme designed to achieve this community layout. Impact fees, public agency spending, regulations, administrative procedures, incentives, and other techniques are designed to facilitate land use change consistent with the communities' overall vision, as expressed in policy and in the land use diagram. There are many widely used design principles that can be depicted in land use and circulation diagrams and implemented according to narrative objectives, standards, and policies:

- Connectivity. A finely-connected transportation network shortens trip lengths and creates the framework for a community where homes and destinations can be placed close in proximity and along direct routes. A hierarchical or circuitous transportation network can increase trip lengths and create obstacles for walking, bicycling, and transit access. This policy language would likely be found in the Circulation Element.

- Compactness. Compact development, by its nature, can increase the efficiency of infrastructure provision and enable travel modes other than the car. If communities can place the same level of activity in a smaller space, GHG emissions would be reduced concurrently with VMT and avoid unnecessary conversion of open space. This policy language would likely be found in the Land Use Element.

- Diversity. Multiple land use types mixed in proximity around central "nodes" of higher-activity land uses can accommodate travel through means other than a car. The character and overall design of this land use mix is, of course, different from community to community. This policy language would likely be found in the Land Use Element.

- Facilities. Pedestrian, bicycle, and public transportation improvements, planning, and programming are sometimes an afterthought. To get a more GHG-efficient mode share, safe and convenient bike lanes, pedestrian pathways, transit shelters, and other facilities are required to be planned along with the vehicular travel network. This policy language would likely be found in the Circulation Element.

- Redevelopment. One way to avoid GHG emissions is to facilitate more efficient and economic use of the lands in already-developed portions of a community. Reinvestment in existing neighborhoods and retrofit of existing buildings is appreciably more GHG efficient than greenfield development, and can even result in a net reduction in GHG emissions. This policy language would likely be found in the Conservation or Land Use Element.

- Housing and Employment. Most communities assess current and future economic prospects along with long-range land use planning. Part of the objective for many communities is to encourage the coalescence of a labor force with locally available and appropriate job opportunities. This concept is best known as "jobs-housing balance." This policy language would likely be found in the Housing Element.

- Planning Level Versus Project Level. For transportation-related GHG emissions that local governments can mitigate through land use entitlement authority, the overall community land use strategy and the overall transportation network are the most fruitful areas of focus. The reduction capacity of project-specific mitigation measures is greatly limited if supportive land use and transportation policies are lacking at the community planning level. The regional economic context, of course, provides an important backdrop for land use and transportation policy to address GHG emissions. Within this context, the general plan is the readily available tool for local governments to establish such land use and transportation strategies. This policy language would likely be found in the Land Use and Circulation Elements.

- Shipping Mode Shift. Locate shipping-intensive land uses in areas with rail access. Some modes of shipping are more GHG-intensive than others. Rail, for example, requires only about 15 to 25 percent of the energy used by trucks to ship freight equivalent distances and involves reduced transportation-related GHG emissions. Cities and counties have little direct control over the method of shipment that any business may choose. Nevertheless, as a part of the general planning process, cities and counties can address constraints on the use of rail for transporting goods. This policy language would likely be found in the Land Use and Circulation Elements.

2. Provide a "toolbox" of strategies after the project site has been selected. In addition to the examples of design principles that are built into the community planning process, communities can offer project applicants a range of tools to reduce GHG emissions. Mitigation strategies are elaborated in detail in Chapter 9.

3. Defer to General Plan implementation measure. Develop and implement a GHG Emissions Reduction Plan. Another option for local governments would be development of an implementation measure as a part of the general plan that outlines an enforceable GHG reduction program. Perhaps the most well known example of this approach is the result of California's Attorney General settlement of the lawsuit brought against San

Bernardino County. The County has agreed to create a 1990 GHG inventory and develop measures to reduce such emissions according to the state's overall goals. Other communities have pursued similar programs (i.e., the City of San Diego, Marin County). Along with the inventories, targets, and example reduction measures, these programs would include quantitative standards for new development; targets for reductions from retrofitting existing development; targets for government operations; fee and spending program for GHG reduction programs; monitoring and reporting; and other elements. The local government itself should serve as a model for GHG reduction plan implementation, by inventorying emissions from government operations and achieving emission reductions in accordance with the plan's standards. An optional climate change element could be added to contain goals, policies, and this implementation strategy, or this could belong in an optional air quality element.

Other Project Types

Air District Rules, Regulations and Air Quality Plans

Air district air quality plans, rules and regulations could have the potential to increase or decrease GHG emissions within their respective jurisdiction. In general, air district air quality plans, rules and regulations act to reduce ozone precursors, criteria air pollutant and toxic air contaminant emissions, which would almost always act to reduce GHG emissions simultaneously. However, this may not always be the case.

Air Quality Plans

Air districts will have to include GHG emissions analysis as part of their criteria air pollutant and toxic air contaminant air pollutant analysis when considering the adoption of air quality plans and their subsequent rules and regulations needed to implement the plans. Multiple models and methodologies will be needed to accomplish this analysis.

Regional Transportation Plans

Regional transportation plans would also need to be evaluated on a case-by-case basis to determine if a net increase or decrease in GHG emissions would occur. Complex interactions between the roadway network, operating conditions, alternative transportation availability (such as public transit, bicycle pathways, and pedestrian infrastructure), and many other independent parameters specific to a region should be considered. Regional transportation models exist to estimate vehicular emissions associated with regional transportation plans, which includes the ability to estimate GHG emissions.

Normalization/Service Population Metric

The above methodology would provide an estimate of the mass GHG emissions generated by a proposed project, which could be compared to a mass emission threshold. EDAW developed a methodology that would measure a project's overall GHG efficiency in order to determine if a project is more efficient than the existing statewide average for per capita GHG emissions. The following steps could be employed to estimate the GHG-"efficiency," which may be more directly correlated to the project's ability to help obtain objectives outlined in AB 32, although it relies on establishment of an efficiency-based significance threshold. The subcommittee believes this methodology may eventually be appropriate to evaluate the long-term GHG emissions from a project in the context of meeting AB 32 goals. However, this methodology will need substantially more work and is not considered viable for the interim guidance presented in this white paper.

- Divide the total operational GHG emissions by the Service Population (SP) supported by the project (where SP is defined as the sum of the number of residents and the number of jobs supported by the project). This value should be compared to that of the projected statewide GHG emissions inventory from the applicable end-use sectors (electricity generation, residential, commercial/institutional, and mobile-source) in 1990 divided by the projected statewide SP for the year 2020 (i.e., AB 32 requirements), to determine if the project would conflict with legislative goals.
    - If the project's operational GHG/SP falls below AB 32 requirements, then the project's GHG emissions are less than cumulatively considerable.
    - If the project's operational GHG/SP exceed AB 32 requirements (a substantial contribution), then the project's GHG emissions would conflict with legislative requirements, and the impact would be cumulatively considerable and mitigation would be required where feasible.
- New stationary and area sources/facilities: calculate GHG emissions using the CCAR GRP. All GHG emissions associated with new stationary or area sources should be treated as a net increase in emissions, and if deemed significant, should be mitigated where feasible.
- Road or levee construction projects or other construction-only projects: calculate GHG emissions using the RoadMod, which will be updated to contain GHG emission factors from EMFAC and OFFROAD. All construction-generated GHG emissions should be treated as a net increase, and if deemed significant, should be mitigated to the extent feasible.
- Air District rulemaking or air quality management plan-type projects should be evaluated on a case-by-case basis for secondary impacts of increased GHG emissions generation. In most cases, the types of projects that act to reduce regional air pollution simultaneously act to reduce GHG emissions, and would be beneficial, but should be evaluated for secondary effects from GHG emissions.
- Regional transportation plans should also be evaluated on a case-by-case basis for potential to either reduce or increase GHG emissions from the transportation sector. EMFAC can be utilized to determine the net change in GHG emissions

associated with projected vehicle VMT and from operating speed changes associated with additional or alleviated congestion.

To achieve the goals of AB 32, which are tied to GHG emission rates of specific benchmark years (i.e., 1990), California would have to achieve a lower rate of emissions per unit of population and per unit of economic activity than it has now. Further, in order to accommodate future population and economic growth, the state would have to achieve an even lower rate of emissions per unit than was generated in 1990. (The goal to achieve 1990 quantities of GHG emissions by 2020 means that this will need to be accomplished in light of 30 years of population and economic growth in place beyond 1990.) Thus, future planning efforts that would not encourage new development to achieve its fair share of reductions in GHG emissions would conflict with the spirit of the policy decisions contained in AB 32, thus impeding California's ability to comply with the mandate.

Thus, if a statewide context for GHG emissions were pursued, any net increase in GHG emissions within state boundaries would be considered "new" emissions. For example, a land development project, such as a specific plan, does not necessarily create "new" emitters of GHG, but would theoretically accommodate a greater number of residents in the state. Some of the residents that move to the project could already be California residents, while some may be from out of state (or would 'take the place' of in-state residents who 'vacate' their current residences to move to the new project). Some may also be associated with new births over deaths (net population growth) in the state. The out-of-state residents would be contributing new emissions in a statewide context, but would not necessarily be generating new emissions in a global context. Given the California context established by AB 32, the project would need to accommodate an increase in population in a manner that would not inhibit the state's ability to achieve the goals of lower total mass of emissions.

The average net influx of new residents to California is approximately 1.4 percent per year (this value represents the net increase in population, including the net contribution from births and deaths). With population growth, California also anticipates economic growth. Average statewide employment has grown by approximately 1.1 percent over the last 15 years. The average percentage of population employed over the last 15 years is 46 percent. Population is expected to continue growing at a projected rate of approximately 1.5 percent per year through 2050. Long-range employment projection data is not available from the California Department of Finance (DOF) and can be extrapolated in different ways (e.g., linear extrapolation by percentage rate of change, percentage of population employed, mathematical series expansion, more complex extrapolation based on further research of demographic projections such as age distribution). Further study would be needed to refine accurate employment projections from the present to 2050. For developing this framework, employment is assumed to have a constant proportionate relationship with the state's population. The projected number of jobs is assumed to be roughly 46 percent of the projected population.

In light of the statewide context established by California law, consistency is most important for evaluating GHG emissions from projects. Thus, URBEMIS and the CCAR GRP are the recommended tools for quantification of GHG emissions from most project types in the short term. Over the long term, more sophisticated models that integrate the relationship between GHG emissions and land use, transportation, energy, water, waste, and other resources, and have similar application statewide would have better application to the problem, but may not currently be as accessible or as easily operable. I-PLACE^{3}S and CTG Energetics' Sustainable Communities Model (SCM) are two examples of such models that contain emission factors for GHGs, which could be refined to have applicability statewide and made available to CEQA practitioners. Other models are likely to be developed, given the importance of this issue.

Short-Term and Long-Term Methodologies

The following tools can be used to quantify a project's GHG emissions until tools that are more comprehensive become available statewide:

1. Land development projects: URBEMIS 2007 v. 9.2 and the CCAR GRP v. 2.2 (short-term); further development of I-PLACE^{3}S or CTG's Sustainable Communities Model (long-term).
2. New stationary and area sources/facilities: AP-42 Chapter 4.3, LandGem v. 3.02, and/or CCAR GRP v. 2.2.
3. Road or levee construction projects or other construction-only projects: RoadMod/OFFROAD 2007.

Ideally, I-PLACE^{3}S or CTG's Sustainable Communities Model would be expanded to apply to all regions of the state. These types of models use an integrated approach, which is the best approach for reasonably approximating the emissions that result from interaction between land uses, but neither is available to the public and would create consistency problems in reporting emissions from projects across the state if these were used today. However, a similar model with statewide applicability will likely be developed due to the importance of the issue.Table 10 Summary of Modeling Tools for Estimating GHG Emissions and Project Applicability

Table 10: Summary of Modeling Tools for GHG Emissions

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
URBEMIS 2007	*Public domain -Download (www.urbemis.com) free of charge*	*Land development and construction projects (construction, mobile- and area-source emissions)*	*Local*	*Fairly Easy*	*Land use information, construction and operational data and assumptions (e.g., jurisdiction, acres of land use type, year of operation, etc.)*	*Mobile-source Construction & Operational CO_2 (lb/day or tons/year)*	*-Recommended for land use development and construction projects -Also recommended for net change in land use (zoning changes)*	*-Does not quantify indirect emissions from energy consumption or other GHGs (except methane from mobile-sources) -Free, available to public, and applicable statewide -Widely used for assessment of other air quality impacts*
California Climate Action Registry General Reporting Protocol v. 2.2	*Public guidance document*	*Indirect emissions from land development projects, stationary- and area-source facilities regulated under AB 32*	*State*	*Easy*	*Energy consumption*	*CO_2e (Metric tons/year)*	*-Recommended for indirect emissions from energy consumption for land use development projects, and for new stationary- or area- sources to be regulated*	*-Contains emission factors for CH_4 and N_2O in addition to CO_2 -Does not contain emission factors broken down by utility provider (statewide average grid only)*
Clean Air and Climate Projection (CACP) Software	*Public agencies (members of ICLEI, NACAA, or similar)*	*Local governments used for emissions inventories*	*Local*	*N/A*	*Energy usage, waste generation/disposal transportation*	*CO_2e (tons/year)*	*-Recommended for inventories of local government entities activities (must be a member of affiliated agency or group)*	*-Not available to public*
CTG Sustainable Communities Model	*Custom model*	*Land development*	*Regional, scalable*	*N/A*	*Land use information, operational (mobile, energy, economic, infrastructure) assumptions*	*CO_2e (tons/year)*	*-An integrated and comprehensive modeling tool, but cannot obtain*	*-Not available to public*

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
I-PLACE[3]S	*Access fee through local COG Only available for eight California counties*	*Land use change*	*Regional, scalable*	*Fairly Easy*	*Parcel information*	*CO_2 (lb/day or tons/year)*	*-Recommended for land use development projects and land use changes -Especially good for general plans*	*-Not freely available to public -Not applicable statewide -Actually provides insight into land use interaction -Can include very specific project attributes -Trip rates are from behavioral survey data, instead of ITE*
EMFAC 2007	*Public domain*	*On-road mobile-sources*	*Statewide, regional*	*Fairly Easy*	*Vehicle fleet information*	*CO_2 (grams/mile)*	*-Not recommended for most projects (URBEMIS preferred) -Could be used for certain Air District Rulemaking applications*	*-Can compare emissions based on speed-distribution -Emission factors contained in URBEMIS -Not a stand-alone model*
OFFROAD 2007	*Public domain*	*Off-road mobile sources (construction equipment)*	*Statewide, regional*	*Fairly Easy*	*Construction fleet information*	*CO_2 (lb/day)*	*-Not recommended (URBEMIS preferred) -could be used for certain Air District Rulemaking applications (re: construction equipment)*	*-Emission factors contained in URBEMIS*
RoadMod (to be updated to include CO_2)	*Public domain*	*Off-road and on-road mobile sources (construction equipment and material haul trucks)*	*Statewide*	*Easy*	*Construction information*	*CO_2 (lb/day or tons/project)*	*-Recommended for construction-only projects (linear in nature; i.e., levees, roads, pipelines)*	*-To be updated to support emissions factors from OFFROAD 2007*

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
DTIM	*Public domain*	*On-road mobile-sources*	*Statewide, regional*	*Difficult (consists of a series of three programs and requires input files from traffic and emissions modeling)*	*-EMFAC files -Traffic model output files (e.g., link, interzonal, and trip end data) -User options file -Optional files*	*CO_2 (tons/year)*	*-Not recommended*	*-Not updated to support EMFAC 2007 emission factors -Input files include output files from regional transportation models which more accurately reflect VMT*
Southeast Climate Change Partnership Spreadsheet Model (UK)	*Public domain http://www.climatesoutheast.org.uk/*	*UK Local government/ agencies/ organizations used for emissions inventories*	*Local, county, regional*	*Fairly easy*	*Energy usage, waste generation/disposal, transportation*	*CO_2 (tonnes/year)*	*-Not recommended for use in California, but could be a valuable source for building an applicable spreadsheet model*	*-Applicability for UK, but could be updated with CA-specific emission factors*
EPA AP-42; Evaporation Loss Sources Chapter 4.3.5	*Public reference document*	*GHG emissions from waste water treatment facilities*	*Facility level*	*Easy equation; substantial research needed to use*	*Biochemical oxygen demand (BOD) loading, Fraction anaerobically digested*	*CH4 (lb/year)*	*-Recommended for Publicly owned treatment works (POTW) projects*	*-Substantial research needed to determine the "fraction anaerobically digested" parameter, which is dependent on the type of treatment plant/process*
LandGem v. 3.02	*Public domain http://www.epa.gov/ttn/catc/dir1/landgem-v302.xls*	*GHG emissions from anaerobic decomposition associated with landfills*	*Facility Level*	*Moderate*	*Solid waste processing, year of analysis, lifetime of waste in place*	*CO_2, CH_4 (Mega grams/year)*	*-Recommended for landfill emissions*	*-Emission rates change dependent on years of decomposition, waste in place rates of change. -Complex decomposition rate equation, but good first approximation*

Method/Tool Description	Availability	Applicability	Scope	Ease of Use	Data Input (Requirements and Guidance)	Data Output	Recommendation Comments	Advantages/ Disadvantages
CARROT	*Registry members*	*Stationary source emissions, vehicle fleet mobile sources*	*Facility level*	*Moderate*	*Facility-specific information*	*All GHGs*	*-Recommended for reporting facilities under AB 32 and for indirect emissions from energy consumption (CCAR Protocol)*	*-Estimates all GHGs and normalizes to CO_2e* *-Not publicly available*

Notes:

GHG = greenhouse gas; AB = assembly bill; CO_2e = carbon dioxide equivalent; CH_4 = methane; N_2O = nitrous oxide; COG = council of governments ; ITE = Institute of Transportation Engineers; CCAR = California Climate Action Registry

Source: Data compiled by EDAW and the California Air Pollution Control Officers Association in 2007

Chapter 9: Mitigation Strategies for GHG

Introduction

This chapter (and Appendix B) identifies existing and potential mitigation measures that could be applied to projects during the CEQA process to reduce a project's GHG emissions that would be identified using the analytical methodologies included in this white paper. The Subcommittee retained the services of EDAW to assist with this effort. EDAW performed a global search of mitigation measures currently in practice and under study that would reduce GHG emissions.

Table 16 (Appendix B) provides a brief description of each measure along with an assessment of their feasibility (from a standpoint of economical, technological, and logistical feasibility, and emission reduction effectiveness), and identifies their potential for secondary impacts to air quality. During the global search performed, EDAW also took note of GHG reduction strategies being implemented as rules and regulation (e.g., early action items under AB 32), which are summarized in Table 18 (Appendix C). It is important to note that though compliance with such would be required by regulation for some sources, such strategies may be applicable to other project and source types.

The recurring theme that echoes throughout a majority of these measures is the shift toward New Urbanism, and research has consistently shown that implementation of Neotraditional Development techniques reduces VMT and associated emissions. The material reviewed assessed reductions from transportation-related measures (e.g., bicycle, pedestrian, transit, and parking) as a single comprehensive approach to land use. This comprehensive approach focuses on development design criteria conducive to enhancing alternate modes of transportation, including transit, walking, and bicycling. Transportation Demand Management (TDM) programs are viewed as a mechanism to implement specific measures. TDM responsibilities may include offering incentives to potential users of alternative modes of transportation and monitoring and reporting mode split changes.

The comprehensive approach makes it more difficult to assess reductions attributable to each measure. Nevertheless, there is a strong interrelationship between many of the measures, which justifies a combined approach. Consider the relationship between bike parking nonresidential, bike parking residential, endtrip facilities, and proximity to bike path/bike lane measures. In reality, these measures combined act as incentives for one individual to bike to work, while implementation of a single measure without the others reduces effectiveness.

The global nature of GHG emissions is an important feature that enables unique mitigation: abatement. When designing a project subject to CEQA, the preferred practice is first to avoid, then to minimize, and finally to compensate for impacts. Where the impact cannot be mitigated on-site, off-site mitigation is often and effectively implemented in several resource areas, either in the form of offsetting the same impact or preserving the resource elsewhere in the region. Frequently, mitigation fee programs or funds are established, where the proponent pays into the program and fees collected throughout the region or state are used to implement projects that, in turn, proportionately offset the impacts of the projects to the given resource. It may be more cost-effective to reduce as much GHG on-site as feasible (economically and technologically). Then the proponent would pay into a "GHG retrofit fund" to reduce equivalent GHG emissions off-site. In contrast to regional air pollutant offset programs such as the Carl Moyer Program, it matters greatly where reductions of ozone precursors occur, as ozone affects regional air quality. The GHG retrofit fund could be used to provide incentives to upgrade older buildings and make them more energy efficient. This would reduce demand on the energy sector and reduce stationary source emissions associated with utilities. This program has been successfully implemented in the United Kingdom where developments advertise "carbon neutrality." Of course, some GHG emissions occur associated with operation of the development, but the development would offset the remainder of emissions through off-site retrofit. Avoiding emissions that would otherwise continue to occur at existing development would be a unique opportunity for mitigation of GHG emissions. Reduction of GHG emissions also may have important side benefits including reduction of other forms of pollution.

Depending on the significance threshold concept adopted, projects subject to the CEQA process would either qualitatively or quantitatively identify the amount of GHG emissions associated with their project using the analytical methodologies identified in the previous chapter. The analysis would then apply the appropriate number of mitigation measures listed in Appendix B to their project to reduce their GHG emissions below the significance level. Calculating the amount of GHG emission reductions attributable to a given mitigation measure would require additional research. The examples below illustrate how a project would be mitigated using this approach.

Residential Project Example

Project Attributes:

- 68 detached dwelling units
- 15.9 acres
- Located in unincorporated Placer County PCAPCD jurisdiction)
- Assume URBEMIS defaults for a rural project in Placer County, in absence of a traffic study (This is contrary to the recommendations contained under Task 1; a traffic study is necessary to asses project-specific GHG emissions).
- Analysis year 2009

Table 11: Residential Project Example GHG Emissions Estimates with Mitigation

URBEMIS Output (Unmitigated)	Metric Tons/Year CO_2e	URBEMIS Output (Mitigated)	Metric Tons/Year CO_2e	Percent Reduction
Area-source emissions	252	Area-source emissions	215	14.6
Mobile-source emissions	1,047	Mobile-source emissions	916	12.5
Total direct operational emissions (area + mobile)	1,299	Total operational emissions (area + mobile)	1,131	12.9

Notes:
CO_2e = carbon dioxide equivalent

Sources: Data compiled by EDAW in 2007

Using URBEMIS 2007 and assuming the project would implement the mitigation measures listed below, yearly project-generated emissions of CO_2e would be reduced by approximately 13 percent. Implementation of the following mitigation measures is assumed:

- 100 housing units within one-half-mile radius of project's center, including this project's 68 residential units;
- provision of 80 jobs in the study area;
- retail uses present with one-half-mile radius of project's center;
- 10 intersections per square mile;
- 100% of streets with sidewalks on one side;
- 50% of streets with sidewalks on both sides;
- 30% of collectors and arterials with bike lanes, or where suitable, direct parallel routes exist;
- 15% of housing units deed restricted below market rate;
- 20% energy efficiency increase beyond Title 24; and
- 100% of landscape maintenance equipment electrically powered and electrical outlets in front and rear of units.

Example Project Methodology and Mitigation

Table 12 –Residential Projects Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors)	MM C-1→MM C-4
Mobile Sources	URBEMIS (EMFAC emission factors)	MM T-3→MM T-8, MM T-10→ MM T-14, MM T-16, MM T-19→ MM T-21 MM D-2→MM D-8, MM D-10→ MM D-15, MM D-17 MM S-1→MM S-2 MM M-1→MM M-2
Area Sources	URBEMIS	MM D-13→MM D-15, MM D-17
Indirect Emissions		
Energy Consumption	CCAR GRP & CEC	MM E-1→MM E-8, MM E-10, MM E-12→MM E-23 MM S-1→MM S-2 MM M-1→MM M-2

Table 13 –Commercial Projects Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors)	MM C-1→MM C-4
Mobile Sources	URBEMIS (EMFAC emission factors)	MM T-1→MM T-2, MM T-4→ MM T-15, MM T-17→MM T-21 MM D-1→MM D-3, MM D-5→ MM D-6, MM D-10, MM D-12, MM D-14→MM D-17 MM E-24 MM S-1→MM S-2 MM M-1→MM M-2
Area Sources	URBEMIS	MM D-14→MM D-17
Indirect Emissions		
Energy Consumption	CCAR GRP & CEC	MM E-1, MM E-4→MM E-13, MM E-16→MM E-24 MM S-1→MM S-2 MM M-1→MM M-2

Table 14 –Specific Plans Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors)	MM C-1→MM C-4
Mobile Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MM T-1→MM T-21 MM D-1→MM D-12, MM D-18→ MM D-19 MM E-24 MM S-1→MM S-2 MM M-1→MM M-2
Area Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MM D-13→MM D-19 MM E-1→MM E-24 MM S-1→MM S-2 MM M-1→MM M-2
Indirect Emissions		
Energy Consumption	Short-term: CCAR GRP & CEC. Long-term: I-PLACE^{3}S/CTG SCM	

General Plans

- Include a general plan policy to reduce emissions within planning area to a level consistent with legislative requirements.
- Implementation strategies include preparation of a GHG reduction plan.
- Projects consistent with a general plan could be responsible for complying with such a policy.

Table 15 –General Plans Example Methodology and Mitigation

Source	Methodology	Mitigation
Direct Emissions		
Construction	URBEMIS (OFFROAD emission factors).	MS G-1 MM G-15
Mobile Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MS G-1 MS G-2→MS C-7, MS G-9, MS G-12, MS-13→MS-14, MS-16→MS-23
Area Sources	Short-term: URBEMIS (EMFAC emission factors). Long-term: I-PLACE^{3}S/CTG SCM	MS G-1 MS G-8→MS C-11, MS G-134, MS G-12, MS-15, MS-17, MS-22
Indirect Emissions		
Energy Consumption	Short-term: CCAR GRP & CEC. Long-term: I-PLACE^{3}S/CTG SCM	

Other Project Types

Air District Rules and Regulations

Air district rules and regulations could have the potential to increase or decrease GHG emissions within the respective jurisdiction. In general, air district rules and regulations act to decrease criteria air pollutant or toxic air contaminant emissions, which would usually act to reduce GHG emissions simultaneously. However, this may not always be the case and air district rules and regulations could address emissions from a large variety of different source types. Reductions of GHG emissions associated with implementation of applicable mitigation, which could also vary greatly, would need to be evaluated on a case-by-case basis. However, once applicable mitigation measures are identified, percent reductions based on the best available research to date, such as those specified in Table 15, could be applied to determine mitigated emissions.

Air Quality Plans

Similarly to air district rules and regulations, air quality plans could have the potential to increase or decrease GHG emissions because of criteria air pollutant reduction strategies. In general, strategies implemented by air districts to reduce criteria air pollutants also act to reduce GHG emissions. However, this may not always be the case. Reductions of GHG emissions associated with implementation of applicable mitigation would need to be evaluated on a case-by-case basis. The methodology identified above for determining whether the strategies contained within the GHG reduction plan would adhere to the level specified in general plan policy could also be used to determine the reductions associated with CAP strategies.

Regional Transportation Plans

Regional transportation plans and reductions of GHG emissions associated with implementation of applicable mitigation would also need to be evaluated on a case-by-case basis to determine if a net increase or decrease in GHG emissions would occur. Complex interactions between the roadway network, operating conditions, alternative transportation availability (such as public transit, bicycle pathways, and pedestrian infrastructure), and many other independent parameters specific to a region should be considered. EMFAC 2007 can be used with VMT from the RTP to create an inventory of GHG emissions. Reductions associated with implementation of applicable measures contained in Table 16 could be accomplished by accounting for VMT reductions in the traffic model.

Chapter 10: Examples of Other Approaches

Many states, counties, and cities have developed policies and regulations concerning greenhouse gas emissions that seek to require or promote reductions in GHG emissions through standards for vehicle emissions, fuels, electricity production/renewables, building efficiency, and other means. However, we could only identify three public agencies in the United States that are considering formally requiring the analysis of greenhouse gas emissions and climate change for development projects during their associated environmental processes. There may be others, but they were not identified during research conducted during preparation of this paper.

The following is a summary of those three efforts.

Commonwealth of Massachusetts - MEPA Greenhouse Gas Emissions Policy and Protocol

The Massachusetts Executive Office of Energy and Environmental Affairs (EEA) has determined that the phrase "damage to the environment" as used in the Massachusetts Environmental Policy Act (MEPA) includes the emission of greenhouse gases caused by projects subjects to MEPA Review. EEA has published a Greenhouse Gas Emissions Policy (GGEP) to fulfill the statutory obligation to take all feasible measurers to avoid, minimize or mitigate damage to the environment.

The GGEP concerns the following projects only:

- The Commonwealth or a state agency is the proponent;
- The Commonwealth or a state agency is providing financial assistance;
- The project is privately funded, but requires an Air Quality Permit from the department of Environmental Protection;
- The project is privately funded, but will generate:
    - 3,000 or more new vehicle trips per day for office projects;
    - 6,000 or more new vehicle trips per day for mixed use projects that are 25% or more office space; or
    - 10,000 or more new vehicle trips per day for other projects.

As a comparison, the trip generation amounts correspond as follows:

- 3,000 vehicle trips per day = approximately 250,000 square foot office development;
- 6,000 or more new vehicle trips per day for mixed use projects that are 25% or more office space = if 25% office space, then equivalent to approximately 130,000 square feet of office and either 100,000 square feet of retail or 450 single-family residential units or some combination thereof.
- 10,000 or more new vehicle trips per day = approximately 1,000 single family residential units or 250,000 square feet retail.

The draft policy states it is not intended to create a numerical GHG emission limit or a numerical GHG emissions reduction target, but rather to ensure that project proponents and reviewers have considered the GHG emissions impacts of their projects and taken all feasible means and measure to reduce those impacts.

The draft policy notes that some projects within these categories will have little or no greenhouse gas emission and the policy will not apply to such projects. EEA intends to identify in the scoping certificate whether a project falls within this *de minimis* exception.

The GGEP requires qualifying projects to do the following:

- to quantify their GHG emissions;
- identify measures to minimize or mitigate such emissions;
- quantify the reduction in emissions and energy savings from mitigation.

Emissions inventories are intended to focus on carbon dioxide, but analysis of other GHGs may be required for certain projects. EEA will require analysis of direct GGH emissions and indirect (electricity and transportation) emissions. The GGEP references the protocols prepared by the World Resource Institute as guidance for inventory preparation.

The policy is still in draft form, but the comment period closed on August 10, 2007.

King County, Washington - Executive Order on the Evaluation of Climate Change Impacts through the State Environmental Policy Act (SEPA)

On June 27, 2007, the King County Executive Ron Sims directed all King County Departments, as follows:

> *"…effective September 1, 2007 to require that climate impacts, including, but not limited to those pertaining to greenhouse gases, be appropriately identified and evaluated when such Departments are acting as the lead agency in reviewing the environmental impacts of private or public proposals pursuant to the State Environmental Policy Act"*.

The Executive Order does not define what a "climate impact" is. Based on statements of the County Deputy Chief of Staff[*]

- County agencies will ask project proponents to supply information on transportation, energy usage and other impacts of proposed projects using the County's existing SEPA checklist.

[*] Marten Law Group: Environmental News, August 1, 2007, "King County (WA) First in Nation to Require Climate Change Impacts to be Considered During Environmental Review of New Projects".

- There is no current plan to require project proponents to take action to mitigate the impacts identifies.
- Development of emissions thresholds and mitigation requirements will be undertaken in connection with the County's upcoming 2008 update of its Comprehensive Plan.

Sacramento Metropolitan Air Quality Management District

The Sacramento Metropolitan Air Quality Management District released an interim guidance on addressing climate change in CEQA documents on September 6, 2007. While very general in nature, the District recommends that CEQA environmental documents include a discussion of anticipated GHG emissions during both the construction and operation phases of the project. This includes assessing the GHG emissions from projects (using readily available models) to determine whether a project may have a significant impact. If so, then the District recommends addressing all of the District's GHG mitigation measures (drawn from comments made by the California Attorney General) – with explanations on how the mitigation will be implemented or providing rationale for why a measure would be considered infeasible. The District provides assistance to agencies in their analysis of GHG emissions and the applicability of specific mitigation measures. The District's guidance can be found at: http://64.143.64.21/climatechange/ClimateChangeCEQAguidance.pdf

Mendocino Air Quality Management District – CEQA Guidelines

The Mendocino AQMD updated its "Guidelines for Use During Preparation of Air Quality Impacts in EIRs or Mitigated Negative Declarations" in May 2007. The guidelines call for preparing estimates of the increased emissions of air contaminations (including GHG) for projects.

The guidelines state that GHG emissions should be presumed to have a significant impact if CO emissions from District-approved modeling exceed either of the following:

- 80% of the level defined as significant for stationary sources in Regulation1, Rule 130 (s2) of the District (which is 550 lbs/day for CO, meaning a threshold of 440 lbs/day for CO for stationary sources); or
- levels established in District Regulation 1 Rule 130 (i2) for indirect sources (which is 690 lbs/day for CO for indirect sources).

If an average passenger vehicle emits 22 grams of CO/mile and 0.8 lb/mile of CO_2, then the 690-lb/day threshold for CO corresponds to approximately 11,400 lb/day CO_2 threshold for passenger vehicle-related emissions. If one assumes that the average passenger vehicle goes 12,500 miles/year (about 35 miles/day), then this is a threshold equivalent to about 420 vehicles. Using an average in California of about 1.77 vehicles/household, this would correspond to about 250 households/dwelling units.

Appendix A

Relevant Citations

Citations from the Public Resources Code (Division 13, §21000 et seq.) as amended through January 1, 2005.

Public Resources Code – Section 21004, MITIGATING OR AVOIDING A SIGNIFICANT EFFECT; POWERS OF PUBLIC AGENCY:
"In mitigating or avoiding a significant effect of a project on the environment, a public agency may exercise only those express or implied powers provided by law other than this division. However, a public agency may use discretionary powers provided by such other law for the purpose of mitigating or avoiding a significant effect on the environment subject to the express or implied constraints or limitations that may be provided by law."

Public Resources Code – Section 21082.2, SIGNIFICANT EFFECT ON ENVIRONMENT; DETERMINATION; ENVIRONMENTAL IMPACT REPORT PREPARATION:
(a) The lead agency shall determine whether a project may have a significant effect on the environment based on substantial evidence in light of the whole record.
(b) The existence of public controversy over the environmental effects of a project shall not require preparation of an environmental impact report if there is no substantial evidence in light of the whole record before the lead agency that the project may have a significant effect on the environment.
(c) Argument, speculation, unsubstantiated opinion or narrative, evidence which is clearly inaccurate or erroneous, or evidence of social or economic impacts which do not contribute to, or are not caused by, physical impacts on the environment, is not substantial evidence. Substantial evidence shall include facts, reasonable assumptions predicated upon facts, and expert opinion supported by facts.
(d) If there is substantial evidence, in light of the whole record before the lead agency, that a project may have a significant effect on the environment, an environmental impact report shall be prepared.
(e) Statements in an environmental impact report and comments with respect to an environmental impact report shall not be deemed determinative of whether the project may have a significant effect on the environment.

Citations from the Guidelines for California Environmental Quality Act, CCR, Title 14, Division 6 (§15000 et seq.) as amended through July 27, 2007.

State CEQA Guidelines – Section 15064, DETERMINING THE SIGNIFICANCE OF THE ENVIRONMENTAL EFFECTS CAUSED BY A PROJECT:

(a) Determining whether a project may have a significant effect plays a critical role in the CEQA process.

(1) If there is substantial evidence, in light of the whole record before a lead agency, that a project may have a significant effect on the environment, the agency shall prepare a draft EIR.

(2) When a final EIR identifies one or more significant effects, the Lead Agency and each Responsible Agency shall make a finding under Section 15091 for each significant effect and may need to make a statement of overriding considerations under Section 15093 for the project.

(b) The determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved, based to the extent possible on scientific and factual data. An ironclad definition of significant effect is not always possible because the significance of an activity may vary with the setting. For example, an activity which may not be significant in an urban area may be significant in a rural area.

(c) In determining whether an effect will be adverse or beneficial, the Lead Agency shall consider the views held by members of the public in all areas affected as expressed in the whole record before the lead agency. Before requiring the preparation of an EIR, the Lead Agency must still determine whether environmental change itself might be substantial.

(d) In evaluating the significance of the environmental effect of a project, the Lead Agency shall consider direct physical changes in the environment which may be caused by the project and reasonably foreseeable indirect physical changes in the environment which may be caused by the project.

(1) A direct physical change in the environment is a physical change in the environment which is caused by and immediately related to the project. Examples of direct physical changes in the environment are the dust, noise, and traffic of heavy equipment that would result from construction of a sewage treatment plant and possible odors from operation of the plant.

(2) An indirect physical change in the environment is a physical change in the environment which is not immediately related to the project, but which is caused indirectly by the project. If a direct physical change in the environment in turn causes another change in the environment, then the other change is an indirect physical change in the environment. For example, the construction of a new sewage treatment plant may facilitate population growth in the service area due to the increase in sewage treatment capacity and may lead to an increase in air pollution.

(3) An indirect physical change is to be considered only if that change is a reasonably foreseeable impact which may be caused by the project. A change which is speculative or unlikely to occur is not reasonably foreseeable.

(e) Economic and social changes resulting from a project shall not be treated as significant effects on the environment. Economic or social changes may be used, however, to determine that a physical change shall be regarded as a significant effect on the environment. Where a physical change is caused by economic or social effects of a

project, the physical change may be regarded as a significant effect in the same manner as any other physical change resulting from the project. Alternatively, economic and social effects of a physical change may be used to determine that the physical change is a significant effect on the environment. If the physical change causes adverse economic or social effects on people, those adverse effects may be used as a factor in determining whether the physical change is significant. For example, if a project would cause overcrowding of a public facility and the overcrowding causes an adverse effect on people, the overcrowding would be regarded as a significant effect.
(f) The decision as to whether a project may have one or more significant effects shall be based on substantial evidence in the record of the lead agency.
(1) If the lead agency determines there is substantial evidence in the record that the project may have a significant effect on the environment, the lead agency shall prepare an EIR (Friends of B Street v. City of Hayward (1980) 106 Cal.App.3d 988). Said another way, if a lead agency is presented with a fair argument that a project may have a significant effect on the environment, the lead agency shall prepare an EIR even though it may also be presented with other substantial evidence that the project will not have a significant effect (No Oil, Inc. v. City of Los Angeles (1974) 13 Cal.3d 68).
(2) If the lead agency determines there is substantial evidence in the record that the project may have a significant effect on the environment but the lead agency determines that revisions in the project plans or proposals made by, or agreed to by, the applicant would avoid the effects or mitigate the effects to a point where clearly no significant effect on the environment would occur and there is no substantial evidence in light of the whole record before the public agency that the project, as revised, may have a significant effect on the environment then a mitigated negative declaration shall be prepared.
(3) If the lead agency determines there is no substantial evidence that the project may have a significant effect on the environment, the lead agency shall prepare a negative declaration (Friends of B Street v. City of Hayward (1980) 106 Cal.App. 3d 988).
(4) The existence of public controversy over the environmental effects of a project will not require preparation of an EIR if there is no substantial evidence before the agency that the project may have a significant effect on the environment.
(5) Argument, speculation, unsubstantiated opinion or narrative, or evidence that is clearly inaccurate or erroneous, or evidence that is not credible, shall not constitute substantial evidence. Substantial evidence shall include facts, reasonable assumptions predicated upon facts, and expert opinion support by facts.
(6) Evidence of economic and social impacts that do not contribute to or are not caused by physical changes in the environment is not substantial evidence that the project may have a significant effect on the environment.
(7) The provisions of sections 15162, 15163, and 15164 apply when the project being analyzed is a change to, or further approval for, a project for which an EIR or negative declaration was previously certified or adopted (e.g. a tentative subdivision, conditional use permit). Under case law, the fair argument standard does not apply to determinations of significance pursuant to sections 15162, 15163, and 15164.
(g) After application of the principles set forth above in Section 15064(f)(g), and in marginal cases where it is not clear whether there is substantial evidence that a project may have a significant effect on the environment, the lead agency shall be guided by the following principle: If there is disagreement among expert opinion supported by facts

over the significance of an effect on the environment, the Lead Agency shall treat the effect as significant and shall prepare an EIR.
(h)(1) When assessing whether a cumulative effect requires an EIR, the lead agency shall consider whether the cumulative impact is significant and whether the effects of the project are cumulatively considerable. An EIR must be prepared if the cumulative impact may be significant and the project's incremental effect, though individually limited, is cumulatively considerable. "Cumulatively considerable" means that the incremental effects of an individual project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.
(2) A lead agency may determine in an initial study that a project's contribution to a significant cumulative impact will be rendered less than cumulatively considerable and thus is not significant. When a project might contribute to a significant cumulative impact, but the contribution will be rendered less than cumulatively considerable through mitigation measures set forth in a mitigated negative declaration, the initial study shall briefly indicate and explain how the contribution has been rendered less than cumulatively considerable.
(3) A lead agency may determine that a project's incremental contribution to a cumulative effect is not cumulatively considerable if the project will comply with the requirements in a previously approved plan or mitigation program which provides specific requirements that will avoid or substantially lessen the cumulative problem (e.g., water quality control plan, air quality plan, integrated waste management plan) within the geographic area in which the project is located. Such plans or programs must be specified in law or adopted by the public agency with jurisdiction over the affected resources through a public review process to implement, interpret, or make specific the law enforced or administered by the public agency. If there is substantial evidence that the possible effects of a particular project are still cumulatively considerable notwithstanding that the project complies with the specified plan or mitigation program addressing the cumulative problem, an EIR must be prepared for the project.
(4) The mere existence of significant cumulative impacts caused by other projects alone shall not constitute substantial evidence that the proposed project's incremental effects are cumulatively considerable.

State CEQA Guidelines – Section 15130, DISCUSSION OF CUMULATIVE IMPACTS:
(a)(3). "An EIR may determine that a project's contribution to a significant cumulative impact will be rendered less than cumulatively considerable and thus is not significant. A project's contribution is less than cumulatively considerable if the project is required to implement or fund its fair share of a mitigation measure or measures designed to alleviate the cumulative impact. The lead agency shall identify facts and analysis supporting its conclusion that the contribution will be rendered less than cumulatively considerable.

State CEQA Guidelines – Section 15064.7, THRESHOLDS OF SIGNIFICANCE:
"Each public agency is encouraged to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects. A threshold of significance is an identifiable quantitative, qualitative or performance level

of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant by the agency and compliance with which means the effect normally will be determined to be less than significant."

Appendix B

Mitigation Measure Summary

Table 16
Mitigation Measure Summary

Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Transportation								
Bicycle/Pedestrian/Transit Measures								
MM T-1: Bike Parking	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	1%-5%/High: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates combined reductions among individual measures (e.g., 2.5% reduction for all bicycle-related measures and one-quarter of 2.5% for each individual measure) (TIAX 2005, EDAW 2006, SMAQMD 2007). VTPI presents % reductions for showers and combined measures in the TDM encyclopedia (VTPI	Yes: Lockers ($1,200-$2,950, $700/bike on average), Racks ($70-$2,000, $70/bike on average).	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	Caltrans, Portland Bicycle Master Plan (City of Portland 1998), CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	Nonresidential projects provide plentiful short- and long-term bicycle parking facilities to meet peak season maximum demand (e.g., one bike rack space per 20 vehicle/employee parking spaces.
MM T-2: End of Trip Facilities	LD (C, M), I, SP, TP, AQP, RR, P/Mobile		Yes	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Nonresidential projects provide "end-of-trip" facilities including showers, lockers, and changing space (e.g., four clothes lockers and one shower provided for every 80 employee parking spaces, separate facilities for each gender for projects with 160 or more employee parking spaces).
MM T-3: Bike-Parking at Multi-	LD (R, M), SP, AQP, RR,		Yes: Lockers ($1,200-	Yes (Caltrans 2005,	Yes (Caltrans	Adverse: No Beneficial:		Long-term bicycle parking is provided at apartment

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Unit Residential	P/Mobile	2007). JSA bases estimates on CCAP information (JSA 2004).	$2,950, $700/bike on average), Racks ($70-$2,000, $70/bike on average).	Dierkers et al. 2007, VTPI 2007)	2005, Dierkers et al. 2007, VTPI 2007)	CAPs, TACs		complexes or condominiums without garages (e.g., one long-term bicycle parking space for each unit without a garage). Long-term facilities shall consist of one of the following: a bicycle locker, a locked room with standard racks and access limited to bicyclists only, or a standard rack in a location that is staffed and/or monitored by video surveillance 24 hours per day.
MM T-4: Proximity to Bike Path/Bike Lanes	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile		Yes	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Yes (Caltrans 2005, Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Entire project is located within one-half mile of an existing/planned Class I or Class II bike lane and project design includes a comparable network that connects the project uses to the existing offsite facility. Project design includes a designated bicycle route connecting all units, on-site bicycle parking facilities, offsite bicycle facilities, site entrances, and primary building entrances to existing Class I or Class II bike lane(s) within one-half mile. Bicycle route connects to all streets contiguous with project site. Bicycle route has minimum conflicts with automobile parking and circulation

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
								facilities. All streets internal to the project wider than 75 feet have Class II bicycle lanes on both sides.

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM T-5: Pedestrian Network	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-10%/High: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates 1% for each individual measure (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	The project provides a pedestrian access network that internally links all uses and connects to all existing/planned external streets and pedestrian facilities contiguous with the project site. Project design includes a designated pedestrian route interconnecting all internal uses, site entrances, primary building entrances, public facilities, and adjacent uses to existing external pedestrian facilities and streets. Route has minimal conflict with parking and automobile circulation facilities. Streets (with the exception of alleys) within the project have sidewalks on both sides. All sidewalks internal and adjacent to project site are minimum of five feet wide. All sidewalks feature vertical curbs. Pedestrian facilities and improvements such as grade separation, wider sidewalks, and traffic calming are implemented wherever feasible to minimize pedestrian barriers. All site entrances provide pedestrian access.
MM T-6: Pedestrian	LD (R, C, M), I, SP, TP,		Yes	Yes (Dierkers et al. 2007,	Yes (Dierkers et	Adverse: No Beneficial:		Site design and building placement minimize barriers to

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Barriers Minimized	AQP, RR, P/Mobile			VTPI 2007)	al. 2007, VTPI 2007)	CAPs, TACs		pedestrian access and interconnectivity. Physical barriers such as walls, berms, landscaping, and slopes between residential and nonresidential uses that impede bicycle or pedestrian circulation are eliminated.
MM T-7: Bus Shelter for Existing/Planned Transit Service	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-2%/High: CCAP presents these % reductions (Dierkers et al., 2007). SMAQMD assigns from .25%-1%, depending on headway frequency (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes: $15,000-$70,000.	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, City of Calgary (City of Calgary 2004), CA air quality management and control districts, and cities/counties.	Bus or streetcar service provides headways of one hour or less for stops within one-quarter mile; project provides safe and convenient bicycle/pedestrian access to transit stop(s) and provides essential transit stop improvements (i.e., shelters, route information, benches, and lighting).

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM T-8: Traffic Calming	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-10%/High: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates .25%-1.0% for each individual measure depending on percent of intersections and streets with improvements (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	Project design includes pedestrian/bicycle safety and traffic calming measures in excess of jurisdiction requirements. Roadways are designed to reduce motor vehicle speeds and encourage pedestrian and bicycle trips by featuring traffic calming features. All sidewalks internal and adjacent to project site are minimum of five feet wide. All sidewalks feature vertical curbs. Roadways that converge internally within the project are routed in such a way as to avoid "skewed intersections;" which are intersections that meet at acute, rather than right, angles. Intersections internal and adjacent to the project feature one or more of the following pedestrian safety/traffic calming design techniques: marked crosswalks, count-down signal timers, curb extensions, speed tables, raised crosswalks, raised intersections, median islands, tight corner radii, and roundabouts or mini-circles. Streets internal and adjacent to the project feature pedestrian safety/traffic calming measures such as on-street parking, planter strips with street trees,

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
								and chicanes/chokers (variations in road width to discourage high-speed travel).
Parking Measures								
MM T-9: Paid Parking (Parking Cash Out)	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	1%-30%/High: CCAP presents a range of 15%-30% reduction for parking programs (Dierkers et al. 2007). SMAQMD presents a range of 1.0%-7.2%, depending on cost/day and distance to transit (TIAX 2005, EDAW 2006, SMAQMD 2007). Shoupe presents a 21% reduction [$5/day for commuters to downtown LA, with elasticity of -0.18 (e.g., if price increases 10%, then solo driving goes down by 1.8% more)] (Shoupe 2005). Urban Transit Institute	Yes: Vary by location and project size.	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, CA air quality management and control districts, and cities/counties.	Project provides employee and/or customer paid parking system. Project must have a permanent and enforceable method of maintaining user fees for all parking facilities. The facility may not provide customer or employee validations. Daily charge for parking must be equal to or greater than the cost of a transit day/monthly pass plus 20%.

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
		presents a range of 1%-10% reduction in trips to central city sites, and 2%-4% in suburban sites (VTPI 2007).						
MM T-10: Minimum Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-30%/High: CCAP presents a range of 15%-30% reduction for parking programs (Dierkers et al. 2007). SMAQMD presents a maximum of 6% (Nelson/Nygaard Consulting Associates, 2005, TIAX 2005, EDAW 2006).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007), Note that in certain areas of the state, the minimum parking required by code is greater than the peak period parking demand for most land uses. Simply meeting minimum code requirements in these areas would not result in an emissions reduction.	Adverse: No Beneficial: CAPs, TACs	CCAP Transportation Emissions Guidebook (Dierkers et al. 2007), SMAQMD Recommended Guidance for Land Use Emission Reductions (SMAQMD 2007), VTPI, Governor's Office of Smart Growth (Annapolis, Maryland) (Zimbler), CA air quality management and control districts, and cities/counties.	Provide minimum amount of parking required. Once land uses are determined, the trip reduction factor associated with this measure can be determined by utilizing the ITE parking generation publication. The reduction in trips can be computed as shown below by the ratio of the difference of minimum parking required by code and ITE peak parking demand to ITE peak parking demand for the land uses multiplied by 50%. Percent Trip Reduction = 50 * [(min parking required by code – ITE peak parking demand)/ (ITE peak parking demand)]

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM T-11: Parking Reduction Beyond Code/Shared Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-30%/High: CCAP presents a range of 15%-30% reduction for parking programs (Dierkers et al. 2007). SMAQMD presents a maximum of 12% (Nelson/Nygaard, 2005, TIAX 2005, EDAW 2006).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Provide parking reduction less than code. This measure can be readily implemented through a shared parking strategy, wherein parking is utilized jointly among different land uses, buildings, and facilities in an area that experience peak parking needs at different times of day and day of the week.
MM T-12: Pedestrian Pathway Through Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-4%/Moderate: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates 0.5% reduction for this measure (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Provide a parking lot design that includes clearly marked and shaded pedestrian pathways between transit facilities and building entrances.

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16
Mitigation Measure Summary

Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM T-13: Off - Street Parking	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-4%/Moderate: CCAP presents combined % reductions for a range of mitigation measures (Dierkers et al. 2007). SMAQMD allocates a range of 0.1%-1.5% for this measure (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs		Parking facilities are not adjacent to street frontage.
MM T-14: Parking Area Tree Cover	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	Annual net CO_2 reduction of 3.1 kg/m^2 canopy cover/Moderate (McPherson 2001).	Yes: $19 per new tree for CA, cost varies for maintenance, removal and replacement (McPherson 2001).	Yes	Yes	Adverse: VOCs Beneficial: CAPs, TACs	AG, State of CA Department of Justice (Goldberg 2007) and cities/counties (e.g., parking lot ordinances in Sacramento, Davis, and Los Angeles, CA).	Provide parking lot areas with 50% tree cover within 10 years of construction, in particular low emitting, low maintenance, native drought resistant trees. Reduces urban heat island effect and requirement for air conditioning, effective when combined with other measures (e.g., electrical maintenance equipment and reflective paving material).
MM T-15: Valet Bicycle Parking	LD (C, M), SP, AQP, TP, RR, P/Mobile	NA/Low	Yes	Yes	Yes: Raley Field (Sacramento, CA)	Adverse: No Beneficial: CAPs, TACs	Raley Field (Sacramento, CA).	Provide spaces for the operation of valet bicycle parking at community event "centers" such as amphitheaters, theaters, and stadiums.
MM T-16: Garage Bicycle Storage	LD (R, M), SP, AQP, TP, RR, P/Mobile	NA/Low	Yes: Less than $200/multiple bike rack.	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	City of Fairview, OR	Provide storage space in one-car garages for bicycles and bicycle trailers.

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM T-17: Preferential Parking for EVs/CNG Vehicles	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	USGBC, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	Provide preferential parking space locations for EVs/CNG vehicles.
MM T-18: Reduced/No Parking Fee for EVs/CNG Vehicles	LD (C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	Hotels (e.g., Argonaut in San Francisco, CA)	Provide a reduced/no parking fee for EVs/CNG vehicles.

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Miscellaneous Measure								
MM T-19: TMA Membership	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	1%-28%/High: CCAP presents a range of 3%-25% for TDMs with complementary transit and land use measures (Dierkers et al. 2007). VTPI presents a range of 6%-7% in the TDM encyclopedia (VTPI 2007). URBEMIS offers a 2%-10% range in reductions for a TDM that has 5 elements that are pedestrian and transit friendly and 1%-5% for 3 elements. SMAQMD presents a reduction of 5% (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007, VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Include permanent TMA membership and funding requirement. Funding to be provided by Community Facilities District or County Service Area or other nonrevocable funding mechanism. TDMs have been shown to reduce employee vehicle trips up to 28% with the largest reductions achieved through parking pricing and transit passes. The impact depends on the travel alternatives.
MM T-20: ULEV	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes: Higher than corresponding gasoline models.	Yes	Yes: Fueling stations might not be readily available depending on location. More than 900 E85 fueling	Adverse: No Beneficial: CAPs, TACs	DGS, CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Use of and/or provide ULEV that are 50% cleaner than average new model cars (e.g., natural gas, ethanol, electric).

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
					stations in the U.S., 5 in CA. Vehicles available in select regions only			
MM T-21: Flex Fuel Vehicles	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	5466.97 lb GHG/year/Low (DOE Fuel Economy)	Yes: E85 costs less than gasoline per gallon, but results in lower fuel economy.	Yes	Yes: More than 900 E85 fueling stations in the U.S., 5 in CA. Vehicles available in select regions only	Adverse: Yes Issues with the energy intensive ethanol production process (e.g., wastewater treatment requirements). Beneficial: CAPs, TACs	DGS, CA air quality management and control districts and cities/counties (e.g., SJVAPCD).	Use of and/or provide vehicles that utilize gasoline/ethanol blends (e.g., E85).
Design								
Commercial & Residential Building Design Measures								
MM D-1: Office/Mixed Use Density	LD (C, M), SP, TP, AQP, RR, P/Mobile	0.05%-2%/Moderate: This range is from SMAQMD, depending	Yes	Yes (VTPI 2007)	Yes (VTPI 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties	Project provides high density office or mixed-use proximate to transit. Project must provide

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16
Mitigation Measure Summary

Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
		on FAR and headway frequencies (Nelson/Nygaard Consulting Associates 2005, EDAW 2006, SMAQMD 2007).					(e.g., SMAQMD).	safe and convenient pedestrian and bicycle access to all transit stops within one-quarter mile.
MM D-2: Orientation to Existing/Planned Transit, Bikeway, or Pedestrian Corridor	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	0.4%-1%/Moderate: CCAP attributes a 0.5% reduction per 1% improvement in transit frequency (Dierkers et al. 2007). SMAQMD presents a range of 0.25%-5% (JSA 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (Dierkers et al. 2007)	Yes (Dierkers et al. 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project is oriented towards existing transit, bicycle, or pedestrian corridor. Setback distance between project and existing or planned adjacent uses is minimized or nonexistent. Setback distance between different buildings on project site is minimized. Setbacks between project buildings and planned or existing sidewalks are minimized. Buildings are oriented towards existing or planned street frontage. Primary entrances to buildings are located along planned or existing public street frontage. Project provides bicycle access to any planned bicycle corridor(s). Project provides pedestrian access to any planned pedestrian corridor(s).
MM D-3: Services Operational	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	0.5%-5%/Moderate	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project provides on-site shops and services for employees.

Table 16
Mitigation Measure Summary

Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM D-4: Residential Density (Employ Sufficient Density for New Residential Development to Support the Use of Public Transit)	LD (R, M), SP, TP, AQP, RR, P/Mobile	1%-40%/High: #7, EPA presents a range of 32%-40% (EPA 2006). SMAQMD presents a range of 1%-12% depending on density and headway frequencies (Nelson/Nygaard Consulting Associates 2005, JSA 2005, EDAW 2006, SMAQMD 2007). Nelson/Nygaard presents a trip reduction formula: Trip Reduction = 0.6*(1-(19749*((4.814+ households per residential acre)/(4.814+7.14))^-06.39)/25914).	Yes	Yes (VTPI 2007, Holtzclaw 2007)	Yes (VTPI 2007, Holtzclaw 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project provides high-density residential development. Transit facilities must be within one-quarter mile of project border. Project provides safe and convenient bicycle/pedestrian access to all transit stop(s) within one-quarter mile of project border.
MM D-5: Street Grid	LD (R, C, M), I, SP, TP, AQP, RR,	1%/Moderate: SMAQMD presents this % reduction (JSA	Yes	Yes (Dierkers et al. 2007, VTPI 2007)	Yes (Dierkers et al. 2007,	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties	Multiple and direct street routing (grid style). This measure only applies to projects

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
	P/Mobile	2005, EDAW 2006, SMAQMD 2007).			VTPI 2007)		(e.g., SMAQMD).	with an internal CF >/= 0.80, and average of one-quarter mile or less between external connections along perimeter of project. [CF= # of intersections / (# of cul-de-sacs + intersections)]. Cul-de-sacs with bicycle/pedestrian through access may be considered "complete intersections" when calculating the project's internal connectivity factor. External connections are bike/pedestrian pathways and access points, or streets with safe and convenient bicycle and pedestrian access that connect the project to adjacent streets, sidewalks, and uses. If project site is adjacent to undeveloped land; streets, pathways, access points, and right-of-ways that provide for future access to adjacent uses may count for up to 50% of the external connections. Block perimeter (the sum of the measurement of the length of all block sides) is limited to no more than 1,350 feet. Streets internal to the project should connect to streets external to the project whenever possible.

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM D-6: NEV Access	LD (R, C, M), SP, TP, AQP, RR, P/Mobile	0.5%-1.5%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (Litman 1999, Sperling 1994)	Yes (Litman 1999, Sperling 1994)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Make physical development consistent with requirements for neighborhood electric vehicles. Current studies show that for most trips, NEVs do not replace gas-fueled vehicles as the primary vehicle.
MM D-7: Affordable Housing Component	LD (R, M), SP, TP, AQP, RR, P/Mobile	0.4%-6%/Moderate: SMAQMD presents this % reduction (Nelson/Nygaard Consulting Associates 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Residential development projects of five or more dwelling units provide a deed-restricted low-income housing component on-site (or as defined in the code). Developers who pay into In-Lieu Fee Programs are not considered eligible to receive credit for this measure. The award of emission reduction credit shall be based only on the proportion of affordable housing developed on-site because in-lieu programs simply induce a net increase in development. Percentage reduction shall be calculated according to the following formula:

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
								% reduction = % units deed-restricted below market rate housing * 0.04
MM D-8: Recharging Area	LD (R, M), SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Provide residential buildings with a "utility" room or space for recharging batteries, whether for use in a car, electric lawnmower, other electric landscaping equipment, or even batteries for small items such as flashlights.
Mixed-Use Development Measures								
MM D-9: Urban Mixed-Use	LD (M), SP, TP, AQP, RR, P/Mobile	3%-9%/Moderate: SMAQMD presents this % reduction (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (EPA 2006)	Yes (EPA 2006)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Development of projects predominantly characterized by properties on which various uses, such as office, commercial, institutional, and residential, are combined in a single building or on a single site in an integrated development project with functional interrelationships and a coherent physical design.
MM D-10: Suburban Mixed-Use	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	3%/Moderate: SMAQMD presents this % reduction (TIAX 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (EPA 2006)	Yes (EPA 2006)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Have at least three of the following on site and/or offsite within one-quarter mile: Residential Development, Retail Development, Park, Open Space, or Office.
MM D-11: Other Mixed-Use	LD (R, M), SP, TP, AQP, RR, P/Mobile	1%/Moderate: SMAQMD presents this % reduction (TIAX 2005, EDAW	Yes	Yes (EPA 2006)	Yes (EPA 2006)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	All residential units are within one-quarter mile of parks, schools or other civic uses.

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
		2006, SMAQMD 2007).						
MM D-12: Infill Development	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	3%-30%/High: Infill development reduces vehicle trips and VMT by 3% and 20%, respectively (Fehr & Peers 2007). CCAP identifies a site level VMT reduction range of 20%-30% (Dierkers et al. 2007).	Yes	Yes (Dierkers et al. 2007)	Yes (Dierkers et al. 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project site is on a vacant infill site, redevelopment area, or brownfield or greyfield lot that is highly accessible to regional destinations, where the destinations rating of the development site (measured as the weighted average travel time to all other regional destinations) is improved by 100% when compared to an alternate greenfield site.
Miscellaneous Measures								
MM D-13: Electric Lawnmower	LD (R, M), SP, AQP, RR, P/Area	1%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Provide a complimentary electric lawnmower to each residential buyer.

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM D-14: Enhanced Recycling/Waste Reduction, Reuse, Composting	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	NA/Low	Yes	Yes	Yes: Association with social awareness.	Adverse: No Beneficial: CAPs, TACs	CIWMB	Provide infrastructure/education that promotes the avoidance of products with excessive packaging, recycle, buying of refills, separating of food and yard waste for composting, and using rechargeable batteries.
MM D-15: LEED Certification	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	NA/Moderate	Yes: Receive tax rebates, incentives (e.g., EDAW San Diego office interior remodel cost $1,700,000 for 32,500 square feet) (USGBC 2007)	Yes	Yes: More than 700 buildings of different certifications in CA (USGBC 2007).	Adverse: No Beneficial: CAPs, TACs	USGBC, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality.
MM D-16: Retro-Commissioning	LD (C, M), I, SP, AQP, RR, P/Stationary & Area	8%-10% reduction in energy usage/Moderate: (Mills et al. 2004)	Yes: Average $0.28/square feet, varies with building size (Haasl and Sharp 1999).	Yes	Yes: 27 projects underway in CA, 21 more to be completed in 2007, mostly state buildings owned by DGS (DGS 2007).	Adverse: No Beneficial: CAPs, TACs	DGS, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	The process ensures that all building systems perform interactively according to the contract documents, the design intent and the owner's operational needs to optimize energy performance.
MM D-17 Landscaping	LD (R, C, M), I, SP, AQP, RR,	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	Alliance for the Chesapeake Bay, EPA Green Landscaping	Project shall use drought resistant native trees, trees with low emissions and high carbon

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
	P/Stationary & Area						Resources	sequestration potential. Evergreen trees on the north and west sides afford the best protection from the setting summer sun and cold winter winds. Additional considerations include the use of deciduous trees on the south side of the house that will admit summer sun; evergreen plantings on the north side will slow cold winter winds; constructing a natural planted channel to funnel summer cooling breezes into the house. Neighborhood CCR's not requiring that front and side yards of single family homes be planted with turf grass. Vegetable gardens, bunch grass, and low-water landscaping shall also be permitted, or even encouraged.
MM D-18: Local Farmers' Market	LD (M), SP/Mobile, Stationary, &	NA/Low	Yes	Yes	Yes: Associated with social	Adverse: No Beneficial: CAPs, TACs	Cities/counties (e.g., Davis, Sacramento)	Project shall dedicate space in a centralized, accessible location for a weekly farmers' market.

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
	Area				choice and public awareness.			
MM D-19: Community Gardens	LD (M), SP/Mobile, Stationary, & Area	NA/Low	Yes	Yes	Yes: Associated with social choice and public awareness.	Adverse: No Beneficial: CAPs, TACs	Cities/counties (e.g., Davis)	Project shall dedicate space for community gardens.
Energy Efficiency/Building Component								
MM E-1: High-Efficiency Pumps	LD (R, C, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., BAAQMD).	Project shall use high-efficiency pumps.
MM E-2: Wood Burning Fireplaces/Stoves	LD (R, M), SP, AQP, RR, P/Stationary & Area	NA/Low: EDAW 2006	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project does not feature fireplaces or wood burning stoves.
MM E-3: Natural Gas Stove	LD (R, M), SP, AQP, RR, P/Stationary & Area	NA/Low: EDAW 2006	Yes: Cost of stove—$350 (gas) and $360 (electric) same brand, total yearly cost of $42.17 as opposed to $56.65 for electric (Saving Electricity 2006).	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project features only natural gas or electric stoves in residences.

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM E-4: Energy Star Roof	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	0.5%-1%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes: 866 Energy Star labeled buildings in California (Energy Star 2007)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project installs Energy Star labeled roof materials.
MM E-5: On-site Renewable Energy System	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	1%-3%/Moderate: SMAQMD presents this % reduction (USGBC 2002 and 2005, EDAW 2006, SMAQMD 2007).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project provides onsite renewable energy system(s). Nonpolluting and renewable energy potential includes solar, wind, geothermal, low-impact hydro, biomass and bio-gas strategies. When applying these strategies, projects may take advantage of net metering with the local utility.

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16
Mitigation Measure Summary

Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM E-6: Exceed Title 24	LD (R, C, M), I, GSP, AQP, RR, P/Stationary & Area	1%/Moderate: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (PG&E 2002, SMUD 2006)	Yes (PG&E 2002, SMUD 2006)	Adverse: No Beneficial: CAPs, TACs	PG&E, SMUD, CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project exceeds title 24 requirements by 20%.
MM E-7: Solar Orientation	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	0.5%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project orients 75% or more of homes and/or buildings to face either north or south (within 30° of N/S). Building design includes roof overhangs that are sufficient to block the high summer sun, but not the lower winter sun, from penetrating south facing windows. Trees, other landscaping features and other buildings are sited in such a way as to maximize shade in the summer and maximize solar access to walls and windows in the winter.
MM E-8: Nonroof Surfaces	LD (R, C, M), I, GSP, AQP, RR, P/Stationary & Area	1.0%/Low: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Provide shade (within 5 years) and/or use light-colored/high-albedo materials (reflectance of at least 0.3) and/or open grid pavement for at least 30% of the site's nonroof impervious surfaces, including parking lots, walkways, plazas, etc.; OR place a minimum of 50% of parking spaces underground or covered by structured parking; OR use an open-grid pavement system (less than 50% impervious) for a minimum of

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
								50% of the parking lot area. The mitigation measure reduces heat islands (thermal gradient differences between developed and undeveloped areas to minimize impact on microclimate and human and wildlife habitats. This measure requires the use of patented or copyright protected methodologies created by the ASTM. The SRI is a measure of the constructed surface's ability to reflect solar heat, as shown by a small rise in temperature. It is defined so that a standard black (reflectance 0.05, emittance 0.90) is "0" and a standard white (reflectance 0.80, emittance 0.90) is 100. To calculate SRI for a given material, obtain the reflectance value and emittance value for the material. SRI is calculated according to ASTM E 1980-01. Reflectance is measured

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16
Mitigation Measure Summary

Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
								according to ASTM E 903, ASTM E 1918, or ASTM C 1549. Emittance is measured according to ASTM E 408 or ASTM C 1371. Default values for some materials will be available in the LEED-NC v2.2 Reference Guide.
MM E-9: Low-Energy Cooling	LD (C, M), I, SP, AQP, RR, P/Stationary & Area	1%-10%/Low: EDAW presents this percent reduction range (EDAW 2006).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: No Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Project optimizes building's thermal distribution by separating ventilation and thermal conditioning systems.
MM E-10: Green Roof	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	1.0%/Moderate: SMAQMD presents this % reduction (EDAW 2006, SMAQMD 2007).	Yes	Yes (USGBC 2002 and 2005)	Yes (USGBC 2002 and 2005)	Adverse: Increased Water Consumption Beneficial: CAPs, TACs	CA air quality management and control districts and cities/counties (e.g., SMAQMD).	Install a vegetated roof that covers at least 50% of roof area. The reduction assumes that a vegetated roof is installed on a least 50% of the roof area or that a combination high albedo and vegetated roof surface is installed that meets the following standard: (Area of SRI Roof/0.75)+(Area of vegetated roof/0.5) >= Total Roof Area. Water consumption reduction measures shall be considered in the design of the green roof.
MM E-11: EV Charging Facilities	LD (C, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: $500-$5000/ vehicle site (PG&E 1999)	Yes	Yes: 381 facilities in CA (Clean Air Maps 2007).	Adverse: No Beneficial: CAPs, TACs	DOE, EERE, CA air quality management and control districts and cities/counties (e.g., BAAQMD).	Project installs EV charging facilities.
MM E-12:	LD (R, C, M),	NA/Low: Increasing	Yes: Light	Yes	Yes: Apply	Adverse: No		Project provides light-colored

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Light-Colored Paving	I, SP, AQP, RR, P/Stationary & Area	the albedo of 1,250 km of pavement by 0.25 would save cooling energy worth $15M per year.	colored aggregates and white cement are more expensive than gray cement. Certain blended cements are very light in color and may reflect similarly to white cement at an equivalent cost to normal gray cement.		natural sand or gravel colored single surface treatments to asphalt (EOE 2007).	Beneficial: CAPs, TACs		paving (e.g., increased albedo pavement).
MM E-13: Cool Roofs	LD (R, C, M), I, SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: 0.75–1.5/square feet coating (EPA 2007a)	Yes	Yes: Over 90% of the roofs in the United States are dark colored	Adverse: No Beneficial: CAPs, TACs	CEC	Project provides cool roofs. Highly reflective, highly emissive roofing materials that stay 50-60°F cooler than a normal roof under a hot summer sun. CA's Cool Savings

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
					(EPA 2007a).			Program provided rebates to building owners for installing roofing materials with high solar reflectance and thermal emittance. The highest rebate went to roofs on air conditioned buildings, while buildings with rooftop ducts and other nonresidential buildings were eligible for slightly less. The program aimed to reduce peak summer electricity demand and was administered by the CEC.
MM E-14: Solar Water Heaters	LD (R, M), SP, AQP, RR, P/Stationary & Area	20%–70% reduction in cooling energy needs/Moderate	Yes: $1675/20 square feet, requires a 50 gallon tank, annual operating cost of $176 (DOE 2007).	Yes	Yes: Based on solar orientation, building codes, zoning ordinances.	Adverse: No Beneficial: CAPs, TACs	Europe	Project provides solar water heaters.
MM E-15: Electric Yard Equipment Compatibility	LD (R, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: $75–$250/outlet from existing circuit (Cost Helper 2007).	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Project provides electrical outlets at building exterior areas.
MM E-16: Energy Efficient Appliance Standards	LD (R, C, M), SP, AQP, RR, P/Stationary & Area	NA/Low	Yes: Varies for each appliance—higher capital costs, lower operating costs (Energy	Yes	Yes: Major retail stores.	Adverse: No Beneficial: CAPs, TACs		Project uses energy efficient appliances (e.g., Energy Star).

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
			Star 2007).					
MM E-17: Green Building Materials	LD (R, C, M), SP, AQP, RR, P/Stationary & Area	NA/Low: 25-30% more efficient on average.	Yes	Yes: BEES software allows users to balance the environmental and economic performance of building products; developed by NIST (NIST 2007).	Yes	Adverse: No Beneficial: CAPs, TACs		Project uses materials which are resource efficient, recycled, with long life cycles and manufactured in an environmentally friendly way.
MM E-18: Shading Mechanisms	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: Up to $450 annual energy savings (Energy Star 2007).	Yes: Higher capital costs, lower operating and maintenance costs (Energy Star 2007).	Yes	Yes: Major retail stores.	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing shading mechanisms for windows, porch, patio and walkway overhangs.

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
MM E-19: Ceiling/Whole-House Fans	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: 50% more efficient than conventional fans (Energy Star 2007).	Yes: $45-$200/fan, installation extra (Lowe's 2007).	Yes	Yes: Major retail stores.	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing ceiling/whole-house fans.
MM E-20: Programmable Thermostats	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: $100 annual savings in energy costs (Energy Star 2007).	Yes: $60/LCD display and 4 settings for typical residential use (Lowe's 2007).	Yes	Yes: Major retail stores.	Adverse: Yes, Mercury Beneficial: CAPs, TACs		Install energy-reducing programmable thermostats that automatically adjust temperature settings.
MM E-21: Passive Heating and Cooling Systems	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low	Yes: $800 (wall heaters) to $4,000+ (central systems)	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing passive heating and cooling systems (e.g., insulation and ventilation).
MM E-22: Day Lighting Systems	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low	Yes: $1,300 to $1,500 depending upon the kind of roof (Barrier 1995), installation extra.	Yes	Yes: Work well only for space near the roof of the building, little benefit in multi-floor buildings.	Adverse: No Beneficial: CAPs, TACs		Install energy-reducing day lighting systems (e.g., skylights, light shelves and interior transom windows).
MM E-23: Low-Water Use Appliances	LD (R, C, M), I, SP, AQP, RR, P/Stationary, & Area	NA/Low: Avoided water agency cost for using water-efficient kitchen pre-rinse spray valves of $65.18 per acre-foot.	Yes: Can return their cost through reduction in water consumption,	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Require the installation of low-water use appliances.

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
			pumping, and treatment.					
MM E-24: Goods Transport by Rail	LD (C, M), I, SP, AQP, RR, P/Mobile	NA/Moderate	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs	ARB Goods Movement Plan (ARB 2007)	Provide a spur at nonresidential projects to use nearby rail for goods movement.
Social Awareness/Education								
MM S-1: GHG Emissions Reductions Education	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile, Stationary, & Mobile	NA/Low	Yes	Yes	Yes: Similar programs currently exist in CA.	Adverse: No Beneficial: CAPs, TACs		Provide local governments, businesses, and residents with guidance/protocols/information on how to reduce GHG emissions (e.g., energy saving, food miles).
MM S-2: School Curriculum	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile, Stationary, & Mobile	NA/Low	Yes	Yes	Yes: Similar programs currently exist in CA.	Adverse: No Beneficial: CAPs, TACs		Include how to reduce GHG emissions (e.g., energy saving, food miles) in the school curriculum.
Construction								
MM C-1: ARB-Certified Diesel Construction Equipment	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes: Oxidation Catalysts, \$1,000-	Yes	Yes	Adverse: Yes, NO_x Beneficial: CAPs, TACs	AG, EPA, ARB, and CA air quality management and pollution control districts.	Use ARB-certified diesel construction equipment. Increases CO_2 emissions when trapped CO and carbon particles

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16 Mitigation Measure Summary								
Mitigation Measure	Applicable Project/Source Type[1]	Effective		Feasible (Yes/No)		Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
			$2,000. DPF, $5000-$10,000; installation extra (EPA 2007b).					are oxidized (Catalyst Products 2007, ETC 2007).
MM C-2: Alternative Fuel Construction Equipment	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: Yes, THC, NO_x Beneficial: CO, PM, SO_x	AG, EPA, ARB, and CA air quality management and pollution control districts.	Use alternative fuel types for construction equipment. At the tailpipe biodiesel emits 10% more CO_2 than petroleum diesel. Overall lifecycle emissions of CO_2 from 100% biodiesel are 78% lower than those of petroleum diesel (NREL 1998, EPA 2007b).
MM C-3: Local Building Materials	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes: Depends on location of building material manufacture sites.	Adverse: No Beneficial: CAPs, TACs		Use locally made building materials for construction of the project and associated infrastructure.
MM C-4: Recycle Demolished Construction Material	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile	NA/Low	Yes	Yes	Yes	Adverse: No Beneficial: CAPs, TACs		Recycle/Reuse demolished construction material. Use locally made building materials for construction of the project and associated infrastructure.

Table 16
Mitigation Measure Summary

Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
Miscellaneous								
MM M-1: Off-Site Mitigation Fee Program	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile & Area	NA/Moderate-High: Though there is currently no program in place, the potential for real and quantifiable reductions of GHG emissions could be high if a defensible fee program were designed.	Yes	Yes	No: Program does not exist in CA, but similar programs currently exist (e.g., Carl Moyer Program, SJVAPCD Rule 9510, SMAQMD Off-Site Construction Mitigation Fee Program).	Adverse: No Beneficial: CAPs, TACs		Provide/Pay into an off-site mitigation fee program, which focuses primarily on reducing emissions from existing development and buildings through retro-fit (e.g., increased insulation).
MM M-2: Offset Purchase	LD (R, C, M), I, SP, TP, AQP, RR, P/Mobile, Stationary, & Area	NA/Low	Yes	Yes	No: ARB has not adopted official program, but similar programs	No		Provide/purchase offsets for additional emissions by acquiring carbon credits or engaging in other market "cap and trade" systems.

AG=Attorney General; ARB=California Air Resources Board; ASTM=American Society for Testing and Material; BAAQMD=Bay Area Air Quality Management District; BEES= Building for Environmental and Economic Sustainability; CA=California; Caltrans=California Department of Transportation; CAPs=Criteria Air Pollutants; CCAP=Center for Clean Air Policy; CF=Connectivity Factor; CIWMB=California Integrated Waste Management Board; CO= Carbon Monoxide; CO_2=Carbon Dioxide; DGS=Department of General Services; DOE=U.S. Department of Energy; DPF=Diesel particulate Filter; E85=85% Ethanol; EERE=Energy Efficiency and Renewable Energy; EOE=Encyclopedia of Earth; EPA=U.S. Environmental Protection Agency; ETC=Edmonton Trolley Coalition; EVs/CNG=Electric Vehicles/Compressed Natural Gas; FAR=Floor Area Ratio; GHG=Greenhouse Gas; ITE=Institute of Transportation Engineers; kg/m^2=kilogram per square meter; km=Kilometer; lb=pound; LEED=Leadership in Energy and Environmental Design; M=Million; NA=Not Available; NEV=Neighborhood Electric Vehicle; NIST=National Institute of Standards and Technology; NO_X=Oxides of Nitrogen; NREL=National Renewable Energy Laboratory; N/S=North/South; PG&E=Pacific Gas and Electric; PM=Particulate Matter; SJVAPCD=San Joaquin Valley Air Pollution Control District; SMAQMD=Sacramento Metropolitan Air Quality Management District; SMUD=Sacramento Municipal Utilities District; SO_x=Sulfur Oxides; SRI=Solar Reflectance Index; TACs=Toxic Air Contaminants; TDM=Transportation Demand Management; TMA=Transportation Management Association; THC=Total Hydrocarbon; ULEV=Ultra Low Emission Vehicle; USGBC=U.S. Green Building Council; and VTPI=Victoria Transit Policy.

Table 16
Mitigation Measure Summary

Mitigation Measure	Applicable Project/Source Type[1]	Effective	Feasible (Yes/No)			Secondary Effects (Yes/No)	Agency/Organization/Other[6]	Description/Comments
		Emissions Reduction/Score[2]	Cost (Yes/No)[3]	Technical[4]	Logistical[5]			
					currently exist.			
Regional Transportation Plan Measures								
MM RTP-1: Dedicate High Occupancy Vehicle (HOV) lanes prior to adding capacity to existing highways.	RTP		Yes	Yes	Yes	Adverse: possible local CO Beneficial: regional CAPs, TACs	Caltrans, local government	Evaluate the trip reduction (and GHG reduction) potential of adding HOV lanes prior to adding standard lanes.
MM RTP-2: Implement toll/user fee programs prior to adding capacity to existing highways.	RTP		Yes	Yes	Yes	Adverse: possible local CO. Beneficial: regional CAPs, TACs	Caltrans	Evaluate price elasticity and associated trip reduction (and GHG reduction) potential with adding or increasing tolls prior to adding capacity to existing highways.

Note:
[1] Where LD (R, C, M) =Land Development (Residential, Commercial, Mixed-Use), I=Industrial, GP=General Plan, SP=Specific Plan, TP=Transportation Plans, AQP=Air Quality Plans, RR=Rules/Regulations, and P=Policy. It is important to note that listed project types may not be directly specific to the mitigation measure (e.g., TP, AQP, RR, and P) as such could apply to a variety of source types, especially RR and P.
[2] This score system entails ratings of high, moderate, and low that refer to the level of the measure to provide a substantive, reasonably certain (e.g., documented emission reductions with proven technologies), and long-term reduction of GHG emissions.
[3] Refers to whether the measure would provide a cost-effective reduction of GHG emissions based on available documentation.
[4] Refers to whether the measure is based on currently, readily available technology based on available documentation.
[5] Refers to whether the measure could be implemented without extraordinary effort based on available documentation.
[6] List is not meant to be all inclusive.
Source: Data complied by EDAW in 2007

Table 17
General Planning Level Mitigation Strategies Summary

Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
MS G-1: Adopt a GHG reduction plan	GP/ Mobile, Stationary, & Area	City of San Bernardino	- Adopt GHG reduction targets for the planning area, based on the current legislation providing direction for state-wide targets, and update the plan as necessary. -The local government agency should serve as a model by inventorying its GHG emissions from agency operations, and implementing those reduction goals.
Circulation			
MS G-2: Provide for convenient and safe local travel	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Create a gridded street pattern with small block sizes. This promotes walkability through direct routing and ease of navigation. -Maintain a high level of connectivity of the roadway network. Minimize cul-de-sacs and incomplete roadway segments. -Plan and maintain an integrated, hierarchical and multi-modal system of roadways, pedestrian walks, and bicycle paths throughout the area. -Apply creative traffic management approaches to address congestion in areas with unique problems, particularly on roadways and intersections in the vicinity of schools in the morning and afternoon peak hours, and near churches, parks and community centers. -Work with adjacent jurisdictions to address the impacts of regional development patterns (e.g. residential development in surrounding communities, regional universities, employment centers, and commercial developments) on the circulation system. -Actively promote walking as a safe mode of local travel, particularly for children attending local schools. -Employ traffic calming methods such as median landscaping and provision of bike or transit lanes to slow traffic, improve roadway capacity, and address safety issues.
MS G-3: Enhance the regional transportation network and maintain effectiveness	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage the transportation authority to reduce fees for short distance trips. -Ensure that improvements to the traffic corridors do not negatively impact the operation of local roadways and land uses.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			-Cooperate with adjacent jurisdictions to maintain adequate service levels at shared intersections and to provide adequate capacity on regional routes for through traffic. -Support initiatives to provide better public transportation. Work actively to ensure that public transportation is part of every regional transportation corridor. - Coordinate the different modes of travel to enable users to transfer easily from one mode to another. -Work to provide a strong paratransit system that promotes the mobility of all residents and educate residents about local mobility choices. - Promote transit-oriented development to facilitate the use of the community's transit services.
MS G-4: Promote and support an efficient public transportation network connecting activity centers in the area to each other and the region.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Promote increased use of public transportation and support efforts to increase bus service range and frequency within the area as appropriate. -Enhance and encourage provision of attractive and appropriate transit amenities, including shaded bus stops, to encourage use of public transportation. -Encourage the school districts, private schools and other operators to coordinate local bussing and to expand ride-sharing programs. All bussing options should be fully considered before substantial roadway improvements are made in the vicinity of schools to ease congestion.
MS G-5: Establish and maintain a comprehensive system, which is safe and convenient, of pedestrian ways and bicycle routes that provide viable options to travel by automobile.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Improve area sidewalks and rights-of-way to make them efficient and appealing for walking and bicycling safely. Coordinate with adjacent jurisdictions and regional agencies to improve pedestrian and bicycle trails, facilities, signage, and amenities. -Provide safe and convenient pedestrian and bicycle connections to and from town centers, other commercial districts, office complexes, neighborhoods, schools, other major activity centers, and surrounding communities. -Work with neighboring jurisdictions to provide well-designed pedestrian and bicycle crossings of major roadways. -Promote walking throughout the community. Install sidewalks where missing and make improvements

Table 17
General Planning Level Mitigation Strategies Summary

Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			to existing sidewalks for accessibility purposes. Particular attention should be given to needed sidewalk improvement near schools and activity centers. -Encourage businesses or residents to sponsor street furniture and landscaped areas. - Strive to provide pedestrian pathways that are well shaded and pleasantly landscaped to encourage use. - Attract bicyclists from neighboring communities to ride their bicycles or to bring their bicycles on the train to enjoy bicycling around the community and to support local businesses. - Meet guidelines to become nationally recognized as a Bicycle-Friendly community. - Provide for an education program and stepped up code enforcement to address and minimize vegetation that degrades access along public rights-of-way. -Engage in discussions with transit providers to increase the number of bicycles that can be accommodated on buses
MS G-6: Achieve optimum use of regional rail transit.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Support regional rail and work with rail authority to expand services. - Achieve better integration of all transit options. -Work with regional transportation planning agencies to finance and provide incentives for multimodal transportation systems. - Promote activity centers and transit-oriented development projects around the transit station.
MS G-7: Expand and optimize use of local and regional bus and transit systems.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage convenient public transit service between area and airports. -Support the establishment of a local shuttle to serve commercial centers. -Promote convenient, clean, efficient, and accessible public transit that serves transit-dependent riders and attracts discretionary riders as an alternative to reliance on single-occupant automobiles.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			- Empower seniors and those with physical disabilities who desire maximum personal freedom and independence of lifestyle with unimpeded access to public transportation. -Integrate transit service and amenities with surrounding land uses and buildings.
Conservation, Open Space			
MS G-8: Emphasize the importance of water conservation and maximizing the use of native, low-water landscaping.	GP/Stationary & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Reduce the amount of water used for landscaping and increase use of native and low water plants. Maximize use of native, low-water plants for landscaping of areas adjacent to sidewalks or other impermeable surfaces. -Encourage the production, distribution and use of recycled and reclaimed water for landscaping projects throughout the community, while maintaining urban runoff water quality objectives. -Promote water conservation measures, reduce urban runoff, and prevent groundwater pollution within development projects, property maintenance, area operations and all activities requiring approval. -Educate the public about the importance of water conservation and avoiding wasteful water habits. -Work with water provider in exploring water conservation programs, and encourage the water provider to offer incentives for water conservation.
MS G-9: Improve air quality within the region.	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Integrate air quality planning with area land use, economic development and transportation planning efforts. -Support programs that reduce air quality emissions related to vehicular travel. -Support alternative transportation modes and technologies, and develop bike- and pedestrian-friendly neighborhoods to reduce emissions associated with automobile use. -Encourage the use of clean fuel vehicles. -Promote the use of fuel-efficient heating and cooling equipment and other appliances, such as water

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			heaters, swimming pool heaters, cooking equipment, refrigerators, furnaces, and boiler units. - Promote the use of clean air technologies such as fuel cell technologies, renewable energy sources. UV coatings, and alternative, non-fossil fuels. -Require the planting of street trees along streets and inclusion of trees and landscaping for all development projects to help improve airshed and minimize urban heat island effects. - Encourage small businesses to utilize clean, innovative technologies to reduce air pollution. - Implement principles of green building. - Support jobs/housing balance within the community so more people can both live and work within the community. To reduce vehicle trips, encourage people to telecommute or work out of home or in local satellite offices.
MS G-10: Encourage and maximize energy conservation and identification of alternative energy sources.	GP/ Stationary & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage green building designs for new construction and renovation projects within the area. -Coordinate with regional and local energy suppliers to ensure adequate supplies of energy to meet community needs, implement energy conservation and public education programs, and identify alternative energy sources where appropriate. -Encourage building orientations and landscaping that enhance natural lighting and sun exposure. -Encourage expansion of neighborhood-level products and services and public transit opportunities throughout the area to reduce automobile use. - Incorporate the use of energy conservation strategies in area projects. - Promote energy-efficient design features, including appropriate site orientation, use of light color roofing and building materials, and use of evergreen trees and wind-break trees to reduce fuel consumption for heating and cooling.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			-Explore and consider the cost/benefits of alternative fuel vehicles including hybrid, natural gas, and hydrogen powered vehicles when purchasing new vehicles. -Continue to promote the use of solar power and other energy conservation measures. - Encourage residents to consider the cost/benefits of alternative fuel vehicles. - Promote the use of different technologies that reduce use of non-renewable energy resources. -Facilitate the use of green building standards and LEED in both private and public projects. -Promote sustainable building practices that go beyond the requirements of Title 24 of the California Administrative Code, and encourage energy-efficient design elements, as appropriate. -Support sustainable building practices that integrate building materials and methods that promote environmental quality, economic vitality, and social benefit through the design, construction, and operation of the built environment. - Investigate the feasibility of using solar (photovoltaic) street lights instead of conventional street lights that are powered by electricity in an effort to conserve energy. - Encourage cooperation between neighboring development to facilitate on-site renewable energy supplies or combined heat and power co-generation facilities that can serve the energy demand of contiguous development.

Table 17
General Planning Level Mitigation Strategies Summary

Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
MS G-11: Preserve unique community forests, and provide for sustainable increase and maintenance of this valuable resource.	GP/Stationary & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Develop a tree planting policy that strives to accomplish specific % shading of constructed paved and concrete surfaces within five years of construction. -Provide adequate funding to manage and maintain the existing forest, including sufficient funds for tree planting, pest control, scheduled pruning, and removal and replacement of dead trees. -Coordinate with local and regional plant experts in selecting tree species that respect the natural region in which Claremont is located, to help create a healthier, more sustainable urban forest. - Continue to plant new trees (in particular native tree species where appropriate), and work to preserve mature native trees. -Increase the awareness of the benefits of street trees and the community forest through a area wide education effort. -Encourage residents to properly care for and preserve large and beautiful trees on their own private property.
Housing			
MS G-12: Provide affordability levels to meet the needs of community residents.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Encourage development of affordable housing opportunities throughout the community, as well as development of housing for elderly and low and moderate income households near public transportation services. -Ensure a portion of future residential development is affordable to low and very low income households.
Land Use			
MS G-13: Promote a visually-cohesive urban form and establish connections between the urban core and outlying portions of the	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Preserve the current pattern of development that encourages more intense and higher density development at the core of the community and less intense uses radiating from the central core. -Create and enhance landscaped greenway, trail and sidewalk connections between neighborhoods and to commercial areas, town centers, and parks.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
community.			-Identify ways to visually identify and physically connect all portions of the community, focusing on enhanced gateways and unifying isolated and/or outlying areas with the rest of the area. -Study and create a diverse plant identity with emphasis on drought-resistant native species.
MS G-14: Provide a diverse mix of land uses to meet the future needs of all residents and the business community.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Attract a broad range of additional retail, medical, and office uses providing employment at all income levels. -Support efforts to provide beneficial civic, religious, recreational, cultural and educational opportunities and public services to the entire community. -Coordinate with public and private organizations to maximize the availability and use of parks and recreational facilities in the community. -Support development of hotel and recreational commercial land uses to provide these amenities to local residents and businesses.
MS G-15: Collaborate with providers of solid waste collection, disposal and recycling services to ensure a level of service that promotes a clean community and environment.	GP/ Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Require recycling, composting, source reduction and education efforts throughout the community, including residential, businesses, industries, and institutions, within the construction industry, and in all sponsored activities.
MS G-16: Promote construction, maintenance and active use of publicly- and privately-operated parks, recreation programs, and a community center.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Work to expand and improve community recreation amenities including parks, pedestrian trails and connections to regional trail facilities. -As a condition upon new development, require payment of park fees and/or dedication and provision of parkland, recreation facilities and/or multi-use trails that improve the public and private recreation system. -Research options or opportunities to provide necessary or desired community facilities.

Table 17
General Planning Level Mitigation Strategies Summary

Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
MS G-17: Promote the application of sustainable development practices.	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Encourage sustainable development that incorporates green building best practices and involves the reuse of previously developed property and/or vacant sites within a built-up area. - Encourage the conservation, maintenance, and rehabilitation of the existing housing stock. -Encourage development that incorporates green building practices to conserve natural resources as part of sustainable development practices. -Avoid development of isolated residential areas in the hillsides or other areas where such development would require significant infrastructure investment, adversely impact biotic resources. - Provide land area zoned for commercial and industrial uses to support a mix of retail, office, professional, service, and manufacturing businesses.
MS G-18: Create activity nodes as important destination areas, with an emphasis on public life within the community.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Provide pedestrian amenities, traffic-calming features, plazas and public areas, attractive streetscapes, shade trees, lighting, and retail stores at activity nodes. -Provide for a mixture of complementary retail uses to be located together to create activity nodes to serve adjacent neighborhoods and to draw visitors from other neighborhoods and from outside the area.
MS G-19: Make roads comfortable, safe, accessible, and attractive for use day and night.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Provide crosswalks and sidewalks along streets that are accessible for people with disabilities and people who are physically challenged. -Provide lighting for walking and nighttime activities, where appropriate. -Provide transit shelters that are comfortable, attractive, and accommodate transit riders.
MS G-20: Maintain and expand where possible the system of neighborhood connections that attach neighborhoods to larger roadways.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Provide sidewalks where they are missing, and provide wide sidewalks where appropriate with buffers and shade so that people can walk comfortably. -Make walking comfortable at intersections through traffic-calming, landscaping, and designated crosswalks.

Table 17 General Planning Level Mitigation Strategies Summary			
Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
			-Look for opportunities for connections along easements & other areas where vehicles not permitted.
MS G-21: Create distinctive places throughout the area.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	-Provide benches, streetlights, public art, and other amenities in public areas to attract pedestrian activities. -Encourage new developments to incorporate drought tolerant and native landscaping that is pedestrian friendly, attractive, and consistent with the landscaped character of area. -Encourage all new development to preserve existing mature trees. -Encourage streetscape design programs for commercial frontages that create vibrant places which support walking, bicycling, transit, and sustainable economic development. -Encourage the design and placement of buildings on lots to provide opportunities for natural systems such as solar heating and passive cooling. - Ensure that all new industrial development projects are positive additions to the community setting, provide amenities for the comfort of the employees such as outdoor seating area for breaks or lunch, and have adequate landscape buffers.
MS G-22: Reinvest in existing neighborhoods and promote infill development as a preference over new, greenfield development	GP/ Mobile, Stationary, & Area	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Identify all underused properties in the plan area and focus development in these opportunity sites prior to designating new growth areas for development. - Implement programs to retro-fit existing structures to make them more energy-efficient. -Encourage compact development, by placing the desired activity areas in smaller spaces.

Table 17
General Planning Level Mitigation Strategies Summary

Strategy	Source Type[1]	Agency/Organization[2]	Description/Comments
Public Safety			
MS G-23: Promote a safe community in which residents can live, work, shop, and play.	GP/ Mobile	Cities/Counties (e.g., Aliso Viejo, Claremont)	- Foster an environment of trust by ensuring non-biased policing, and by adopting policies and encouraging collaboration that creates transparency. - Facilitate traffic safety for motorists and pedestrians through proper street design and traffic monitoring.

Note:
[1] Where GP=General Plan.
[2] List is not meant to be all inclusive.
Source: Data complied by EDAW in 2007

Appendix C

Rule and Regulation Summary

Table 18
Rule and Regulation Summary

Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Low Carbon Fuel Standard	10-20 MMT CO_2e by 2020	January 1, 2010	ARB	This rule/regulation will require fuel providers (e.g., producers, importers, refiners and blenders) to ensure that the mix of fuels they sell in CA meets the statewide goal to reduce the carbon intensity of CA's transportation fuels by at least 10% by the 2020 target.	ARB Early Action Measure
Reduction of HFC-134a Emissions from Nonprofessional Servicing of Motor Vehicle Air Conditioning Systems	1-2 MMT CO_2e by 2020	January 1, 2010	ARB	This rule/regulation will restrict the use of high GWP refrigerants for nonprofessional recharging of leaky automotive air conditioning systems.	ARB Early Action Measure
Landfill Gas Recovery	2-4 MMT CO_2e by 2020	January 1, 2010	IWMB, ARB	This rule/regulation will require landfill gas recovery systems on small to medium landfills that do not have them and upgrade the requirements at landfills with existing systems to represent best capture and destruction efficiencies.	ARB Early Action Measure
Vehicle Climate Change Standards (AB 1493 Pavley, Chapter 200, Statutes of 2002)	30 MMT CO_2e by 2020	2009	ARB	This rule/regulation will require ARB to achieve the maximum feasible and cost effective reduction of GHG emissions from passenger vehicles and light-duty trucks.	ARB Early Action Measure
Reduction of PFCs from the Semiconductor Industry	0.5 MMT CO_2e by 2020	2007–2009	ARB	This rule/regulation will reduce GHG emissions by process improvements/source reduction, alternative chemicals capture and beneficial reuse, and destruction technologies	Underway or to be initiated by CAT members in 2007-2009 period

AB=Assembly Bill; ARB=California Air Resources Board; Calfire=California Fire; CA=California; Caltrans=California Department of Transportation; CAT=California Action Team; CEC=California Energy Commission; CDFA=California Department of Food and Agriculture; CH_4=Methane; CO_2=Carbon Dioxide; CPUC=California Public Utilities Commission; CUFR=California Urban Forestry; DGS=Department of General Services; DWR=Department of Water Resources; GHG=Greenhouse Gas; GWP=Global Warming Potential; IGCC= Integrated Gasification Combined Cycle; IOU= Investor-Owned Utility; IT=Information Technology; IWCB= Integrated Waste Management Board; LNG= Liquefied Natural Gas; MMT CO_2e=Million Metric Tons Carbon Dioxide Equivalent; MW=Megawatts; NA=Not Available; N_2O=Nitrous Oxide; PFC= Perfluorocompound; POU= Publicly Owned Utility; RPS= Renewable Portfolio Standards; RTP=Regional Transportation Plan SB=Senate Bill; SWP=State Water Project; TBD=To Be Determined; UC/CSU=University of California/California State University; ULEV=Ultra Low Emission Vehicle.

Table 18
Rule and Regulation Summary

Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Restrictions on High GWP Refrigerants	9 MMT CO_2e by 2020	2010	ARB	This rule/regulation will expand and enforce the national ban on release of high GWP refrigerants during appliance lifetime.	ARB Early Action Measure
Cement Manufacture	<1 MMT CO_2e per year (based on 2004 production levels)	2010	Caltrans	This rule/regulation will allow 2.5% interground limestone concrete mix in cement use.	CAT Early Action Measure
Hydrogen Fuel Standards (SB 76 of 2005)	TBD	By 2008	CDFA	This rule/regulation will develop hydrogen fuel standards for use in combustion systems and fuel cells.	CAT Early Action Measure
Regulation of GHG from Load Serving Entities (SB 1368)	15 MMT CO_2e by 2020	May 23, 2007	CEC, CPUC	This rule/regulation will establish a GHG emission performance standard for baseload generation of local publicly owned electric utilities that is no higher than the rate of emissions of GHG for combined-cycle natural gas baseload generation.	CAT Early Action Measure
Energy Efficient Building Standards	TBD	In 2008	CEC	This rule/regulation will update of Title 24 standards.	CAT Early Action Measure
Energy Efficient Appliance Standards	TBD	January 1, 2010	CEC	This rule/regulation will regulate light bulb efficiency	CAT Early Action Measure
Tire Efficiency (Chapter 8.7 Division 15 of the Public Resources Code)	<1 MMT CO_2e by 2020	January 1, 2010	CEC & IWMB	This rule/regulation will ensure that replacement tires sold in CA are at least as energy efficient, on average, as tires sold in the state as original equipment on these vehicles.	CAT Early Action Measure
New Solar Homes Partnership	TBD	January 2007	CEC	Under this rule/regulation, approved solar systems will receive incentive funds based on system performance above building standards.	CAT Early Action Measure

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Water Use Efficiency	1 MMT CO_2e by 2020	2010	DWR	This rule/regulation will adopt standards for projects and programs funded through water bonds that would require consideration of water use efficiency in construction and operation.	CAT Early Action Measure
State Water Project	TBD	2010	DWR	This rule/regulation will include feasible and cost effective renewable energy in the SWP's portfolio.	CAT Early Action Measure
Cleaner Energy for Water Supply	TBD	2010	DWR	Under this rule/regulation, energy supply contracts with conventional coal power plants will not be renewed.	CAT Early Action Measure
IOU Energy Efficiency Programs	4 MMT CO_2e by 2020	2010	CPUC	This rule/regulation will provide a risk/reward incentive mechanism for utilities to encourage additional investment in energy efficiency; evaluate new technologies and new measures like encouraging compact fluorescent lighting in residential and commercial buildings	CAT Early Action Measure
Solar Generation	TBD	2007–2009	DGS	3 MW of clean solar power generation implemented in CA last year, with another 1 MW coming up. The second round is anticipated to total additional 10 MW and may include UC/CSU campuses and state fairgrounds.	Underway or to be initiated by CAT members in 2007-2009 period

AB=Assembly Bill; ARB=California Air Resources Board; Calfire=California Fire; CA=California; Caltrans=California Department of Transportation; CAT=California Action Team; CEC=California Energy Commission; CDFA=California Department of Food and Agriculture; CH_4=Methane; CO_2=Carbon Dioxide; CPUC=California Public Utilities Commission; CUFR=California Urban Forestry; DGS=Department of General Services; DWR=Department of Water Resources; GHG=Greenhouse Gas; GWP=Global Warming Potential; IGCC= Integrated Gasification Combined Cycle; IOU= Investor-Owned Utility; IT=Information Technology; IWCB= Integrated Waste Management Board; LNG= Liquefied Natural Gas; MMT CO_2e=Million Metric Tons Carbon Dioxide Equivalent; MW=Megawatts; NA=Not Available; N_2O=Nitrous Oxide; PFC= Perfluorocompound; POU= Publicly Owned Utility; RPS= Renewable Portfolio Standards; RTP=Regional Transportation Plan SB=Senate Bill; SWP=State Water Project; TBD=To Be Determined; UC/CSU=University of California/California State University; ULEV=Ultra Low Emission Vehicle.

Table 18
Rule and Regulation Summary

Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Transportation Efficiency	9 MMT CO_2e by 2020	2007–2009	Caltrans	This rule/regulation will reduce congestion, improve travel time in congested corridors, and promote coordinated, integrated land use.	Underway or to be initiated by CAT members in 2007-2009 period
Smart Land Use and Intelligent Transportation	10 MMT CO_2e by 2020	2007–2009	Caltrans	This rule/regulation will integrate consideration of GHG reduction measures and energy efficiency factors into RTPs, project development etc.	Underway or to be initiated by CAT members in 2007-2009 period
Cool Automobile Paints	1.2 to 2.0 MMT CO_2e by 2020	2009	ARB	Cool paints would reduce the solar heat gain in a vehicle and reduce air conditioning needs.	ARB Early Action Measure
Tire Inflation Program	TBD	2009	ARB	This rule/regulation will require tires to be checked and inflated at regular intervals to improve fuel economy.	ARB Early Action Measure
Electrification of Stationary Agricultural Engines	0.1 MMT CO_2e by 2020	2010	ARB	This rule/regulation will provide incentive funding opportunities for replacing diesel engines with electric motors.	ARB Early Action Measure
Desktop Power Management	Reduce energy use by 50%	2007–2009	DGS, ARB	This rule/regulation will provide software to reduce electricity use by desktop computers by up to 40%.	Currently deployed in DGS
Reducing CH_4 Venting/Leaking from Oil and Gas Systems (EJAC-3/ARB 2-12)	1 MMT CO_2e by 2020	2010	ARB	This rule/regulation will reduce fugitive CH_4 emissions from production, processing, transmission, and distribution of natural gas and oil.	ARB Early Action Measure
Replacement of High GWP Gases Used in Fire Protection Systems with Alternate Chemical (ARB 2-10)	0.1 MMT CO_2e by 2020	2011	ARB	This rule/regulation will require the use of lower GWP substances in fire protection systems.	ARB Early Action Measure
Contracting for Environmentally Preferable Products	NA	2007–2009	DGS	New state contracts have been or are being created for more energy and resource efficient IT goods, copiers, low mercury fluorescent lamps, the CA Gold Carpet Standard and office furniture.	Underway or to be initiated by CAT members in 2007-2009 period
Hydrogen Fuel Cells	NA	2007–2009	DGS	This rule/regulation will incorporate clean hydrogen fuel cells in stationary applications	Underway or to be initiated by CAT members in 2007-2009

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
				at State facilities and as back-up generation for emergency radio services.	period
High Performance Schools	NA	2007–2009	DGS	New guidelines adopted for energy and resource efficient schools; up to $100 million in bond money for construction of sustainable, high performance schools.	Underway or to be initiated by CAT members in 2007-2009 period
Urban Forestry	1 MMT CO_2e by 2020	2007–2009	Calfire, CUFR	This rule/regulation will provide five million additional trees in urban areas by 2020.	Underway or to be initiated by CAT members in 2007-2009 period
Fuels Management/Biomass	3 MMT CO_2e by 2020	2007–2009	Calfire	This rule/regulation will provide biomass from forest fuel treatments to existing biomass utilization facilities.	Underway or to be initiated by CAT members in 2007-2009 period
Forest Conservation and Forest Management	10 MMT CO_2e by 2020	2007–2009	Calfire, WCB	This rule/regulation will provide opportunities for carbon sequestration in Proposition 84 forest land conservation program to conserve an additional 75,000 acres of forest landscape by 2010.	Underway or to be initiated by CAT members in 2007-2009 period
Afforestation/Reforestation	2 MMT CO_2e by 2020	2007–2009	Calfire	This rule/regulation will subsidize tree planting.	Underway or to be initiated by CAT members in 2007-2009 period
Dairy Digesters	TBD	January 1, 2010	CDFA	This rule/regulation will develop a dairy digester protocol to document GHG emission reductions from these facilities.	ARB Early Action Measure

AB=Assembly Bill; ARB=California Air Resources Board; Calfire=California Fire; CA=California; Caltrans=California Department of Transportation; CAT=California Action Team; CEC=California Energy Commission; CDFA=California Department of Food and Agriculture; CH_4=Methane; CO_2=Carbon Dioxide; CPUC=California Public Utilities Commission; CUFR=California Urban Forestry; DGS=Department of General Services; DWR=Department of Water Resources; GHG=Greenhouse Gas; GWP=Global Warming Potential; IGCC= Integrated Gasification Combined Cycle; IOU= Investor-Owned Utility; IT=Information Technology; IWCB= Integrated Waste Management Board; LNG= Liquefied Natural Gas; MMT CO_2e=Million Metric Tons Carbon Dioxide Equivalent; MW=Megawatts; NA=Not Available; N_2O=Nitrous Oxide; PFC= Perfluorocompound; POU= Publicly Owned Utility; RPS= Renewable Portfolio Standards; RTP=Regional Transportation Plan SB=Senate Bill; SWP=State Water Project; TBD=To Be Determined; UC/CSU=University of California/California State University; ULEV=Ultra Low Emission Vehicle.

Table 18
Rule and Regulation Summary

Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Conservation Tillage and Enteric Fermentation	1 MMT CO_2e by 2020	2007–2009	CDFA	This rule/regulation will develop and implement actions to quantify and reduce enteric fermentation emissions from livestock and sequester soil carbon using cover crops and conservation tillage.	Underway or to be initiated by CAT members in 2007-2009 period
ULEV	TBD	2007–2009	DGS	A new long term commercial rental contract was released in March 2007 requiring a minimum ULEV standard for gasoline vehicles and requires alternative fuel and hybrid-electric vehicles.	Underway or to be initiated by CAT members in 2007-2009 period
Flex Fuel Vehicles	370 metric tons CO_2, 0.85 metric tons of CH_4, and 1.14 metric tons of N_2O	2007–2009	DGS	Under this rule/regulation, DGS is replacing 800 vehicles with new, more efficient vehicles.	Underway or to be initiated by CAT members in 2007-2009 period
Climate Registry	TBD	2007–2009	DGS	Benchmarking and reduction of GHG emissions for state owned buildings, leased buildings and light duty vehicles.	Underway or to be initiated by CAT members in 2007-2009 period
Municipal Utilities Electricity Sector Carbon Policy	Included in SB 1368 reductions	2007–2009	CEC, CPUC, ARB	Under this rule/regulation, GHG emissions cap policy guidelines for CA's electricity sector (IOUs and POUs).	Underway or to be initiated by CAT members in 2007-2009 period
Alternative Fuels: Nonpetroleum Fuels	TBD	2007–2009	CEC	State plan to increase the use of alternative fuels for transportation; full fuel cycle assessment.	Underway or to be initiated by CAT members in 2007-2009 period
Zero Waste/High Recycling Strategy	5 MMT CO_2e by 2020	2007–2009	IWMB	This rule/regulation will identify materials to focus on to achieve GHG reduction at the lowest possible cost; Builds on the success of 50% Statewide Recycling Goal.	Underway or to be initiated by CAT members in 2007-2009 period
Organic Materials Management	TBD	2007–2009	IWMB	This rule/regulation will develop a market incentive program to increase organics diversion to the agricultural industry.	Underway or to be initiated by CAT members in 2007-2009 period
Landfill Gas Energy	TBD	2007–2009	IWMB	Landfill Gas to Energy & LNG/biofuels	Underway or to be initiated by CAT members in 2007-2009 period

Table 18 Rule and Regulation Summary					
Rule/Regulation	Reduction	Implementation Date	Agency	Description	Comments
Target Recycling	TBD	2007–2009	IWMB	This rule/regulation will focus on industry/public sectors with high GHG components to implement targeted commodity recycling programs.	Underway or to be initiated by CAT members in 2007-2009 period
Accelerated Renewable Portfolio Standard	Included in SB 1368 reductions	2007–2009	CPUC	This rule/regulation will examine RPS long term planning and address the use of tradable renewable energy credits for RPS compliance.	Underway or to be initiated by CAT members in 2007-2009 period
CA Solar Initiative	1 MMT CO_2e by 2020	2007–2009	CPUC	Initiative to deliver 2000 MWs of clean, emissions free energy to the CA grid by 2016.	Underway or to be initiated by CAT members in 2007-2009 period
Carbon Capture and Sequestration	TBD	2007–2009	CPUC	Proposals for power plants with IGCC and/or carbon capture in the next 18 months.	Underway or to be initiated by CAT members in 2007-2009
Source: Data complied by EDAW in 2007					

AB=Assembly Bill; ARB=California Air Resources Board; Calfire=California Fire; CA=California; Caltrans=California Department of Transportation; CAT=California Action Team; CEC=California Energy Commission; CDFA=California Department of Food and Agriculture; CH_4=Methane; CO_2=Carbon Dioxide; CPUC=California Public Utilities Commission; CUFR=California Urban Forestry; DGS=Department of General Services; DWR=Department of Water Resources; GHG=Greenhouse Gas; GWP=Global Warming Potential; IGCC= Integrated Gasification Combined Cycle; IOU= Investor-Owned Utility; IT=Information Technology; IWCB= Integrated Waste Management Board; LNG= Liquefied Natural Gas; MMT CO_2e=Million Metric Tons Carbon Dioxide Equivalent; MW=Megawatts; NA=Not Available; N_2O=Nitrous Oxide; PFC= Perfluorocompound; POU= Publicly Owned Utility; RPS= Renewable Portfolio Standards; RTP=Regional Transportation Plan SB=Senate Bill; SWP=State Water Project; TBD=To Be Determined; UC/CSU=University of California/California State University; ULEV=Ultra Low Emission Vehicle.

CASE STUDY: CALIFORNIA TITLE 24 ENERGY CODE

1. THE POLICY

Title 24 was developed by the State of California in response to the energy crisis of the early 1970s. The standard was established in 1978 and has undergone numerous revisions since, the latest being in 2005. The California Energy Commission formally adopted the 2008 Standards in April 2008, which will come into effect as of July 1, 2009,.

The current (2005) and upcoming (2008) versions of the regulations are largely centered on energy use influenced at the design stage (for example in requiring mandatory performance standards in HVAC-R equipment and fabric to be achieved) and in construction (for example through residential duct leakage testing or non residential acceptance testing requirements). There are no provisions in the code related to the ‘in operation’ energy use of a building.

Title 24 is a compilation of three types of building standards from three different origins:

- Building standards that have been adopted by state agencies without change, from building standards contained in national codes.
- Building standards that have been adopted and adapted from the national model code standards to meet California conditions.
- Building standards, authorized by the California legislature, that constitute extensive additions not covered by the model codes, that have been adopted to address particular California concern.

In addition, local Californian jurisdictions can modify the state energy code to be more stringent when appropriate documentation is provided to the California Energy Commission.

Compliance can be demonstrated by meeting the mandatory measures contained within the code, in addition to following either the prescriptive or performance based routes to compliance. While the performance based approach is currently only voluntary, state officials expect subsequent versions of the code to increasingly move toward requiring performance based analysis to be undertaken. Current expectations are that a performance based approach will become mandatory in the 2013 update.

Mandatory Requirements

The mandatory measures within the code require, among other standards, minimum insulation, HVAC-R, lighting and water heating efficiencies to be met. Regardless of which approach to compliance is subsequently followed, the minimum performance standards outlined in the mandatory requirements must be achieved.

Prescriptive Approach

As the simplest route to achieving compliance, the prescriptive approach requires each individual energy component within the building (for example building shell elements or HVAC equipment) to meet a prescribed minimum efficiency. The code covers all aspects of a building’s design (and in some instances, construction) including, but not limited to the building envelope (insulation and fenestration), indoor and outdoor lighting, domestic hot water heating, and HVAC-R systems. In some instances, following the prescriptive route to compliance requires more stringent elemental methods than those outlined in the mandatory measures.

Performance Based Approach

Using the performance based approach, the annual Time Dependent Valuation (TDV) energy use of the proposed design must be shown to be less than or equal to the annual TDV energy use of the standard design. The standard design is defined as a building like the proposed design, but one that complies exactly with the mandatory measures and prescriptive requirements. Since 2005, TDV energy, rather than source energy has been required for this calculation. This approach values energy use differently depending on the time it is used (for example during periods of peak demand, when energy use is more costly than energy used during the periods of lowest demand).

Following the California electricity crisis of 2001, the Energy Commission has placed additional emphasis on demand reductions, hence the requirement to assess the TDV energy instead of source energy, which is the approach taken by most existing performance based building codes. The 2001 revision of the code helped to reduce peak electricity demand by approximately 150MW each year, with an additional 180MW (i.e. 330MW total) per year achieved through the 2005 revision.

Post Construction (In Operation) Performance

There are no explicit provisions in Title 24 related to the measured energy use of commercial or residential buildings. Upon the sale of a residential home, however, a buyer may request a home energy assessment which could include an inspection of insulation R-values in attics, roofs, walls, floors and heating and cooling ducts; an assessment of window types; an assessment of the age, fuel type and efficiency ratings of heating and cooling equipment, water heating efficiencies and the efficiencies of other major appliances; and an inspection of the general integrity and air leakage through walls, windows, doors and duct systems. Comprehensive energy inspections are not required under State law. Since October 2005, however, dwellings located away from the coast in climate zones specified by the Energy Commission must have their ducts pressure tested, sealed and verified by a HERS (Home Energy Rating System) rater whenever heating or cooling equipment is replaced. According to staff at the Energy Commission, this has helped to reduce average duct leakage in homes from over to 20% to around 6%, with associated improvements in energy efficiency.

2. ENERGY EFFICIENCY POTENTIAL

2.1. Policy Uptake

Compliance with Title 24 is mandatory for all new construction projects in the state of California. The code applies to all residential and non-residential new construction projects and refurbishment projects requiring a permit. Consequently, changes to Title 24 have far reaching effects on energy use in the state.

2.2. Energy Savings Potential

As there is no requirement in the code pertaining to the actual measured energy performance of buildings, detailed historical energy savings data is not readily accessible. Despite this, some energy bill and modeling analysis has been undertaken which indicates that 2005 code compliant non-residential buildings are approximately 11% more energy efficient than buildings constructed under the 2001 standard. For residential buildings, increased efficiencies of approximately 13% are seen. For the 2008 revision of the code, energy savings of approximately 8% for non-residential buildings and 13% to 15% for residential buildings are expected to be achieved, compared to the 2005 version of the code. Since its inception, Title 24 is estimated to have saved more than $56 billion in electricity and gas costs within the state. It is estimated an additional $23 billion of energy will be saved through 2013. The Energy Commission's route map points toward achieving carbon neutrality through the code by 2020, though no plan detailing the incremental requirements to meet this target has been published.

Staff at Consol Energy Consultants noted that the true energy savings potential of the code is often compromised in the field by poor construction and enforcement practices in the state. Anecdotal evidence suggests that building efficiencies are typically up to 10% lower than anticipated at the design stage due to poor quality construction and installation practices and a lack of strong enforcement practices. It was noted that, while State inspection staff are trained and available, there is insufficient travel budget to enable them to carry out inspections across the State.

3. COST OF IMPLEMENTATION

3.1. Program Cost

A team of 20 people administers updates to the code in three to four year cycles. State officials expect this number to increase to approximately 40 people within the next few years as the State energy code regulations move toward a performance based program, with comprehensive greenhouse gas mandates aimed at achieving carbon neutrality in new buildings by 2020. Not all of these staff are involved directly in the implementation and development of Title 24 on a full time basis, as staff are distributed across all areas of building regulation development. Updates to smaller, less controversial aspects of the code are carried out within the commission; however, more substantial revisions are contracted out to external analysts. As updates to Title 24 are carried out as part of the State's cyclic code update program, detailed cost data for each revision is not readily available, though as the standard becomes more stringent, officials expect development and administration costs to substantially increase.

3.2. Cost to the Developer

Prior to implementation of the code, the city must carry out detailed life cycle costs analysis to demonstrate that any policies they are putting forward are cost effective. Rob Hammon of Consol Energy Consultants estimates that for an increase in code stringency of between 15% and 20%, construction costs are increased by approximately $2000 to $2500 per home (typically 1% to 2% of construction costs). Costs increases for commercial buildings are more difficult to ascertain due to the wide range in size and type of non-residential buildings. Anecdotal evidence similarly suggests that a 1% and 2% increase in construction costs would result from increasing the code stringency between 15% and 20%. Detailed data regarding increases in construction costs is not collected by Energy Commission.

4. ADMINISTRATIVE FEASIBILITY

4.1. Administering Agency

The code is administered by the California Energy Commission. Compliance with the code is overseen by local building officials and inspectors.

4.2. Ease of Initiation

As Title 24 is updated cyclically in 3-4 year intervals, updated versions of the code have traditionally been relatively easy to implement. According to state officials, however, the implementation process of recent versions of the code has become increasingly more difficult due to the escalating technical requirements in each subsequent revision of the code. It was also noted that the more technically challenging the standard, the more difficult it was to get the building industry in the State to understand and adopt to its requirements. Education and outreach is likely to become increasingly important and wide ranging with future revisions, particularly if a performance based compliance route is mandated in 2013.

4.3. Educational Outreach Requirements

According to Commission officials, countless different types of education and outreach programs have been conducted on the code. Currently, Title 24 compliance training is conducted through the State's utility companies and is unrelated to the Energy Commission. The State has approximately $1MM per year for education and outreach activities; however this is not consistent year upon year. Education and outreach requirements are higher at the time before and around a new revision of the code and decrease throughout the lifespan of the code revision.

5. STAKEHOLDER IMPACTS

5.1. Acceptability to the Building Industry

The State involved stakeholders throughout the development process; maintaining a strong dialogue with California building industry associations through personal relationships and ad-hoc consultation with industry representatives. This approach was taken in order to allow the State to consult with the building industry to develop "reasonable measures" which are achievable by builders and developers alike. It was also noted by State officials that there are often contradictory requirements between local building departments and the building community regarding new code standards. While it is often advantageous to give the industry flexibility in meeting code requirements (as this allows new legislation to be more easily introduced), this approach often causes difficulties for building inspectors in enforcing code standards. As such, it was noted by State officials that it was vital to consider the enforceability of any new standards being proposed, in order to not burden building officials with unenforceable standards.

During the 2008 code development process, it was reported that there was significant opposition to some of the more far reaching requirements. Eventually, the State removed some of these to get industry approval. For instance, requirements for "programmable communicating thermostats" (PCTs) faced such backlash from the media, consumer groups and the general public that the requirements were dropped altogether. Requirements pertaining to the urban heat island effect and in particular the provision of "cool roofs" were also dropped due to concern from the product industry about the feasibility of supplying such roofing systems to all new building's in the State, in addition to opposition from builders and developers relating to the costs of installing cool roof systems on all buildings. Requirements related to the provision of radiant barriers were also removed during the industry consultation process, primarily due to concerns from builders relating to the cost of installing radiant barriers on all new construction projects.

Other areas of contention have been ongoing with industry for a number of years. Requirements relating to the provision of exterior shading screens were intended to be included several years ago, but opposition from the architectural and developers communities led to the requirements being removed, largely due to the threat from the industry that, if screens were mandated in the code, they would be installed for the purposes of being code compliant but immediately removed following building department approval. New legislation requiring shading screens to be permanently installed was also rebuked by the industry, due to concerns from the design community that screens would not necessarily fill in with the aesthetic or technical requirements of projects. Although legislation was never introduced, Energy Commission Officials reported that shading screens are now becoming voluntarily more commonplace on new buildings in the State.

According to Rob Hammon at Consol, in recent years there has been a move from an adversarial relationship between builders and developers to a more collaborative relationship, as the industry and the Energy Commission work together to ensure the code is satisfactory to all parties. The industry is generally concerned that the code be as cost effective and practical to implement as possible. Their concerns also extend to impacts in the market; industry is worried that stringent and costly code revisions will increase the cost of leasing or buying new buildings compared to existing buildings. It was also noted that there was some concern from the building sector that increasing the stringency of the code (with associated increases in costs for builders complying with the code) would, without proper enforcement, lead to a “black market” of “cowboy” builders undercutting more reputable builders by not fully complying with the code requirements.

6. REFERENCES

Rob Hudler, California Energy Commission

Rob Hammon, Consol Energy Consultants

United States Government Accountability Office

GAO

Report to Congressional Requesters

CARBON OFFSETS

The U.S. Voluntary Market Is Growing, but Quality Assurance Poses Challenges for Market Participants

G A O

Accountability * Integrity * Reliability

GAO-08-1048

August 2008

CARBON OFFSETS

The U.S. Voluntary Market Is Growing, but Quality Assurance Poses Challenges for Market Participants

GAO Accountability•Integrity•Reliability

Highlights

Highlights of GAO-08-1048, a report to congressional requesters

Why GAO Did This Study

Carbon offsets—reductions of greenhouse gas emissions from an activity in one place to compensate for emissions elsewhere—are a way to address climate change by paying someone else to reduce emissions. To be credible, an offset must be additional—it must reduce emissions below the quantity emitted in a business-as-usual scenario—among other criteria. Assessing credibility is inherently challenging because it is difficult to make business-as-usual projections. Outside the U.S., offsets may be purchased on compliance markets to meet requirements to reduce emissions. In the U.S., there are no federal requirements and offsets may be purchased in the voluntary market.

GAO was asked to examine (1) the scope of the U.S. voluntary carbon offset market, including the role of the federal government; (2) the extent to which mechanisms for ensuring the credibility of offsets are available and used and what, if any, related information is shared with consumers; and (3) trade-offs associated with increased oversight of the U.S. market and including offsets in climate change mitigation policies. This report is based on analysis of literature and data, interviews with stakeholders, and GAO's purchase of offsets.

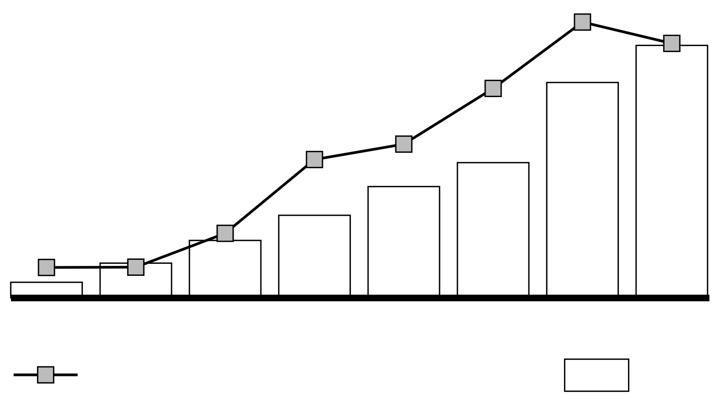
GAO is not recommending executive action. However, as it considers legislation that allows the use of offsets for compliance, Congress might consider, among other things, directing the establishment of standardized quality assurance mechanisms.

To view the full product, including the scope and methodology, click on GAO-08-1048. For more information, contact John B. Stephenson at (202) 512-3841 or stephensonj@gao.gov.

What GAO Found

The scope of the U.S. voluntary carbon offset market is uncertain because of limited data, but available information indicates that the supply of offsets generated from projects based in the United States is growing rapidly. Data obtained from a firm that analyzes the carbon market show that the supply of offsets increased from about 6.2 million tons in 2004 to about 10.2 million tons in 2007. Over 600 organizations develop, market, or sell offsets in the United States, and the market involves a wide range of participants, prices, transaction types, and projects. The federal government plays a small role in the voluntary market by providing limited consumer protection and technical assistance, and no single regulatory body has oversight responsibilities.

U.S. Supply of Voluntary Offsets by Volume and Number of Projects from 2000 through 2007



A variety of quality assurance mechanisms, including standards for verification and monitoring, are available and used to evaluate offsets, but data are not sufficient to determine the extent of their use. Information shared with consumers on credibility is also limited. Participants in the offset market face challenges ensuring the credibility of offsets, including problems determining additionality, and the existence of many quality assurance mechanisms. GAO, through its purchase of offsets, found that the information provided to consumers by retailers offered limited assurance of credibility.

Increased federal oversight of the U.S. voluntary market could enhance the market's transparency and improve consumer protection, but may also reduce flexibility, increase administrative costs, and stifle innovation, according to certain stakeholders. Including offsets in regulatory programs to limit greenhouse gas emissions could also lower the cost of compliance, according to recent EPA analyses and economic literature. However, some stakeholders said that concerns about the credibility of offsets could compromise the environmental integrity of a compliance system.

Tables

Figures

Abbreviations

CAO	U.S. House of Representatives Office of the Chief Administrative Officer
CCBS	Carbon Capture and Biological Storage
CCGS	Carbon Capture and Geological Storage
CCX	Chicago Climate Exchange
CFTC	Commodity Futures Trading Commission
DEFRA	United Kingdom Department for Environment, Food, and Rural Affairs
ECM	Exempt Commercial Market
EIA	Energy Information Administration
EPA	Environmental Protection Agency
EU	European Union
FTC	Federal Trade Commission
FWS	U.S. Fish and Wildlife Service
NFF	National Forest Foundation
REC	Renewable Energy Certificate
UK	United Kingdom
USDA	United States Department of Agriculture

United States Government Accountability Office
Washington, DC 20548

August 29, 2008

Congressional Requesters

Carbon offsets provide a way for individuals, businesses, and governments to address concerns about the impact of their greenhouse gas emissions on the earth's climate by paying others to undertake activities that reduce, avoid, or sequester greenhouse gases.[1] A carbon offset can be defined as a measurable reduction of greenhouse gas emissions from an activity or project in one location that is used to compensate for emissions occurring elsewhere. For example, a U.S. manufacturer might offset its emissions by funding an external project that captures methane, a greenhouse gas emitted from agricultural sources and landfills. The emissions reduced, avoided, or sequestered by such projects are collectively termed carbon offsets, though they may involve different greenhouse gases.[2]

Carbon offsets are a potentially attractive option for those interested in addressing concerns about climate change because they can offer a potentially low-cost and convenient means of reducing, avoiding, or sequestering greenhouse gas emissions relative to other options, such as altering manufacturing processes or using less fossil fuel.[3] At the same time, consumers of offsets need assurance that buying an offset has the same effect on emissions as if they had decided to reduce emissions on

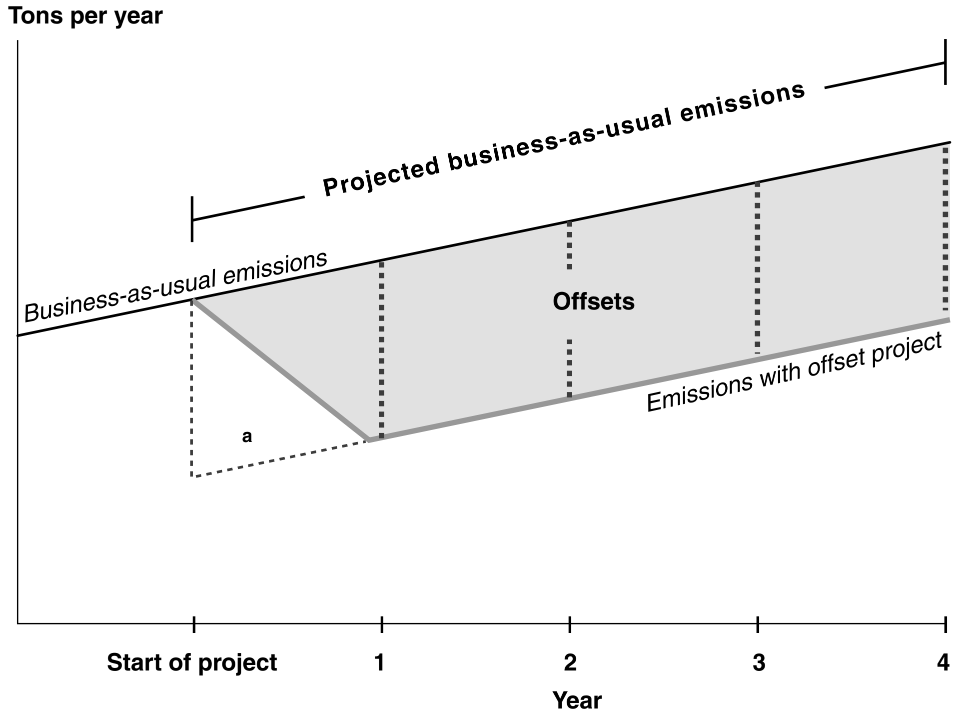
[1]Major greenhouse gases include carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and synthetic gases: hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6).

[2]Carbon offsets are typically quantified and described in terms of metric tons of carbon dioxide equivalent. A metric ton equals 2,205 pounds, while a short ton, a measurement used in the United States, equals 2,000 pounds. Unless otherwise specified, this report uses metric tons. Carbon dioxide equivalents provide a common standard for measuring the warming potential of different greenhouse gases and are calculated by multiplying the emissions of the non-carbon dioxide gas by its global warming potential, a factor that measures its heat-trapping ability relative to that of carbon dioxide.

[3]In 2006, carbon dioxide released from the burning of fossil fuels accounted for approximately 78 percent of human-caused greenhouse gas emissions in the United States. The remaining 22 percent of emissions included carbon dioxide from nonenergy use of fossil fuels and iron and steel production; methane from landfills, coal mines, oil and gas operations, and agriculture; nitrous oxide from fossil fuels, fertilizers, and industrial processes; and other synthetic gases emitted from industrial sources, such as sulfur hexafluoride and perfluorocarbons, from the production of magnesium and aluminum.

their own. Providing this assurance is inherently challenging because it involves measuring the reductions achieved through an offset project against a projected baseline of what would have occurred in its absence. For example, if a facility that emitted 200 tons of carbon dioxide per year implemented a project that reduced its emissions by 100 tons, it may have created 100 tons of offsets. See figure 1 for a hypothetical depiction of an offset project measured against a projected business-as-usual scenario.

Figure 1: Hypothetical Depiction of Offset Project Measured against Business-as-Usual Scenario



Source: GAO.

Notes: Business-as-usual emissions could be stable, increase, or decrease over time depending upon the source.

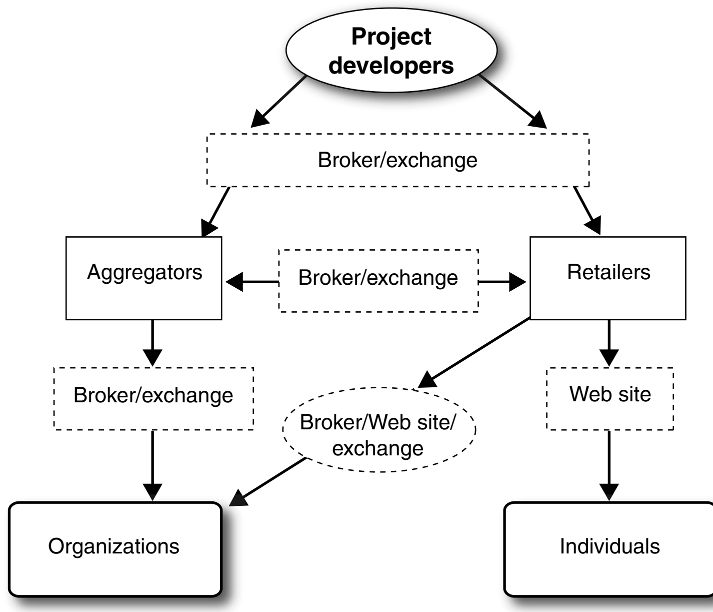
The shaded area in the diagram represents carbon offsets generated from the project.

[a]Emissions reductions from an offset project could occur immediately or gradually over time, depending upon the project type.

Although definitions differ, our review of literature and discussions with stakeholders identified four general criteria for credible offsets: They must be additional, quantifiable, real, and permanent. A carbon offset project is generally considered "additional" if it decreases emissions of greenhouse gases below the quantity that would have been emitted in a projected business-as-usual scenario. “Quantifiable” means the reductions can be measured, and “real” means the reductions can be verified. “Permanent” means the emissions reduced, avoided, or sequestered by a project will not be released into the atmosphere in the future. In addition, it is important to ensure that double-counting of a particular offset does not occur, where multiple purchasers use the same offset. Participants in the offset market may use a variety of quality assurance mechanisms to substantiate the credibility of offsets. Market participants may also track the sale and ownership of offsets by using one of several registries. The use of a registry may help participants share details about offsets available for purchase on the market.

Participants in the offset market include project developers, who identify and perform actions that reduce, avoid, or sequester emissions; third party verifiers, who ensure that projects adhere to relevant quality assurance mechanisms; intermediaries, including aggregators, who buy offsets and bundle them into larger quantities for resale; and retailers, who market and sell offsets to consumers, including organizations and individuals. Other participants include brokers and exchanges, which facilitate transactions between buyers and sellers. Participants may play multiple roles. For example, a single company may develop projects, purchase offsets from other developers, and market offsets to consumers. Project developers may also skip steps in the supply chain and sell directly to consumers. Figure 2 illustrates a generalized carbon offsets supply chain.

Figure 2: Generalized Carbon Offsets Supply Chain



Source: GAO based on Ricardo Bayon, Amanda Hawn, and Katherine Hamilton, *Voluntary Carbon Markets*, (Sterling, Virginia: Earthscan).

Note: Dashed boxes illustrate optional steps. Quality assurance mechanisms may be employed at multiple stages of the supply chain.

Some carbon offsets are purchased by entities that are subject to legal requirements to decrease their greenhouse gas emissions, such as the European Union's (EU) Emissions Trading Scheme.[4] In such cases, the market for offsets is referred to as a "compliance market." In contrast, the U.S. market is a "voluntary market," and purchasers are not required to limit their emissions or purchase offsets. However, the Congress is considering several proposals for limiting greenhouse gas emissions that would enable regulated entities to rely, in part, on offsets for compliance in a fashion similar to the European Union's program. Offsets also may play a role in U.S. state and regional programs that are under development.

[4]The EU's program to limit greenhouse gas emissions enables regulated entities to use certain types of offsets, including Clean Development Mechanism (CDM) credits, for compliance. The CDM, administered by the United Nations, is part of the Kyoto Protocol. CDM enables industrialized countries to achieve emissions reductions by paying for certified emission reduction credits, each equivalent to one metric ton of carbon dioxide, from projects in developing countries. GAO is reviewing the European Union's program and the CDM in a report that we will issue later in 2008.

A brief description of certain international and domestic programs is provided in appendix VI.

In the United States, market participants may purchase offsets through the Chicago Climate Exchange (CCX) and on the retail market, which includes transactions that occur outside of a formal exchange. CCX is a voluntary greenhouse gas reduction and trading system through which members make legally binding commitments to reduce their emissions.[5] In addition to these members, the CCX platform is also available to offset providers, who may register tons on CCX that represent various greenhouse gas reduction projects. CCX participants may trade offsets generated from qualifying emissions reduction projects. According to CCX, to verify the validity of offsets offered for sale on the exchange, and ensure that the underlying offset projects conform to CCX rules, all tons registered for sale have been verified by approved third party verification firms that are specialized in particular fields. Further, in addition to other quality assurance procedures, CCX market participants use a registry to help track purchases and sales of offsets acquired or sold on the exchange. In contrast to exchange trading, which occurs through platforms designed to facilitate trades on a larger scale, retail sales typically involve transactions directly between two parties. However, certain retailers buy offsets through CCX and retire them on behalf of consumers.[6] In addition, offsets may be bought and sold across international borders and through Web sites.

In this context, you asked us to (1) describe the scope of the U.S. voluntary carbon offset market, including the role of the federal government; (2) analyze the extent to which mechanisms for ensuring the credibility of voluntary carbon offsets are available and used, and what, if any, related information is shared with consumers; and (3) assess the trade-offs associated with increasing the federal oversight of the U.S.

[5]CCX defines "legally binding" to mean that members who undertake the reduction commitment sign a contract with CCX that requires them to abide by the CCX rulebook, submit their emissions data to a standardized data review by Financial Industry Regulatory Authority (FINRA), and be subject to the various governance committees of CCX for a stipulated and fixed period of membership. CCX Phase I required compliance from 2003 to 2006 and Phase II from 2007 to 2010.

[6]The term "retirement" refers to the permanent recorded disposition of an offset after which it cannot be resold or otherwise used by any entity to facilitate, enable, or offset any past, present, or future greenhouse gas emission.

voluntary carbon offset market and incorporating offsets into broader climate change mitigation policies.

In conducting our work, we reviewed available government and trade literature related to carbon offset markets and conducted semistructured interviews with nonprobability samples of stakeholders, including providers, third party verifiers, and other knowledgeable stakeholders.[7] To respond to the first objective, we interviewed officials responsible for offset-related programs at the departments of Agriculture (Forest Service), Energy (Energy Information Administration), and Interior (U.S. Fish and Wildlife Service), as well as the Commodity Futures Trading Commission (CFTC), the Environmental Protection Agency (EPA), the Federal Trade Commission (FTC), and the U.S. House of Representatives Office of the Chief Administrative Officer (CAO). We also met with, among others, representatives of the Council on Environmental Quality and officials responsible for managing state and regional greenhouse gas mitigation programs. To obtain detailed information about carbon offset projects in the United States, we purchased and analyzed data from Point Carbon, a provider of independent carbon market news, analysis, and consulting services.[8] We assessed the reliability of these data and determined that they were sufficiently reliable for the purposes of this report. In addition, to respond to the second objective, we purchased offsets from a nonprobability sample of retail providers and analyzed the materials we received in return as well as information provided on Web sites. To respond to the third objective, we reviewed available economic literature and information collected through stakeholder responses to semistructured interview questions. A more detailed description of our scope and methodology is presented in appendix I. We conducted our work from July 2007 to August 2008.

[7]Nonprobability samples cannot be used to generalize or make inferences about a population. In this instance, we cannot generalize the results of our interviews to all carbon offset market participants.

[8]These data represent a conservative estimate of supply because Point Carbon estimates that its database accounts for approximately 80 percent of the offsets generated from projects located in the United States based on its analysis of domestic and global carbon markets.

Results in Brief

The scope of the U.S. voluntary carbon offset market is uncertain because complete data on the volume of transactions do not exist, but available information shows that the supply of offsets generated from projects based in the United States is growing rapidly. In addition, the role of the federal government in the market is generally limited to certain consumer protection and technical assistance efforts, although several agencies facilitate offset projects or purchase offsets as part of efforts to address the environmental impacts of their operations. Over 600 entities develop, market, or sell offsets in the United States, and the exchange of offsets may involve a wide range of participants, prices, transaction types, and projects. Data on the total volume of offsets traded in the United States are not available and the market's transparency is limited. Despite the lack of complete data on the overall volume of transactions, available data show a significant increase in the supply of offsets generated in the United States. Specifically, the supply has increased approximately 66 percent, from about 6.2 million tons in 2004 to about 10.2 million tons in 2007. Furthermore, the supply is concentrated in a handful of states—projects in Texas and Virginia accounted for 34 percent of the total volume in 2007—and about 49 percent of the offsets were generated from projects that involved methane, a potent greenhouse gas. While data on the average price of offsets paid by U.S. consumers were not available, prices paid on the global market ranged from $1.83 per ton to $306 per ton in 2007, with a volume-weighted average of $6 per ton, according to a 2007 report by two market research organizations. The federal government plays a small role in the voluntary market, and no single regulatory body has oversight responsibility. The CFTC, EPA, and FTC, among others, have undertaken some consumer protection and technical assistance efforts. In addition, the Forest Service and the Fish and Wildlife Service are involved in partnerships that may result in the generation of offsets on public lands, and the Chief Administrative Officer of the House of Representatives has purchased offsets as part of the House's efforts to address its environmental impacts. While federal oversight is limited, offset transactions are subject to applicable state fraud and consumer protection laws, which are generally enforced by each state's attorney general.

A variety of quality assurance mechanisms are available and used in the U.S. voluntary offset market, but the extent of their use is uncertain. In addition, our purchase of offsets from a nonprobability sample of retailers found that the information given to consumers provided limited assurance of credibility. Available data show that many carbon offsets in the voluntary market were subject to some quality assurance mechanisms, but the data are not sufficient to determine the extent of their use. The available information suggests that fewer providers use registries to track the ownership and disposition of offsets than use third party verification or other quality assurance mechanisms. Participants in the offset market face several challenges to ensuring the credibility of offsets, including problems determining additionality, and the existence of many quality assurance mechanisms for verification and monitoring. The lack of comprehensive data on the use of quality assurance mechanisms and differences in the substance and application of these mechanisms limit the market's transparency and raise questions about whether offsets are interchangeable commodities. To understand the perspective of consumers, we purchased offsets from 33 retail providers and found that the information they provided about the offsets varied considerably and offered limited assurance of credibility. Specifically, 3 of 33 retailers provided information related to the additionality of the underlying projects along with our purchase, and only 9 provided information related to the use of quality assurance mechanisms, including verification and monitoring. A majority of the providers, however, did provide further information on their Web sites that was not directly related to our transactions. Overall, we did not always obtain sufficient information to understand exactly what we received as a result of the transaction, and other consumers may face similar challenges with their transactions.

Increased federal oversight of the U.S. voluntary market could address some concerns about the credibility of offsets, but would likely increase costs for providers and consumers. Similarly, including offsets in regulatory programs intended to limit greenhouse gas emissions could lower the cost of compliance, but may make it more difficult to ensure that the programs achieve their goals. Greater oversight of the U.S. voluntary market could increase the credibility of offsets and enhance consumer protection, according to certain stakeholders and the available literature. However, more oversight could reduce flexibility and increase the administrative burden on providers, which could raise costs and stifle innovation. Using offsets in a mandatory emissions reduction program would involve similar trade-offs. Specifically, offsets could lower the cost of compliance, encourage investment and innovation in sectors not required to reduce emissions, and provide time for regulated entities to change existing technologies. Recent EPA analyses state that the cost of compliance with proposed greenhouse gas legislation decreases considerably as the allowable use of offsets increases. This is because it is often cheaper for regulated entities to pay for offsets than to make reductions themselves. Several stakeholders said that using offsets for compliance could also give regulated entities increased flexibility to meet emissions reduction requirements and could give them time to implement long-term plans and develop new technologies. However, any use of offsets for compliance that lack credibility would undermine the achievement of the program's goals. In addition, some stakeholders said that the availability of low-cost offsets could discourage regulated entities from investing in technology to reduce their own emissions. Finally, the stakeholders varied in their views on the extent to which regulated entities should be allowed to rely on offsets in a compliance scheme.

We are not recommending executive actions. However, as the Congress considers legislation intended to limit greenhouse gas emissions that allows the use of carbon offsets for compliance, it may wish to incorporate provisions that would direct the relevant federal agency (or agencies) to establish (1) clear rules about the types of offset projects that regulated entities can use, as well as standardized quality assurance mechanisms for these allowable project types; (2) procedures to account and compensate for the inherent uncertainty associated with offset projects, such as discounting or overall limits on the use of offsets for compliance; (3) a standardized registry for tracking the creation and ownership of offsets; and (4) procedures for amending the offset rules, quality assurance mechanisms, and registry, as necessary, based on experience and the availability of new information over time.

The U.S. Voluntary Market Is Growing Rapidly with Limited Federal Oversight

Over 600 organizations develop, market, or sell offsets in the United States, and the market involves a wide range of participants, prices, transaction types, and projects. While the exact scope of the U.S. voluntary market is uncertain because of a lack of complete data, available information shows that the supply of offsets generated in the United States has increased by about 66 percent over the last 3 years, from about 6.2 million tons in 2004 to about 10.2 million tons in 2007. The federal government plays a small role in the U.S. market. While no single regulatory body oversees the market, FTC and EPA, among others, have undertaken some consumer protection and technical assistance efforts. In addition, certain federal entities participate in the market as providers and consumers. For example, the Forest Service works with a nonprofit partner that solicits donations to support forestry projects.

The Market Includes a Range of Participants, Prices, and Transaction Types

A wide range of participants are involved in the U.S. voluntary market, including providers of different types of offsets, developers of quality assurance mechanisms, third party verifiers, and consumers who purchase offsets from domestic or international providers. According to available data, more than 600 entities are involved in the supply of offsets in the United States, including companies, governments, colleges and universities, and other organizations.

- Offset providers include project developers and intermediaries. We identified 210 offset providers of various types, including 87 U.S.-based providers. Project developers implement individual projects and may sell offsets directly to consumers or to intermediaries. Intermediaries are further subdivided into retailers, aggregators, and brokers, among other categories. Retailers generally sell smaller quantities of offsets to individuals or organizations. Aggregators, also known as wholesalers, sell in bulk and often own a portfolio of offsets. Brokers facilitate transactions between sellers and buyers. Providers obtain the rights to the offsets they sell in a number of ways, including developing their own projects or purchasing directly from project developers, sometimes through brokers. Other providers purchase and retire offsets through CCX on behalf of customers. Providers may also play multiple roles in the offset market. For example, a single company may develop projects, aggregate offsets from other projects or providers for resale, and sell offsets directly to consumers. In addition, other entities, including investment banks and other financial institutions, support the development of projects through financing.

- Quality assurance providers include those involved in activities such as verification and monitoring of offset projects, and the development of quality assurance mechanisms such as accounting standards for calculating offsets. Project developers may use a third party verifier to confirm that offsets generated by a project were accurately calculated. Once verified, the offset might then be recorded by another independent party in a registry to track its sale and ownership. Multiple registries operate in the United States to help market participants track the ownership and retirement of offsets, although not all offsets are listed on registries.

- A wide variety of consumers buy offsets, including individuals, businesses, nonprofits, governments, research institutions, universities, religious congregations, utilities, and other organizations. Consumers' motivations for purchasing offsets may include corporate responsibility and public relations, among others. Consumers may purchase offsets to compensate for emissions that result from a variety of activities including flying, driving, and purchasing consumer products.

Offsets sell on the market at a wide range of prices. In 2007, prices on the global voluntary market ranged from $1.83 per ton to about $306 per ton, with an average of about $6 per ton, according to one recent market study.[9] We purchased offsets from 33 retail providers, both domestic and international, and prices ranged from about $5 per ton to about $31 per ton. CCX prices were at their lowest in 2004, at $0.79 per ton, but recently peaked at $7.40 per ton in June 2008.[10]

There are also different types of carbon offset transactions, including direct purchase and payment or donation in support of a service. The difference between these transactions is whether the offsets are sold as a commodity. In a direct purchase, consumers pay for the delivery of offsets as a commoditized economic good. Direct purchases may allow the consumer to evaluate the parameters of the offset project, including how verification and monitoring methodologies were employed to create the offset. When the transaction does not involve the exchange of a commodity, consumers pay or donate money to a provider to support the retirement of offsets or the development of new offset projects, but the consumer does not own an asset after the transaction has been completed. In this case, the payment or donation amounts to a promise by the provider to supply the service of purchasing offsets or supporting offset projects. Donations may be tax deductible, effectively reducing the cost of the carbon offset.

Another key distinction involves the timing of an offset's creation. In cases where offsets are sold before they are produced, the quantity of offsets generated from projects can be calculated using what is known as ex-ante (or future value) accounting. On the other hand, when offsets are sold after they are produced, the quantity of offsets can be calculated using ex-post accounting. Using future value accounting, consumers may purchase an offset today, but it may take several years before the offset is generated.

---

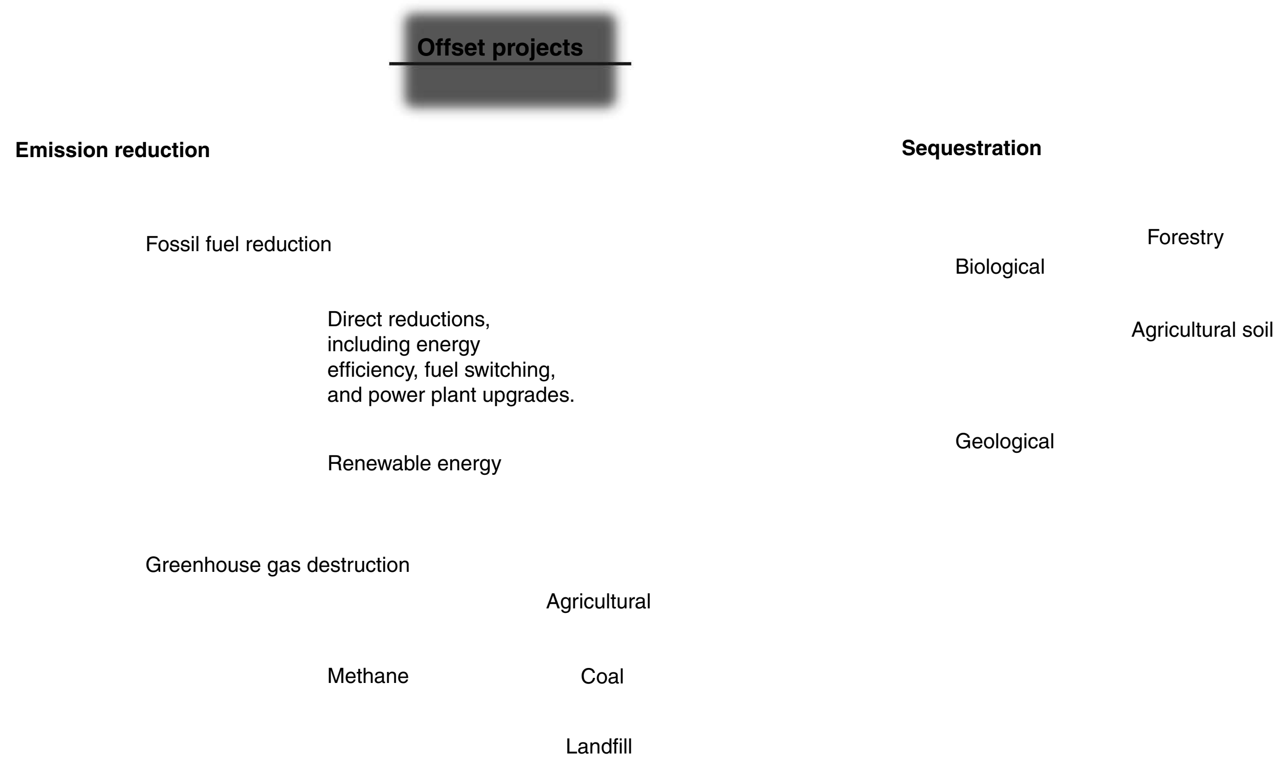
[9]Katherine Hamilton, Milo Sjardin, Thomas Marcello, and Gordon Xu, *Forging a Frontier: State of the Voluntary Carbon Markets 2008* (Ecosystem Marketplace and New Carbon Finance: May 2008). This report said that the $306 per ton price resulted from one particularly high transaction. The sponsors of Ecosystem Marketplace include, among others, organizations that facilitate projects to reduce, avoid, or sequester greenhouse gas emissions. Prices are reported in 2008 U.S. dollars.

[10]See http://www.chicagoclimatex.com/market/data/summary.jsf for CCX market information. Prices are reported in 2008 U.S. dollars.

Project Developers Generate Offsets from a Wide Range of Activities

In addition to a range of participants, project developers generate offsets from different types of projects by either reducing emissions at the source or through sequestration. Emission reduction projects involve either fossil fuel projects based on changes in energy production and use practices—such as energy efficiency, fuel switching, power plant upgrades, and certain renewable energy projects—or greenhouse gas destruction projects, including projects that capture and destroy methane from coal mines, landfills, and agricultural operations. Sequestration projects include biological sequestration projects that pull carbon dioxide out of the air by, for example, planting trees or enhancing the management of agricultural soils, and geological sequestration projects that capture and store carbon dioxide in underground formations. See figure 3 for a diagram of common types of carbon offset projects, and see appendix II for descriptions of offset project types.

Figure 3: Common Offset Project Types



Source: GAO based on Ricardo Bayon, Amanda Hawn, and Katherine Hamilton, *Voluntary Carbon Markets*, (Sterling, Virginia: Earthscan).

The Scope of the Market Is Uncertain, but Supply Is Growing Rapidly

The U.S. voluntary market is part of an expanding global market, with an estimated 65 million tons sold in 2007, valued at approximately $337.3 million.[11] Complete data on the volume of offsets traded in the United States are not available, and the market's transparency is limited. Efforts to quantify and report on the voluntary carbon market have focused on the global market and include limited information focused solely on the United States. It is also difficult to separate out the U.S. portion of the global market because U.S. market participants buy and sell across domestic and international boundaries and transactions are private. However, according to one study, an estimated 23 percent of the volume sold in 2007 on the global market came from U.S. providers.[12]

While the exact scope of the U.S. voluntary carbon offset market is uncertain because of a lack of complete data, available information shows that the supply of offsets based in the United States is growing rapidly. In the last 3 years, the supply of offsets from projects based in the United States increased approximately 66 percent, from about 6.2 million tons in 2004 to about 10.2 million tons in 2007.[13] By comparison, EPA data show that U.S. greenhouse gas emissions have averaged about 7 billion tons annually since 2000. In addition, in 2007, at least 211 projects produced offsets in the United States, as compared to 93 projects in 2004, an increase of about 125 percent.[14] See figure 4 for data on the U.S. supply of offsets.

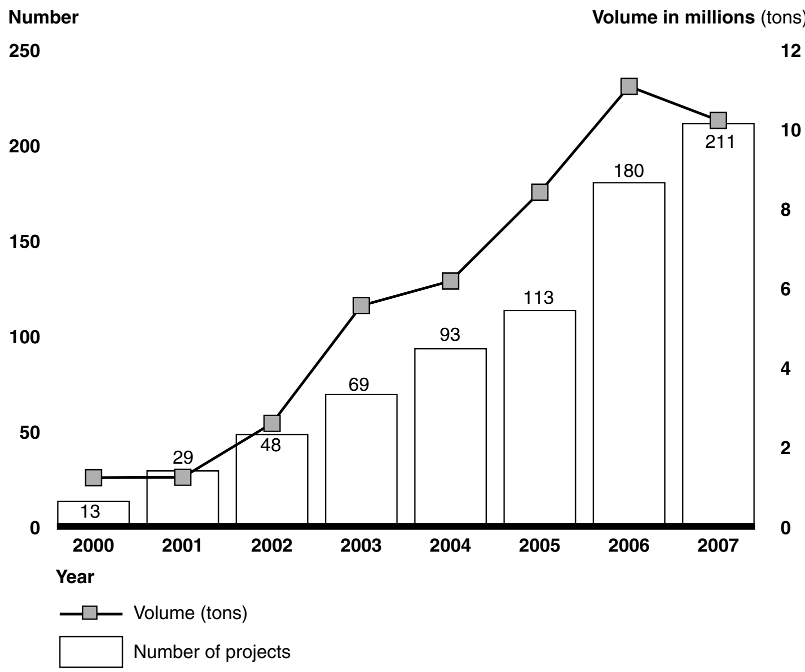
[11]Hamilton, Sjardin, Marcello, and Xu, *Forging a Frontier*. Prices are reported in 2008 U.S. dollars.

[12]Hamilton, Sjardin, Marcello, and Xu, *Forging a Frontier*.

[13]GAO analysis of Point Carbon data.

[14]GAO analysis of Point Carbon data.

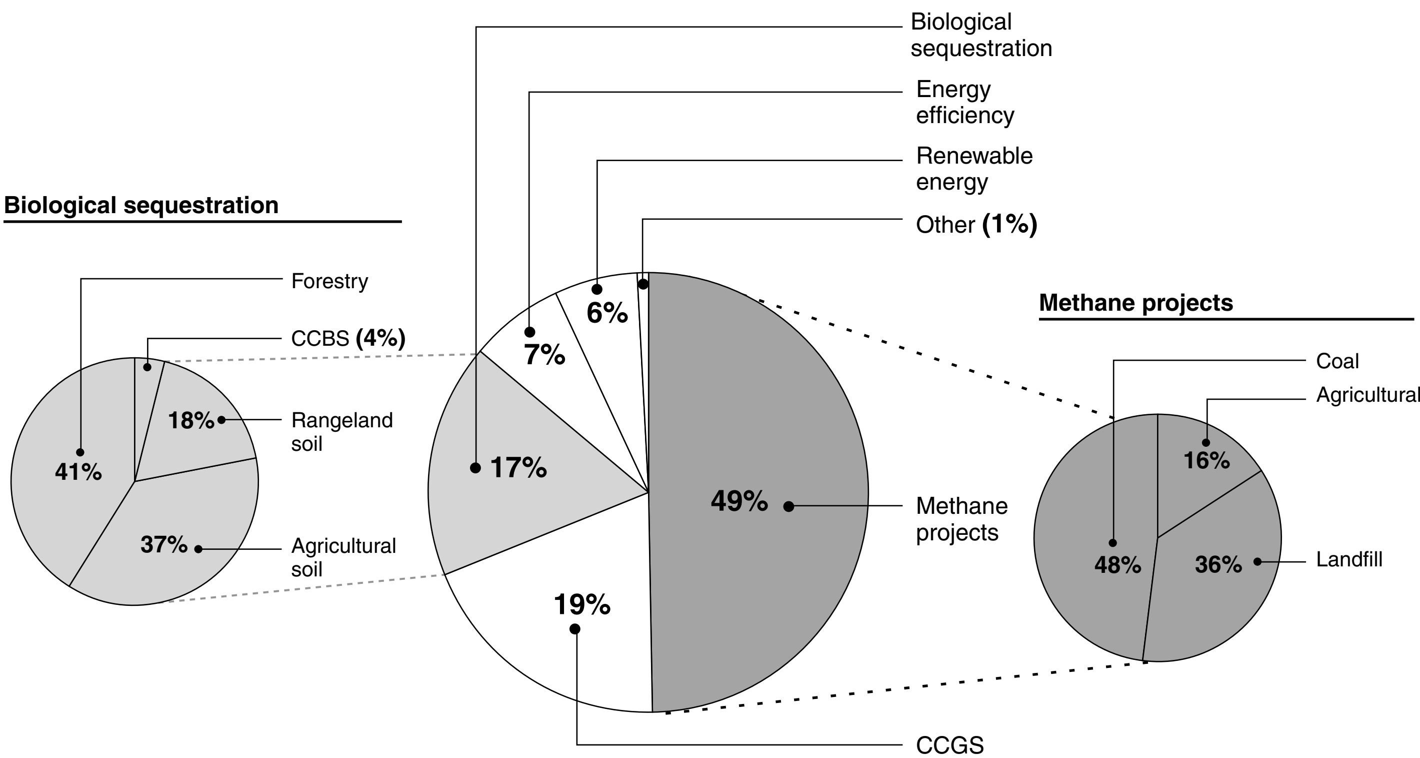
Figure 4: U.S. Supply of Offsets by Volume and Number of Projects from 2000 through 2007



Source: GAO analysis of Point Carbon data.

Of the total U.S. offset supply in 2007, about 85 percent was generated from three categories of projects: methane, carbon capture and geological storage (CCGS), and biological sequestration. About 49 percent of U.S. supply was produced from projects that capture and destroy methane from coal mines, agricultural operations, or landfills. An additional 19 percent was produced from CCGS projects that capture emissions from industrial and energy-related emissions sources and then store these emissions in geologic formations. Also, 17 percent was produced from biological sequestration projects, including agricultural soil projects such as no-till farming and forestry projects. Figure 5 illustrates U.S. offset supply by project type in 2007.

Figure 5: U.S. Offset Supply by Type of Project in 2007



Source: GAO analysis of Point Carbon data.

Notes: CCBS refers to carbon capture and biological storage. Totals may not equal 100 because of rounding.

Coal Mine Methane

Coal mines account for about 10 percent of all man-made methane emissions in the United States. Methane, a potent greenhouse gas, is contained in coal seams and presents a safety hazard for mine operators because it is explosive at certain concentrations in the air. Underground coal mines are designed and operated so that methane released during the extraction of coal is removed from the mine through powerful ventilation fans and is typically vented to the atmosphere. Utilization of recovered methane is not currently a typical operational practice at underground coal mines. However, through an offset project, such methane could be recovered and burned for its energy content or flared to reduce its heat-trapping ability when released to the atmosphere.

One factor influencing the quantity of offsets generated from a particular project is the type of greenhouse gas involved. This is because most greenhouse gases, including methane, have greater heat-trapping ability relative to carbon dioxide. Thus, the global warming potential of these greenhouse gases influences the volume of offsets generated. For example, reducing one ton of methane emissions has the same effect as decreasing 25 tons of carbon dioxide.[15] Accordingly, projects that decrease gases with high global warming potential may be attractive from a developer's perspective.

Available data show that in 2007, 93 of the 211 projects that produced offsets in the United States were methane projects.[16] Of these, 5 coal mine projects—2 percent of the total—accounted for 24 percent of the total volume generated in 2007. On the other hand, 62 biological sequestration projects (about 29 percent of the total) produced 17 percent of the supply. This includes 52 forestry projects that produced about 7 percent of total supply from U.S.-based projects. Table 1 presents U.S. project types by number, volume, and percentage of total supply in 2007.

[15]See the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

[16]GAO analysis of Point Carbon data.

Table 1: U.S. Project Types by Number, Volume, and Percentage of Total Supply in 2007

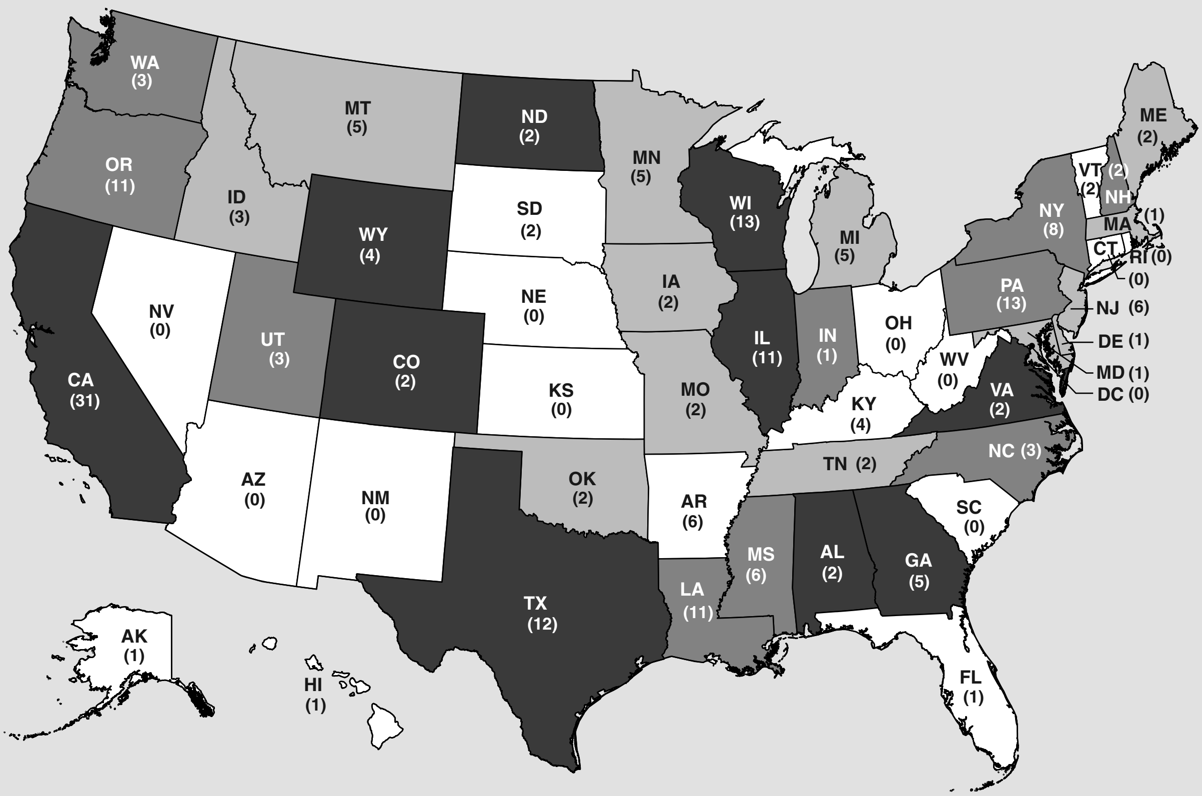
Project type	Number of projects	Percentage of total projects	Total volume	Percentage of total volume
Methane projects	93	44%	**5,044,583**	49%
Agricultural	51	24%	**798,222**	8%
Landfill	37	18%	**1,803,111**	18%
Coal	5	2%	**2,443,250**	24%
Biological sequestration	62	29%	**1,706,982**	17%
Forestry	52	25%	**693,282**	7%
Agricultural soil	7	3%	**628,700**	6%
Rangeland soil	2	1%	**310,000**	3%
Carbon capture and biological storage (CCBS)	1	<1%	**75,000**	1%
Renewable energy	33	16%	**631,073**	6%
Energy efficiency	10	5%	**701,262**	7%
Carbon capture and geological storage	7	3%	**1,977,366**	19%
Other	6	3%	**147,770**	1%
Total	**211**		**10,209,036**	

Source: GAO analysis of Point Carbon data.

Note: Totals may not equal 100 because of rounding.

In the United States, projects are located in 40 states, but 34 percent of the supply in 2007 was produced by 14 projects in Texas and Virginia. Projects in these states include high-yielding projects such as coal mine methane projects. While California had the greatest number of projects in 2007, these 31 projects accounted for about 4 percent of the total supply. Figure 6 presents the volume and number of offset projects by state, and detailed data are provided in appendix III.

Figure 6: Volume and Number of Offset Projects by State in 2007



>250,000

State	Volume (tons)
Texas	1,830,258
Virginia	1,680,500
Multiple States	727,313
Wyoming	606,082
Georgia	532,779
Alabama	500,000
Illinois	464,284
California	407,125
Colorado	403,000
North Dakota	400,000
Wisconsin	294,263

100,000 to 250,000

State	Volume (tons)
Pennsylvania	188,063
North Carolina	181,365
Washington	174,080
Oregon	168,663
New Hampshire	156,125
Louisiana	150,558
New York	149,407
Utah	121,000
Mississippi	108,340
Indiana	106,800

25,000 to 99,999

State	Volume (tons)
New Jersey	96,853
Michigan	94,691
Montana	80,410
Oklahoma	77,335
Maryland	75,000
Minnesota	72,165
Delaware	60,000
Maine	55,000
Massachusetts	53,405
Iowa	42,374
Idaho	40,773
Missouri	40,000
Tennessee	31,773

<25,000

State	Volume (tons)
Kentucky	18,400
Arkansas	12,550
South Dakota	6,084
Vermont	1,639
Alaska	360
Florida	130
Hawaii	90
Arizona	0
Connecticut	0
District of Columbia	0
Kansas	0
Nebraska	0
Nevada	0
New Mexico	0
Ohio	0
Rhode Island	0
South Carolina	0
West Virginia	0

Sources: GAO analysis of Point Carbon data; Map Resources (map).

Note: Twelve projects occur across multiple states. The data for these projects are included under the category of multiple states and not included in the volume or number of projects for the individual states involved in these projects.

The Federal Government Plays a Small Role in the Market

While no single regulatory body has oversight of the U.S. voluntary carbon offset market as a whole, offset transactions are subject to applicable state fraud and consumer protection laws, which are generally enforced by each state's attorney general. Certain federal entities provide some consumer protection and technical assistance efforts and also participate in the market as providers and consumers.

- Commodity Futures Trading Commission

  The mission of the Commodity Futures Trading Commission is to protect market users and the public from fraud, manipulation, and abusive practices related to the sale of commodity and financial futures and options, and to foster open, competitive, and financially sound futures and option markets. The CFTC exercises limited oversight over the Chicago Climate Exchange due to its status as an Exempt Commercial Market (ECM), a category established under the Commodity Futures Modernization Act of 2000. Participants in such markets, in general terms, must be large, sophisticated traders. Moreover, ECMs are allowed to trade only exempt commodities.[17] ECMs must abide by certain notification requirements and affirm annually that they continue to operate under the same parameters.

  The 2008 Farm Bill increases the CFTC's oversight of ECM contracts that serve a significant price discovery function.[18] The CFTC confirmed that CCX is eligible to operate as an ECM, but at this time, CCX's contracts have not been determined by the CFTC to serve a significant price discovery function. In cases where contracts serve a significant price discovery function, ECMs must adhere to a number of core principles, including monitoring of trading and the submission of certain data to the CFTC. Generally, CCX operates with less oversight because participants in the market are experienced. However, if the CFTC receives complaints, it can take appropriate action.

- Department of Agriculture, Forest Service

  The mission of the Forest Service, an agency within the Department of Agriculture (USDA), is to sustain the health, diversity, and productivity of

[17] According to CFTC officials, exempt commodities include emissions allowances.

[18] Price discovery refers to the process by which market prices incorporate new information.

the nation's forests and grasslands to meet the needs of present and future generations. The Forest Service works with a congressionally chartered nonprofit partner, the National Forest Foundation (NFF), to solicit donations to the Carbon Capital Fund, which provides financial support for carbon sequestration projects on lands managed by the Forest Service. The Carbon Capital Fund donations are invested in Forest Service reforestation projects to sequester carbon. According to the Forest Service, donations to the Carbon Capital Fund will be used to replant areas on national forests that have been damaged by wildfire and other natural disturbances and to demonstrate the role of forest carbon sequestration in addressing climate change. The Forest Service manages the reforestation projects and also selects the project sites by using a forest vegetation simulation model to estimate the amount of carbon that will be sequestered by prospective projects. NFF operates the fund and uses a private contractor to measure and verify offsets. The first demonstration project was planned for the summer of 2008 on the Custer National Forest in Montana and South Dakota, and projects tentatively scheduled for the summer of 2009 will take place on the Plumas and San Bernardino National Forests in California.

According to Forest Service and NFF officials, they offer no guarantees about the performance of Carbon Capital Fund projects. Donations to the fund do not transfer rights or ownership of offsets. USDA officials said that contributions to the fund are donations and do not create tradable offsets. These officials also said that donations to the Carbon Capital Fund would enable the Forest Service to plant trees, which would, in the long term, lead to carbon reductions. NFF said that it would notify donors if the forestry projects fail and that it plans to send documentation to donors, including pictures, when projects are complete. As of January 2008, a total of about $55,000 had been donated to the fund. Ten percent of the donations was set aside for third party verification and monitoring, according to NFF.

USDA also encourages the use of consistent forestry and agriculture offset methodologies by working with market participants such as the Chicago Climate Exchange and state and regional programs. For example, USDA's Natural Resources Conservation Service provided a $750,000 grant to the Chicago Climate Exchange to promote the inclusion of agriculture projects in the offset market by lowering costs and developing methodologies for calculating reductions from no-till farming and establishing a pool of project verifiers.

- Department of Energy, Energy Information Administration

  The mission of the Energy Information Administration (EIA) is to provide policy-neutral data, forecasts, and analyses to promote sound policy making, efficient markets, and public understanding regarding energy and its interaction with the economy and the environment. EIA's Voluntary Reporting of Greenhouse Gases Program, established under section 1605(b) of the Energy Policy Act of 1992, provides a means for organizations and individuals who have reduced their emissions to record their accomplishments in a registry. In 2006 and 2007, EIA revised the program to allow participants to report on offsets in certain circumstances. The revised guidelines have not yet been implemented.

- Department of the Interior, U.S. Fish and Wildlife Service

  The mission of the U.S. Fish and Wildlife Service (FWS), a bureau within the Department of the Interior, is to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people. FWS partners with companies and nonprofits to develop carbon sequestration projects on national wildlife refuges in the southeastern United States. FWS enters into these partnerships to obtain funds to restore and enhance native forest and wildlife habitat on national wildlife refuges. FWS identifies refuge lands that are important for its overall conservation goals and manages sequestration projects on these lands, but does not play a role in the calculation, verification, or monitoring of carbon offsets. Carbon sequestration projects must support the purposes of each national wildlife refuge and be consistent with refuge forest management plans. FWS negotiates additional funding commitments with partners to meet long-term operations and maintenance needs as well.

  In return for funding carbon sequestration activities related to FWS conservation goals, partners retain rights to any carbon credits that may result from the restoration projects. The partners may in turn provide their clients or donors with the opportunity to offset their carbon emissions by contributing funds to these projects. Companies involved in partnership agreements with FWS may restore or reforest refuges, or buy land identified by FWS and then gift the land back to FWS and underwrite the restoration of that land. Partners include energy companies and nonprofit land trusts. According to FWS, these partnerships have led to the addition of 40,000 acres of land to the refuge system and restored a total of 80,000 acres of wildlife habitat with more than 22 million trees. The Solicitor's Office of the Department of the Interior determined that FWS may accept donations of this kind as long as it complies with the Department of the Interior's guidelines for accepting donations and applicable laws and regulations.

- Environmental Protection Agency

  The mission of the Environmental Protection Agency is to protect human health and the environment. EPA Climate Leaders, a voluntary emissions reduction program, provides technical assistance to companies on calculating and tracking greenhouse gas emissions over time, calculating emissions reductions from offsets, and incorporating offsets into emission reduction strategies. In the Climate Leaders program, partner companies commit to reduce their impact on the environment by completing a greenhouse gas emissions inventory, setting reduction goals, and annually reporting progress to EPA. EPA also provides guidance to partners on calculating emissions reductions from offsets. For offsets to be credible, according to EPA, they must meet four key accounting principles: the offsets must be real, additional, permanent, and verifiable. Partners may choose to develop their own offset projects or purchase offsets. Offset projects must meet Climate Leaders requirements for use toward meeting a greenhouse gas reduction goal, including the use of a performance standard-based approach to quantifying emissions reductions. EPA has developed accounting methodologies for certain offset project types, including landfill gas, manure management, afforestation, transportation, and boiler replacement projects. EPA is also developing protocols for additional project types, such as coal bed methane.

- Federal Trade Commission

  The mission of the Federal Trade Commission is to protect consumers, strengthen free and open markets, and promote informed consumer choice. The Federal Trade Commission Act prohibits unfair or deceptive trade practices, including deceptive advertising. Among other things, the FTC enforces a wide variety of consumer protection laws and is evaluating the treatment of carbon offsets in its *Green Guides*, a publication designed to help advertisers avoid making false or misleading environmental marketing claims.[19] The FTC announced in November 2007 that it would conduct a regulatory review of the *Green Guides*, which were last updated in 1998 and do not currently address carbon offsets. According to the FTC,

[19] FTC, Guides for the Use of Environmental Marketing Claims 16 C.F.R. Part 260.

carbon offset marketing claims may present a heightened potential for deception because it is difficult, if not impossible, for consumers to verify the accuracy of the seller's claims. The FTC held a public workshop in January 2008 about carbon offsets to obtain input on consumer protection issues and to determine whether more direct guidance is needed. The workshop examined the emerging market for greenhouse gas emission reduction products and related advertising claims, among other issues. The FTC is reviewing the public comments obtained through the workshop but has not issued proposed changes to the guides and has not decided whether to issue guidance specifically regarding offsets.

- U.S. House of Representatives, Office of the Chief Administrative Officer

The Office of the Chief Administrative Officer provides operations infrastructure and support services for the community of about 10,000 House Members, officers, and staff. The CAO purchased 30,000 metric tons of offsets through the Chicago Climate Exchange as part of the Green the Capitol Initiative, an effort to reduce the greenhouse gas emissions from House operations. Among other measures, the Green the Capitol Initiative outlines three strategies, including (1) purchasing electricity generated from renewable sources; (2) meeting the House's heating and cooling needs by switching from using coal, oil, and natural gas at the Capitol power plant to natural gas only; and (3) purchasing offsets to compensate for any remaining carbon emissions. See appendix IV for more information about the purchase of offsets by the CAO.

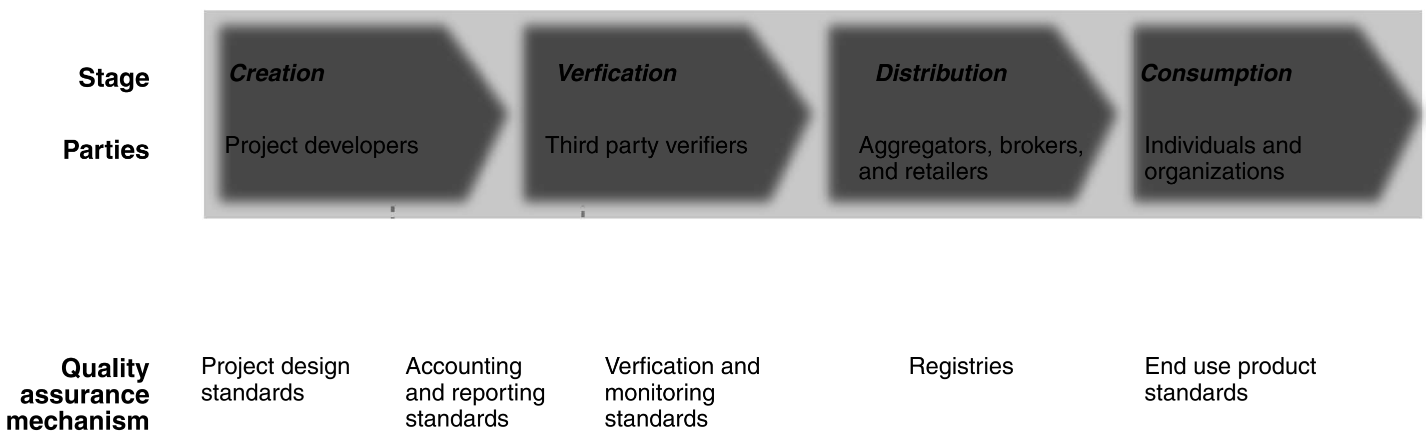
A Variety of Quality Assurance Mechanisms Are Available and Used, but Information on the Credibility of Offsets Is Limited

Multiple quality assurance mechanisms are available and used to ensure the credibility of carbon offsets available for purchase on the U.S. voluntary offset market, but a lack of centralized information makes it difficult to estimate the extent of their use. Participants in the offset market face several challenges to ensuring the credibility of offsets, including problems determining additionality, and the availability and use of many mechanisms for verification, and monitoring. Our purchase of offsets found that the information supplied by a nonprobability sample of retailers provides limited assurance of credibility.

Quality Assurance Mechanisms Are Available and Applied to Offset Projects, but the Extent of Their Use Is Uncertain

A wide range of quality assurance mechanisms, commonly described collectively as “standards,” are available to ensure the credibility of carbon offsets. Market participants and third parties apply these standards at different stages of the carbon offset supply chain for a variety of purposes. For example, accounting and reporting methods define how to measure emissions reductions from specific types of projects. In addition, verification and monitoring standards are used to confirm that offsets are calculated correctly and that a project was indeed implemented, and to monitor progress over time. End use product standards, applied later in the supply chain, can be used to certify product marketing claims. Certain mechanisms cover multiple aspects of quality assurance and specify the use of registries to track the ownership and disposition of offsets, while others focus on one aspect, such as ensuring that emissions reductions are calculated correctly. Figure 7 illustrates how quality assurance mechanisms relate to the various components of a simplified offset supply chain, and appendix VII describes selected offset standards used in the voluntary market.

Figure 7: Quality Assurance Mechanisms in a Simplified Carbon Offset Supply Chain



Sources: GAO based on Ricardo Bayon, Amanda Hawn, and Katherine Hamilton, *Voluntary Carbon Markets*, (Sterling, Virginia: Earthscan).

Our review of the available literature and discussions with stakeholders identified widely varying estimates of the extent to which market participants use quality assurance mechanisms. Available information suggests that many carbon offsets in the voluntary market were subject to a quality assurance mechanism, but the fragmented nature of the market and limited data preclude exact estimates of the use of such mechanisms. One study estimated that more than 85 percent of the offsets purchased on the retail market in 2007 were verified by third parties, but this estimate did not include data on verification for many transactions.[20] In contrast, another study stated that the majority of voluntary offsets are currently not certified against a third party standard.[21] The available information suggests that fewer providers use registries to track the ownership and disposition of offsets than use third party verification or other quality assurance mechanisms. For example, one study estimated that more than 50 percent of the offsets available on the retail market were not listed in a registry, but this estimate did not include data for many transactions.[22] Because of incomplete and conflicting data on the use of quality assurance mechanisms, including registries, we cannot accurately gauge the extent of their use. In addition, these data limitations detract from the market's transparency.

Market Participants Face Challenges in Ensuring the Credibility of Offsets

Our interviews with stakeholders identified additionality and the presence of many different verification and monitoring methods as the two greatest challenges facing participants in the market. This is important because stakeholders and the available literature identify additionality and verification and monitoring as among the most important characteristics for establishing the credibility of offsets.[23] (See app. V for more information about stakeholders' ratings of characteristics of offset credibility and market challenges.)

According to most stakeholders and key studies, additionality is fundamental to the credibility of offsets because only offsets that are additional to business-as-usual activities result in new environmental benefits. However, certain stakeholders said that additionality is not a critical factor at this early stage in the development of carbon markets and that the key goal should be to keep transaction costs and barriers to entry low to create financial incentives for reducing emissions. Several stakeholders said that there is no correct technique for determining

[20]Hamilton, Sjardin, Marcello, and Xu, *Forging a Frontier.*

[21]Anja Kollmuss, Helge Zink, and Clifford Polycarp, *Making Sense of the Voluntary Carbon Market: A Comparison of Carbon Offset Standards* (Stockholm Environment Institute and Tricorona: March 2008).

[22]Hamilton, Sjardin, Marcello, and Xu, *Forging a Frontier.*

[23]Stakeholders who responded to our questions also identified the concept of "leakage"—the possibility that emissions increase elsewhere as a result of the implementation of a carbon offset project—as a challenge, which we address later in this report.

additionality because it requires comparison of expected reductions against a projected business-as-usual emissions baseline (also referred to as a counterfactual scenario). Determining additionality is inherently uncertain because, it may not be possible to know what would have happened in the future had the projects not been undertaken.

Stakeholders offered different definitions for additionality and preferred different methods for determining whether projects are additional. For example, some stakeholders said that additionality should be evaluated on a case-by-case examination of the unique circumstances of each project, while other stakeholders preferred evaluating projects against efficiency standards for a technology or sector, known as a performance benchmark approach. There are many other ways to determine whether projects are additional, and many stakeholders said that applying a single test is too simplistic because every project is different from others and operates under different circumstances. See table 2 for descriptions of selected additionality tests.

Table 2: Descriptions of Selected Additionality Tests

Additionality test	General description
Barriers	The underlying assumption of this test is that the production of offsets is a decisive reason that a project is able to overcome significant implementation barriers, such as local resistance to new technologies. Under other versions of the test, at least one alternative of the project must be shown not to face such barriers.
Common practice	To meet this test, an offset project must reduce emissions below levels produced by “common practice” technologies that provide the same products and services as the project. If the project does not meet the test, the assumption is that offsets are not a decisive reason for pursuing the project.
Investment, or financial	The most common version of this test (often termed financial additionality) assumes an offset project to be additional if it can be demonstrated that the project would have a lower than acceptable rate of return without revenue from offsets. The underlying assumption is that offsets must be a decisive reason for implementing a project that is not an attractive investment without revenues associated with those offsets. Under some versions of this test, an offset project with a high or competitive rate of return could still be additional, but must demonstrate additionality through other means.

Additionality test	General description
Legal, regulatory, or institutional	To satisfy this test, an offset project must reduce emissions below the level required by any official policies, regulations, guidance, or industry standards. If it does not reduce emissions beyond these levels, the assumption is that the only real reason for pursuing the project is compliance and the project, therefore, is not additional. Under some versions of this test, the converse is true–if the project reduces emissions beyond required levels, it is assumed that the only reason for pursuing the project is to earn offsets, and the project is therefore additional.
Performance benchmark	To meet this test, an offset project must demonstrate an emissions rate that is lower than a predetermined benchmark emissions rate for a particular technology or practice. This test is premised on the assumption that most, if not all, projects that beat the specified benchmark are ones in which climate change mitigation is a decisive factor in the decision to exceed the benchmark. The benchmark may also be used to calculate baseline emissions.
Project in, project out	This test reviews whether an offset project results in lower emissions than a scenario in which the project had not been implemented. If emissions associated with the project are lower than the business-as-usual scenario, then it is assumed that reducing emissions was a decisive reason for the project and that the project is additional.
Technology	The offset project and its associated reductions are considered additional if the offset project involves a technology specified as not being business as usual. The default assumption is that for these “additional” technologies, offsets are a decisive reason for using the technology in a particular project.
Timing	In this test, an offset project must have been initiated after a certain date, such as the date of initiation of a compliance program. The assumption is that any project started before that date must have had motivations other than offsets. Under most versions of this test, projects started after the required date must also establish additionality through a second test.

Source: GAO analysis of Dr. Mark C. Trexler, Derik J. Broekhoff, and Laura H. Kosloff. “A Statistically-Driven Approach to Offset-Based GHG Additionality Determinations: What Can We Learn?” Sustainable Development Law and Policy, Vol. VI, Iss. 2 (Winter 2006): 30-40.

Note: This table summarizes and introduces the variety of additionality tests that have been circulated over the past decade. It is not an exhaustive list of additionality tests, nor is it intended to provide precise definitions of the different tests.

Stakeholders also identified the existence of many different verification and monitoring methods as a key challenge to ensuring the credibility of offsets. There are many standards for measuring, verifying, monitoring, and tracking the distribution of carbon offsets but few standards, if any, that cover the entire supply chain. The proliferation of standards has caused confusion in the market, and the existence of multiple quality assurance mechanisms with different requirements raises questions about the quality of offsets available on the voluntary market, according to many stakeholders.

The lack of standardization in the U.S. market may also make it difficult for consumers to determine whether offsets are fully fungible—interchangeable and of comparable quality—a characteristic of an efficient commodity market. The term “carbon offset” implies a uniform commodity, but offsets may originate from a wide variety of project types based on different quantification and quality assurance mechanisms. Because offsets are not all the same, it may be difficult for consumers to understand what they purchase. In addition, several stakeholders said that a standardized offset registration process would foster transparency and prevent double-counting. Because there is no single registry and because of a lack of communication among existing registries, it is difficult for consumers to determine the quality of the offsets they purchase.

Certain stakeholders said that a single standard would bring greater credibility to the voluntary carbon offset market and result in projects that meet more stringent protocols. However, some stakeholders said that they did not expect that a single standard would emerge because of the wide variety and complexity of offset projects. Further, several stakeholders said that a single standard may not be desirable because it could stifle innovation and limit access to the market. Certain stakeholders said that the flexibility offered by multiple standards encourages the testing of new methodologies and emissions reduction technologies.

While the concept of carbon offsets rests on the notion that a ton of carbon reduced, avoided, or sequestered is the same regardless of the activity that generated the offset, some stakeholders believe that certain types of projects are more credible than others. Specifically, the stakeholders identified methane capture and fuel-switching projects as the most credible, and renewable energy certificates (REC) and agricultural and rangeland soil carbon sequestration as less credible.[24] Some stakeholders also pointed out that projects that use future value accounting practices to calculate offsets may be less credible. However, certain stakeholders said that this does not mean such projects should be categorically excluded from the offset market, only that they may require more rigorous quality assurance. Approximately one-third of the respondents said that credibility varies depending upon circumstances specific to the project. See table 5 in appendix V for more details about

[24]Renewable energy certificates certify that a certain quantity of electricity has been generated from a qualifying type of renewable generation technology.

stakeholders' rating of the credibility of different types of carbon offset projects.

The stakeholders' views on the credibility of different project types may stem from the fact that methane and fuel-switching projects are relatively simple to measure and verify, while RECs, forestry, and agricultural and rangeland soil carbon projects face challenges related to additionality, measurement, and permanence. According to several stakeholders, RECs and carbon offsets are not comparable environmental commodities and differ in their objectives, the actions they represent, and the standards by which they are defined. RECs certify that a certain quantity of electricity has been generated from a qualifying type of renewable generation technology, whereas carbon offsets represent an amount of carbon reduced in comparison with a projected business-as-usual emissions baseline. RECs may be bought and sold to satisfy state-level requirements to produce electricity from renewable sources—known as renewable portfolio standards—and also in the voluntary carbon offset market. The carbon benefits of RECs may be double-counted if sold in both markets, according to some stakeholders. With respect to agricultural and rangeland sequestration and forestry, certain stakeholders said it is difficult to accurately measure emissions reductions from these types of projects. In addition, forestry offset projects may not be permanent because disturbances such as insect outbreaks and fire can return stored carbon to the atmosphere.

Projects using future value accounting practices to calculate offsets may also be less credible than those that do not, according to some stakeholders. Ensuring the credibility of offsets purchased before they are produced inherently involves a higher degree of uncertainty than purchasing an offset that has already been generated. Some stakeholders told us that future value accounting practices expose consumers to more risk that the offsets will not materialize because it is more difficult to verify and monitor such projects over time. Other stakeholders said that future value accounting is an important way to fund certain types of offset projects that might otherwise not be possible.

Information Provided to Consumers Offers Limited Assurance of Credibility

The information provided to consumers about offset projects and quality assurance mechanisms offers limited assurance of credibility, according to certain stakeholders and analysis of documents obtained through the purchase of offsets. Several studies and stakeholders said that it is difficult for consumers to make educated choices about offset purchases because the information they need may not be provided by retail offset providers.

However, one stakeholder said that the strengths and weaknesses of offsets could be determined with a reasonable amount of due diligence, which is important to any buyer of a commodity in an emerging market.

To better understand the perspective of consumers, we purchased offsets from 33 retail providers and found that the information provided about the offsets varied considerably and offered limited assurance of credibility. We retrospectively analyzed information provided to us by the retailers directly as a result of the transaction as well as information provided on their Web sites. We expected that the information provided by retailers as a result of the transaction would yield detailed project-specific information related to credibility, and our review of Web sites was intended to supplement the information received directly from providers as a result of transactions. We found that retailers provided limited information about important characteristics for establishing the credibility of offsets, including additionality, verification, and the use of a registry to track offsets. We also found that few retailers identified specific projects associated with our transactions, and that the information provided on Web sites—in some cases general information about the retailers' quality assurance approaches—could not be linked to particular transactions. As a result, we found it difficult, in many cases, to determine exactly what we had purchased, and consumers in the offset market may face similar challenges.

With respect to information provided directly as a result of a transaction, 3 of 33 retailers said that their offsets were additional but only 2 explained how they defined additionality. The remaining 30 retailers did not provide information on additionality. With regard to verification, less than one-third of retailers (9 of 33) specified that their offsets were verified by a third party. The remaining 24 retailers did not provide information on verification. In addition, 5 of 33 retailers specified that the offsets were tracked in a registry and included the name of the registry, and 4 of these provided associated tracking numbers. The remaining 28 retailers did not provide information about the use of a registry. Further, as a direct result of the transaction, less than half of the retailers (13 of 33) provided information about whether the transaction resulted in the exchange of a good or the provision of a service.

We also found that retailers provided limited information about the offset projects associated with our transactions. Less than half (13 of 33) provided information about the location of their projects, but the majority of retailers (24 of 33) provided information on the type of project, and 9 of these retailers identified multiple project types. In addition, 8 retailers provided information related to the timing of the project, specifically, when the project started or is scheduled to begin or when the offsets would occur.

However, many provided more information on their Web sites that was not directly related to our transactions. We found that almost all of the retailers (30 of 33) provided some information related to verification on their Web sites. This information varied considerably among the retailers, with all 30 stating that the offsets were verified and 6 providing detailed information such as verification reports. With regard to additionality, 22 retailers provided information on their Web sites, including some explanation of how they define additionality. Finally, less than half of the retailers (12 of 33) said that their offsets are tracked in a registry, including 10 retailers that identified a specific registry, and 2 that operate their own.

Both Increased Federal Oversight and the Use of Offsets in Climate Change Policies Involve Trade-offs between Cost and Credibility

Increased government oversight of the voluntary market could address some concerns about the credibility of offsets by standardizing quality assurance mechanisms and registries, and this could encourage new projects and help protect consumers. However, more oversight could reduce flexibility and increase the administrative burden for government agencies and providers, which could raise costs and stifle innovation. Using offsets in a mandatory emissions reduction program would involve similar trade-offs. Offsets could lower the cost of compliance, encourage investment and innovation in sectors not required to reduce emissions, and provide time for regulated entities to change existing technologies. However, if the offsets used for compliance are not credible, the environmental integrity of a compliance system may be compromised.

More Oversight of the Voluntary Market Involves Trade-offs between Credibility and Cost

Increased oversight could address some concerns about the credibility of offsets by standardizing the use of quality assurance mechanisms and registries. Some stakeholders said that the voluntary offset market cannot operate efficiently without standardized mechanisms for ensuring the credibility of offsets. More government oversight could also help increase the fungibility and commoditization of offsets and improve the market's transparency. Other benefits of oversight and standardization could include encouraging the development of new projects, improving consumer protection and awareness, and addressing concerns about weaknesses of the voluntary market spilling over into a future compliance market. Certain stakeholders said that enhanced oversight of the voluntary carbon market would provide it with increased legitimacy that would help to spur new offset projects and increase the size of the market.

On the other hand, increased oversight would likely increase the cost of providing offsets in the voluntary market by introducing complex quality assurance requirements, which reduce flexibility and increase transaction costs. Oversight could also stifle innovation, according to some stakeholders, by requiring complex procedures with greater administrative costs, and by excluding some types of offset projects from the market. The federal government could also incur costs associated with increased oversight activities.

Stakeholders held different opinions about whether the government should play a larger role in the U.S. voluntary market. Several said that organizations have already invested time, money, and expertise in developing standards and that increased oversight should rely on and build on these investments. Other stakeholders thought that standardized quality assurance methods and registries would evolve naturally over time as the result of market forces. Several stakeholders said that government should focus on creating a mandatory greenhouse gas reduction program instead of improving the voluntary market and that a future compliance market will largely drive the standards for the voluntary market.

Certain stakeholders and available studies illustrated several policy options for enhancing oversight of the market. One option would involve requiring participants in the market to adopt standardized quality assurance mechanisms and use a specific registry. A second option would involve the federal government providing incentives or developing voluntary programs to encourage participants to take certain actions. Other options include prohibiting certain types of projects that are considered less credible and applying discounts or imposing insurance requirements on certain types of offsets with greater uncertainty or potential for failure. As an example of government oversight in the voluntary offset market, several stakeholders mentioned the United Kingdom Department for Environment, Food and Rural Affairs (DEFRA) framework for the Code of Best Practice for Carbon Offsetting. The code is designed to increase consumer confidence in the integrity of carbon offsets available for purchase in the United Kingdom. Offset products meeting the requirements of the code will be assigned a certification mark that providers may use for marketing purposes. The code initially covers only Certified Emissions Reductions that are compliant with the Kyoto Protocol, but voluntary emissions reductions could be included in the code in the future.

Offsets Could Lower the Cost of Future Mitigation Policies but Increase Uncertainty about Achieving Emissions Reductions

Allowing offsets in a future compliance scheme could decrease the overall compliance costs because it could provide regulated entities with a wider variety of compliance options. In many cases, regulated entities may find it economically advantageous to buy offsets instead of reducing emissions themselves. Recent EPA analyses state that the cost of compliance with mitigation policies under consideration by the Congress decreases substantially as the use of offsets increases. Specifically, the agency's recent analysis of the Climate Security Act of 2008 (S. 2191) reported that if the use of domestic and international offsets is unlimited, then compliance costs fall by an estimated 71 percent compared to the bill as written.[25] Alternatively, the price increases by an estimated 93 percent compared to the bill as written if no offsets are allowed. A 2007 EPA study analyzing the economic impacts of the Climate Stewardship and Innovation Act of 2007 (S. 280) found similar results.[26] Other quantitative studies by economists also show that the use of offsets will decrease the cost of achieving emissions reductions.[27] In general, the carbon price is lower in quantitative models of a U.S. compliance system when domestic and international offsets are widely available and their use is unrestricted.[28] Using offsets in a compliance scheme could also increase the administrative costs of the scheme because of increased government oversight of quality assurance mechanisms used to ensure the credibility of offsets.

A lower carbon price due to the availability of offsets as a compliance tool may have several effects, according to available economic literature. In the short term, lower prices make compliance with a policy to reduce emissions less expensive. Lower prices may also facilitate agreements to

[25]See EPA Analysis of the Lieberman-Warner Climate Security Act of 2008, S.2191 in the 110th Congress (March 2008), available at http://www.epa.gov/climatechange/economics/economicanalyses.html.

[26]See EPA Analysis of the Climate Stewardship and Innovation Act of 2007, S.280 in the 110th Congress, (July 2007), available at http://www.epa.gov/climatechange/economics/economicanalyses.html.

[27]See EIA analysis of the Climate Stewardship and Innovation Act of 2007, S.280 in the 110th Congress (July 2007), available at http://www.eia.doe.gov/oiaf/servicerpt/csia/. See also Congressional Research Service Report for Congress, *Climate Change: Costs and Benefits of S.2191*, which analyzes the role of offsets in six different quantitative economic models of the Lieberman-Warner Climate Security Act of 2008, S.2191 in the 110th Congress (July 2008).

[28]EPA analyses and other economic literature generally evaluate cap-and-trade compliance systems as opposed to other policy options.

limit emissions and enhance their environmental integrity by reducing the incentive for regulated sources to either cheat on the agreement or shift production to areas where carbon emissions are not regulated.[29] Including offsets in compliance schemes could also encourage investment and innovation in unregulated sectors of the economy, possibly at the expense of investment and innovation in regulated sectors.[30] According to several stakeholders and available economic literature, a market for offsets may support climate-related innovation in sectors that supply offsets. For example, unregulated facilities may devise new ways to limit greenhouse gas emissions because they could sell offsets in the compliance market.

The availability of offsets in a compliance scheme could also provide time for regulated facilities to develop new technologies and processes. Some stakeholders said that access to offsets provides more flexibility in meeting short-term requirements, leaving more time to implement long-term plans for internal emissions reductions and technology development. Further, according to certain stakeholders, offsets may allow regulated sources to continue using assets such as power plants until the end of their useful lives, thereby reducing their premature retirement and the cost of emissions reductions overall. In addition, multiple stakeholders said that offsets may allow covered sources to avoid investing in long-lived assets that achieve only marginal improvements, instead focusing on more effective assets that take longer to develop.

On the other hand, allowing the use of offsets could compromise the environmental integrity of a compliance system if nonadditional offsets are used as compliance tools. Certain stakeholders said that because offset programs increase the total quantity of compliance instruments available to regulated sources, the integrity of the system can be maintained only if offsets are additional. If a significant number of nonadditional offsets enter the market, emissions may rise beyond levels intended by the scheme, according to some stakeholders. Nonadditional offsets could thus increase uncertainty about achieving emissions reduction goals. This concern underscores the importance of using quality

[29] See Judson Jaffe and Robert Stavins. "Linking a U.S. Cap-and-Trade System for Greenhouse Gas Emissions: Opportunities, Implications, and Challenges." American Enterprise Institute Center for Regulatory and Market Studies, Working Paper 08-01 (January 2008).

[30] See Jaffe and Stavins (2008), and Joseph Kruger, Wallace E. Oates, and William A. Pizer. "Decentralization in the EU Emissions Trading Scheme and Lessons for Global Policy." *Review of Environmental Economics and Policy*, Vol. 1, Iss. 1 (winter 2007).

assurance mechanisms to ensure the credibility of any offsets allowed into a compliance scheme. In addition, these concerns could be minimized by limiting the use of offsets or including policy options for enhancing oversight of the market such as applying discounts or imposing insurance requirements on offsets with greater uncertainty or potential for failure.

The available economic literature supports some of the environmental integrity concerns raised by stakeholders. Economic analyses of offsets acknowledge difficulties with their use, including baseline determination, additionality, permanence, double-counting, and verification and monitoring.[31] If these criteria are more likely to be satisfied by internal reductions from regulated sources than by offsets, the use of offsets may result in greater emissions, according to these sources. Economists have also identified "leakage" as a potential problem for offsets, especially those created on a project-by-project basis. Leakage occurs when economic activity is shifted as a result of emission control regulation. Consequently, emissions abatement achieved in one location that is subject to emission control regulation is diminished by increased emissions in unregulated locations. For an offset project, leakage occurs when economic activity is shifted from the site of the offset project to another location or sector where emissions are not controlled. For example, an offset project that restricts timber harvesting at a specific site may boost logging at an alternative location, thus reducing the effectiveness of the offset project. Forestry projects are thought to be particularly vulnerable to these challenges, as are credits originating in developing countries, even though these offsets have been identified as sources of significant cost savings to compliance regimes in developed countries.[32]

Multiple stakeholders also said that including offsets in a compliance scheme could slow investment in certain emissions reduction technologies

[31]For example, see Jaffe and Stavins (2008), and Kruger, Oates, and Pizer (2007). See also Carolyn Fischer. "Project Based Mechanisms for Emissions Reductions: Balancing Trade-offs with Baselines," RFF DP 04-32, Resources for the Future (August 2004).

[32]A recent report by the Congressional Research Service discusses the potential and drawbacks of incorporating forestry projects into carbon markets. See *Forest Carbon Markets: Potential and Drawbacks*, RL34560 (Washington, D.C.: July 3, 2008). Other related Congressional Research Service reports include *Voluntary Carbon Offsets: Overview and Assessment*, RL34241 (Washington, D.C.: Nov. 7, 2007), and *The Role of Offsets in a Greenhouse Gas Emissions Cap-and-Trade Program: Potential Benefits and Concerns*, RL34436 (Washington, D.C.: Apr. 4, 2008).

in regulated sectors and lessen the motivation of market participants to reduce their own emissions. According to some stakeholders, if more cost-effective offsets are available as compliance tools, regulated sources may delay making investments to reduce emissions internally, an outcome that could ultimately slow the development of, and transition to, a less carbon-intensive economy. For example, a senior representative of the Council on Environmental Quality said that there is a trade-off between short-term focus on the marginal cost of reductions and long-term investment in technology. This representative said that offsets may be a cheaper way to reduce emissions today, but that investment in technology, not offsets, builds emissions reductions into the economy for the long term. Other stakeholders and the available economic literature raise similar concerns. According to the literature, a market for offsets may support innovation in sectors that supply offsets at the expense of investment in technology to reduce emissions from regulated sources. Furthermore, certain stakeholders said that it may be more difficult for regulators to mandate the amount and timing of emissions reductions in specific economic sectors if offsets are part of a compliance scheme.

Certain stakeholders suggested imposing limits on the use of offsets in a compliance scheme to address some of these challenges, but stakeholders held different opinions about the potential effectiveness of this approach. Some said it may be necessary to place restrictions on the use of offsets in order to achieve internal emissions reductions from regulated sources. If all the effort to reduce emissions is in the form of offsets, then the compliance system may not provide the price signals necessary for long-term investment in technology at domestic industrial facilities and power plants, according to multiple stakeholders. They said that domestic abatement is central to achieving the long-term goal of any emissions reduction system. However, other stakeholders said that incorporating offsets into a compliance scheme will enable greater overall climate benefits to be achieved at a lower cost, as long as offsets are additional and are not double-counted.

Existing international programs to limit greenhouse gas emissions that allow the use of offsets for compliance may provide insights into trade-offs between cost and credibility. For example, the European Union's program to limit greenhouse gas emissions enables regulated entities to use certain types of offsets for compliance. GAO is reviewing the European Union's program, including the role of offsets, in a report that we will issue later in 2008.

Concluding Observations

The voluntary market for carbon offsets provides a potentially low-cost way for purchasers of offsets to compensate for their emissions of greenhouse gases by paying others to undertake activities that avoid, reduce, or sequester greenhouse gas emissions. However, several factors contribute to challenges in understanding the market. First, while most markets involve tangible goods or services, the carbon market involves a product that represents the absence of something—in this case, an offset equals the absence of one ton of carbon dioxide emissions. Second, ensuring the credibility of carbon offsets poses challenges because of the inherent uncertainty in measuring emissions reductions or sequestration relative to a projected business-as-usual scenario. Any measurement involving projections is inherently uncertain. These challenges are compounded by the fact that project developers produce offsets from a variety of activities—such as sequestration in agricultural soil, and forestry projects, and methane capture—and do not use a single set of commonly accepted quality assurance mechanisms. Third, many transactions do not involve a central trading platform, exchange, or registry system. These factors limit the market's transparency and pose challenges for market participants, especially consumers.

Additional oversight of the voluntary market could address some of these challenges, but would also impose costs on government oversight bodies and increase costs for market participants. Some options for increased oversight include requiring the use of standard quality assurance mechanisms, mandating the use of a common registry, establishing product disclosure requirements that help consumers evaluate an offset's quality, establishing best practices, developing a government certification system, providing incentives or developing voluntary programs to encourage participants to take certain actions, and limiting the allowable types of activities that can generate offsets. Consideration of these approaches involves trade-offs among cost, quality assurance, and consumer protection. The Federal Trade Commission's efforts to update its Green Guides for environmental marketing claims may also enhance the existing oversight framework, which consists primarily of laws affecting contractual agreements and fraud.

The options for enhanced oversight identified above may increase in importance in the context of a compliance market associated with any future policies that place binding limits on greenhouse gas emissions. While allowing carbon offsets for compliance with mandated reductions in emissions can decrease overall compliance costs for regulated entities, challenges with the credibility of offsets could compromise the integrity of a compliance scheme. In addition to the oversight options identified above, the government could consider further steps to address uncertainties with offsets such as limiting the extent of their use for compliance, discounting a percentage of all offsets, and imposing insurance requirements for offset providers and purchasers.

Matter for Congressional Consideration

GAO is not recommending executive actions. However, as the Congress considers legislation intended to limit greenhouse gas emissions that allows the use of carbon offsets for compliance, it may wish to incorporate provisions that would direct the relevant federal agency (or agencies) to establish (1) clear rules about the types of offset projects that regulated entities can use, as well as standardized quality assurance mechanisms for these allowable project types; (2) procedures to account and compensate for the inherent uncertainty associated with offset projects, such as discounting or overall limits on the use of offsets for compliance; (3) a standardized registry for tracking the creation and ownership of offsets; and (4) procedures for amending the offset rules, quality assurance mechanisms, and registry, as necessary, based on experience and the availability of new information over time.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to others who are interested and make copies available to others who request them. In addition, the report will be available at no charge on the GAO Web site at http://www.gao.gov.

If you or your staff have any questions about this report, please contact me at (202) 512-3841 or stephensonj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix VIII.

John B. Stephenson
Director, Natural Resources
and Environment

List of Requesters

The Honorable Joe Barton
Ranking Member
Committee on Energy and Commerce
House of Representatives

The Honorable Tom Davis
Ranking Member
Committee on Oversight and Government Reform
House of Representatives

The Honorable Vernon J. Ehlers
Ranking Member
Committee on House Administration
House of Representatives

The Honorable Darrell Issa
Ranking Member
Subcommittee on Domestic Policy
Committee on Oversight and Government Reform
House of Representatives

The Honorable John Shimkus
Ranking Member
Subcommittee on Oversight and Investigations
Committee on Energy and Commerce
House of Representatives

Appendix I: Objectives, Scope, and Methodology

This report examines (1) the scope of the U.S. voluntary carbon offset market, including the role of the federal government; (2) the extent to which mechanisms for ensuring the credibility of voluntary carbon offsets are available and used, and what, if any, related information is shared with consumers; and (3) the trade-offs associated with increasing the oversight of the U.S. voluntary carbon offset market and incorporating offsets into broader climate change mitigation policies.

In conducting our work, we reviewed available government and trade literature related to carbon offset markets and conducted structured and open-ended interview questions with nonprobability samples of 34 stakeholders, including 12 providers, 3 third party verifiers, 7 developers of standards, and 12 other knowledgeable stakeholders. We selected nonprobability samples of relevant stakeholders based on analysis of existing market literature, referrals from other stakeholders, and other criteria, such as participation in carbon offset trade conferences.[1] In general, we selected stakeholders that were frequently cited in available studies of the offset market or participated in related conferences and meetings, and preferentially selected stakeholders based in the United States. We also conducted scoping interviews with several trade groups and other knowledgeable stakeholders.

To describe the scope of the U.S. voluntary carbon offset market, including the role of the federal government, we interviewed officials responsible for offset-related programs at the Department of Agriculture (Forest Service), the Department of Energy (Energy Information Administration), the Department of the Interior (U.S. Fish and Wildlife Service), and the Environmental Protection Agency, and officials at the Federal Trade Commission and the Commodity Futures Trading Commission. To obtain an official administration position on carbon offsets, we met with the Council on Environmental Quality. We attended public meetings and congressional briefings and attended several conferences focused on the voluntary carbon offset market. We met with officials responsible for managing state and regional greenhouse gas mitigation programs, including California's recently passed legislation to regulate greenhouse gases (Assembly Bill 32), the Regional Greenhouse Gas Initiative (RGGI), and the Western Climate Initiative. We met with

[1]Nonprobability samples cannot be used to generalize or make inferences about a population. In this instance, we cannot generalize the results of our interviews to all carbon offset market participants.

representatives of the Chicago Climate Exchange, the Chief Administrative Officer of the House of Representatives, and other officials involved in the purchase of carbon offsets for the House of Representatives. To obtain perspectives on the role of the voluntary offset market in comparison and as a complement to compliance markets, we interviewed officials at the United Kingdom (UK) Department for Environment, Food and Rural Affairs (DEFRA). We also met with the UK National Audit Office, and a variety of other offset market participants and stakeholders in the UK. To obtain specific information about the supply of offsets in the United States, including the number and type of offset projects and the quantity of offsets by state, we analyzed data purchased from Point Carbon, a provider of independent news, analysis, and consulting services for European and global power, gas, and carbon markets. Data presented in this report on the supply of offsets refer specifically to offsets generated from projects located in the United States. Point Carbon estimates that its database accounts for approximately 80 percent of the offsets generated from projects located in the United States based on its analysis of domestic and global carbon markets. As such, our analysis may not have included all projects that are operating in the United States; however, we believe these data represent the best information available. To assess the reliability of the Point Carbon data, we (1) performed electronic testing of required data elements, (2) reviewed existing information about the data and the system that produced them, and (3) interviewed Point Carbon staff who are knowledgeable about the data. We determined that the data were sufficiently reliable for the purposes of this report.

To analyze the extent to which mechanisms for ensuring the credibility of voluntary carbon offsets are available and used, and what, if any, related information is shared with consumers, we obtained about $100 worth of offsets from each of a nonprobability sample of 33 retail providers for a total expenditure of approximately $3,300. The information we obtained from the nonprobability sample of purchases does not address how the market may evolve over time or how consumers interpret the information they receive from providers. To select the sample of retailers from whom offsets would be obtained, we used available information to identify providers that sold or accepted donations for offsets online. To select the sample of retailers, we developed a list of providers based on primary sources, including reports, studies, surveys, and lists from membership organizations. We used information from providers' Web sites to identify whether providers sold or accepted donations for offsets online and selected retailers that did and were identified in two or more primary sources. We conducted online transactions because they cater directly to individual consumers, a portion of the U.S. voluntary carbon offset market that is not well characterized in available studies. We analyzed the documentation directly related to each transaction, including (1) transaction documents—information provided while conducting the online transaction, (2) e-mail documents—any information received through e-mail after conducting the transaction, and (3) mail documents—any information received through the mail after conducting the transaction. We analyzed the documentation directly related to the transaction, if provided, to determine whether it contained information related to volume, price, project type and location, standards, registry, verification, monitoring, additionality, timing, and ownership. We also reviewed information presented on the retailer's Web site to determine whether information was provided about the retailers' offsets related to price, project type and location, standards, registry, verification, monitoring, additionality, timing, and ownership.

To assess the trade-offs associated with increasing the oversight of the U.S. voluntary carbon offset market and incorporating offsets into broader climate change mitigation policies, we reviewed available economic literature and information collected through stakeholder responses to structured and open-ended interview questions. We conducted our work from July 2007 to August 2008.

Appendix II: Description of Offset Project Types

Project type	Description
Agricultural methane	Projects that capture and combust or contain methane produced from agricultural operations. This involves the installation of complete-mix or plug-flow digesters or lagoon covers that collect aggregated waste from dairy, avian, and/or hog sources.
Agricultural soil	Projects that sequester carbon in soil through the adoption of conservation tillage and activities such as planting grass or adopting certain tilling practices.
Carbon capture and biological storage (CCBS)	Projects that capture and sequester greenhouse gases using biological techniques such as algae lagoons.
Carbon capture and geological storage (CCGS)	Projects that separate CO2 emissions from industrial and energy-related emissions sources, transport the CO2 to a suitable storage site, and then isolate the CO2 by injecting it into an underground geologic formation such as active and abandoned oil and gas reservoirs, saline aquifers, or unminable coal seams.
Coal mine methane	Projects that capture and burn or contain methane emitted by coal mines.
Energy efficiency	Projects that reduce CO2 emissions by reducing on-site combustion of natural gas, oil, or propane for end use by improving the energy efficiency of fuel usage and/or the energy efficient delivery of energy services.
Forestry	Projects that occur on land managed in accordance with sustainable forestry practices and promote the restoration of native forests by using mainly native species and avoiding the introduction of invasive nonnative species.
Landfill methane	Projects that capture and burn or contain methane produced by landfills.
Rangeland soil	Projects that involve the adoption of certain sustainable grazing practices on rangeland that include moderate livestock density and rotational and seasonal grazing techniques.
Renewable energy	Projects that reduce emissions by generating energy from renewable sources including but not limited to hydro, wind, and solar power.
Renewable energy certificates (REC)	RECs are tradable certificates that represent the environmental attributes that result from one megawatt hour of electricity generated by a renewable source, such as wind power.

Source: GAO.

Appendix III: Volume and Number of Offset

Range	State	Volume	Percentage of total volume	Number of projects
More than 250,000	Texas	1,830,258	18	12
	Virginia	1,680,500	16	2
	Multiple States	727,313	7	12
	Wyoming	606,082	6	4
	Georgia	532,779	5	5
	Alabama	500,000	5	2
	Illinois	464,284	5	11
	California	407,125	4	31
	Colorado	403,000	4	2
	North Dakota	400,000	4	2
	Wisconsin	294,263	3	13
100,000 to 250,000	Pennsylvania	188,063	2	13
	North Carolina	181,365	2	3
	Washington	174,080	2	3
	Oregon	168,663	2	11
	New Hampshire	156,125	2	2
	Louisiana	150,558	1	11
	New York	149,407	1	8
	Utah	121,000	1	3
	Mississippi	108,340	1	6
	Indiana	106,800	1	1
25,000 to 99,999	New Jersey	96,853	<1	6
	Michigan	94,691	<1	5
	Montana	80,410	<1	5
	Oklahoma	77,335	<1	2
	Maryland	75,000	<1	1
	Minnesota	72,165	<1	5
	Delaware	60,000	<1	1
	Maine	55,000	<1	2
	Massachusetts	53,405	<1	1
	Iowa	42,374	<1	2
	Idaho	40,773	<1	3
	Missouri	40,000	<1	2
	Tennessee	31,773	<1	2

Range	State	Volume	Percentage of total volume	Number of projects
Less than 25,000	Kentucky	18,400	<1	4
	Arkansas	12,550	<1	6
	South Dakota	6,084	<1	2
	Vermont	1,639	<1	2
	Alaska	360	<1	1
	Florida	130	<1	1
	Hawaii	90	<1	1
	Arizona	0	0	0
	Connecticut	0	0	0
	District of Columbia	0	0	0
	Kansas	0	0	0
	Nebraska	0	0	0
	Nevada	0	0	0
	New Mexico	0	0	0
	Ohio	0	0	0
	Rhode Island	0	0	0
	South Carolina	0	0	0
	West Virginia	0	0	0

Source: GAO analysis of Point Carbon data.

[a]Twelve projects occur across multiple states. The data for these projects are included under the category of multiple states and not included in the volume or number of projects for the individual states involved in these projects.

Appendix IV: Description of the Purchase of Carbon Offsets by the Chief Administrative Officer of the House of Representatives

On March 1, 2007, the Speaker and Majority Leader of the U.S. House of Representatives and Chairwoman of the Committee on House Administration directed the House Chief Administrative Officer (CAO) to develop a Green the Capitol Initiative to provide an environmentally responsible and healthy working environment for House employees. Among other measures, the CAO's June 21, 2007, report recommended that the House operate in a carbon neutral manner by the end of the 110th Congress and identified three strategies to achieve this goal, including (1) purchasing electricity generated from renewable sources; (2) meeting the House's heating and cooling needs by switching from using coal, oil, and natural gas at the Capitol power plant to natural gas only; and (3) purchasing offsets to compensate for any remaining carbon emissions. According to the CAO, using strategies one and two, the House would need to offset 24,000 short tons of carbon dioxide emissions to operate in a carbon neutral manner.[1]

The CAO recommended purchasing carbon offsets through the Chicago Climate Exchange (CCX), a voluntary greenhouse gas reduction and trading system through which members make commitments to decrease their emissions. If CCX members reduce emissions beyond their reduction goals, they may sell the extra reductions to other members of the exchange. In addition to emitting members, the CCX platform is also available to offset providers, who may register tons on CCX that represent greenhouse gas mitigation projects. To meet their commitments, CCX members may trade emissions reductions or offsets known as Carbon Financial Instruments (CFI).[2] According to CCX, to verify the validity of offsets offered for sale on the exchange, and ensure that the underlying offset projects conform to CCX rules, all tons registered for sale on the CCX platform from offset projects must have been verified by CCX-approved outside verifier firms that are specialized in particular fields. The outside verification firms are to ensure that the projects are in accordance with CCX eligibility rules and methodologies, verify that projects have been implemented, conduct on-site inspections, and send verification reports to CCX. CCX staff and, in certain cases, the CCX Offsets Committee, review the verification reports and request corrective actions, if necessary. After completion of any corrective actions, CCX sends the

[1]The Green the Capitol Initiative report presents data in English short tons. One short ton equals 2,000 pounds.

[2]Carbon Financial Instruments are contracts equal to 100 metric tons of carbon dioxide equivalent that are traded on the Chicago Climate Exchange.

verification reports to the Financial Industry Regulatory Authority (FINRA) for a final review to ensure project verification documentation is complete.[3] Uniquely serialized Carbon Financial Instruments based on these offsets are then issued to the project owner's CCX registry account, and may then be sold in the CCX market. The market participants' registry accounts help the market participant track purchases and sales of offsets acquired or sold on the exchange that can be used to identify specific information about the offset projects, including verification documents. According to CCX, all participants have the option of buying CFIs anonymously and all transaction prices must be reported so that CCX can post prices on its trading platform.

The House Appropriations Committee, in its June 19, 2007, report on the 2008 Legislative Branch Appropriations Bill, stated: "The Committee believes it is important to offset greenhouse gases generated by the House. In that regard, the Committee requests the Chief Administrative Officer purchase Carbon Financial Instruments to offset carbon produced by all House operations. These offsets should be fully transparent, verified, American, project-based offset credits."[4] The CAO requested and received approval from the Committee on House Administration on August 29, 2007, to purchase offsets and submit an application to CCX with the necessary fee. According to CAO officials, CCX was the best option for the House because it is well established relative to the rest of the industry, has clear verification and monitoring standards, and allows for the anonymous purchase of offsets. The CAO requested that CCX conduct a blind auction because the CAO did not want to decide or know which projects were selected. According to the CAO, this approach was adopted to eliminate any opportunity for House funds to be used to benefit one geographical region or congressional district over another. For example, the CAO decided not to purchase offsets on the retail market from domestic nonprofit groups because a decision to select specific vendors or offset projects in one location instead of another could be construed as a political act. On October 23, 2007, CCX made a public announcement to potential sell-side market participants that it would hold the reverse

[3]The Financial Industry Regulatory Authority is the largest nongovernmental regulator for all securities firms doing business in the United States. It was created in July 2007 through the consolidation of the National Association of Securities Dealers (NASD) and the member regulation, enforcement, and arbitration functions of the New York Stock Exchange. FINRA's predecessor was established pursuant to the Maloney Act, which was passed by Congress in 1938.

[4]See H.R. Rep. No. 110-198 at 10 (2007).

auction on behalf of the House of Representatives and stipulated that the projects sought had to be verified and approved CCX projects undertaken in the United States. The auction closed on November 1, resulting in the purchase of 30,000 metric tons for a total of $90,550 including transaction fees. Results of the auction were announced at a public ceremony on November 5, 2007.

The CAO bought offsets before implementing the emissions reduction strategies specified in the Green the Capitol Initiative. Based on calculations performed for the Green the Capitol Initiative report by the Department of Energy and the Lawrence Berkeley National Laboratory, the carbon footprint of the House is approximately 91,000 short tons. According to the CAO, until the Architect of the Capitol's metering program is complete, in March 2009, House emissions data are based on historical estimates. To reach the goal of carbon neutrality, the Green the Capitol Initiative called for two emissions reduction strategies and the purchase of carbon offsets to compensate for whatever emissions remained. Purchasing electricity generated from renewable sources would decrease emissions to 34,000 short tons. Switching from burning coal, oil, and natural gas at the Capitol power plant to burning only natural gas would further decrease emissions to 24,000 short tons. The third strategy to reach the goal of carbon neutrality was to purchase offsets for the remaining carbon emissions—24,000 short tons. However, the first two strategies had not been completed when the CAO purchased offsets through CCX in November 2007. Concerning the first two strategies, the Architect of the Capitol purchased renewable energy in June 2008, and the CAO, in written comments, told us that the Architect of the Capitol had purchased natural gas to account for the House's portion of energy used at the Capitol Power Plant. According to the CAO, there was no benefit to waiting to purchase offsets.

The CAO used data from 2006 that GAO developed as part of a broader characterization of greenhouse gas emissions from legislative branch agencies and later analyzed by Lawrence Berkeley National Laboratory to identify the amount of offsets the CAO would purchase to reach its goal of carbon neutrality by the end of 2008.[5] The CAO stated that it does not have current emissions data and that the Architect of the Capitol does not have

[5]GAO, *Legislative Branch: Energy Audits Are Key to Strategy for Reducing Greenhouse Gas Emissions*, GAO-07-516 (Washington, D.C.: Apr. 25, 2007). GAO's analysis identified the amount of greenhouse gas emissions generated by legislative branch operations.

meters that enable it to directly monitor its energy use or emissions in real time. According to the CAO, emissions data projected from a 2006 baseline provide a reasonable estimate of current emissions.

In November 2007, the CAO purchased 30,000 *metric* tons of offsets through CCX, which is more than the 24,000 *short* tons identified in the Green the Capitol Initiative report and a memorandum approving the CAO's Chicago Climate Exchange application, which was signed by the Committee on House Administration in August 2007.[6] The CAO purchased approximately 9,075 short tons (about 8,231 metric tons), more than identified in the Green the Capitol Initiative, an amount valued at about $24,447 based on the weighted average purchase price of $2.97 per metric ton paid by the CAO.[7] According to the House CAO and CCX, the purchase of additional tons was an administrative error that resulted from the difference between short and metric tons and reference to the draft report rather than the final report.[8] An April 2007 draft of the Green the Capitol Initiative report identified the need to purchase 34,000 tons, but the June 2007 final report identified the need to purchase 24,000 short tons. On March 27, 2008, the CAO requested that CCX retire 24,000 of the 30,000 *metric* tons.[9] Currently, 6,000 metric tons remain in the CAO's registry account, which, according to the CAO, may be used to offset additional emissions generated by the operation of the House. The CAO said that the initial purchase of carbon offsets was an approximation and plans to reconcile the purchase in fiscal year 2009.

Because it retired 24,000 metric tons instead of short tons, the CAO retired about 2,460 short tons (about 2,231 metric tons) more than identified in the Green the Capitol Initiative report. These extra tons are valued at about $6,626 based on the CAO's purchase price. According to the CAO, the retirement of extra tons may address uncertainties in the emissions calculations used to determine the amount of offsets to purchase.

---

[6] A metric ton is equivalent to 2,205 pounds and a short ton equals 2,000 pounds.

[7] The price per metric ton of carbon traded on CCX has increased since the CAO purchase. For example, in June 2008, the market closing price of CFIs reached $7.40 per metric ton.

[8] The CAO and CCX said that the cost of 30,000 metric tons purchased in November was below the cost projected for 24,000 metric tons and also below the cost estimated for the purchase of 24,000 metric tons at the time of passage of the relevant appropriations bill.

[9] The term "retirement" refers to the permanent recorded disposition of an offset after which it cannot be resold or otherwise utilized by any entity to facilitate, enable, or offset any past, present, or future greenhouse gas emission.

Following the auction, the CAO received information from CCX about the number and types of projects underlying its purchase. No other information was provided by CCX or requested by the CAO. The offsets purchased by the CAO came from a variety of project types, including agricultural methane, agricultural soil sequestration, coal mine methane, landfill methane, and renewable energy. The CCX auction notice required that offsets submitted to the auction originate from U.S.-based projects, and CCX officials said that they screened the registry accounts of auction participants to confirm that the sellers' offsets were from U.S.-based projects. Registry accounts maintained by CCX for market participants track the type of information necessary to satisfy the criteria directed by the appropriations committee report. Thus, the CAO could verify that the offsets met the criteria, if necessary. The CAO can also request that CCX provide additional quality assurance documentation, including detailed verification reports.

Appendix V: Summary of Stakeholder Responses to Interview Questions

Table 3: Stakeholders' Rating of Carbon Offset Market Challenges

How challenging, if at all, are each of the following for the effective functioning of the U.S. voluntary carbon offset market?	(0) Not at all challenging	(1) Slightly challenging	(2) Moderately challenging	(3) Very challenging	(4) Extremely challenging	Don't know/ unsure	Total responses[a]	Average[b]
Additionality	0	8	5	13	7	0	33	2.58
Many different verification and monitoring methodologies	0	4	13	9	7	0	33	2.58
Press coverage of offsets	2	4	10	8	8	1	33	2.50
Education	1	3	15	11	3	0	33	2.36
Permanence	1	8	11	11	2	0	33	2.15
Baseline quantification methodologies	0	4	22	7	0	0	33	2.09
Transaction costs associated with quantification, verification, and monitoring	0	9	13	8	2	1	33	2.09
Leakage	1	9	16	4	3	0	33	1.97
Reduction quantification methodologies	0	6	23	4	0	0	33	1.94
Liability	0	12	13	2	3	3	33	1.87
Timing of reductions (future, past)	5	10	11	5	1	1	33	1.59
Establishment of ownership	0	18	9	3	1	2	33	1.58
Finding / matching buyers and sellers	7	9	12	3	0	1	32	1.35
Many different types of projects	8	15	5	4	1	0	33	1.24

Source: GAO.

[a]The total column represents the number of stakeholders that answered each question with a single answer.

[b]The average column represents the average of the numerical ratings submitted by stakeholders for (0) Not at all challenging through (4) Extremely challenging. The average does not include responses for Don't know/ unsure, because this is not a numerical rating.

Table 4: Stakeholders' Rating of Characteristics of Offset Credibility

How important, if at all, are each of the following for establishing the credibility of a carbon offset?	(0) Not at all important	(1) Slightly important	(2) Moderately important	(3) Very important	(4) Extremely important	Don't know/ unsure	Total responses[a]	Average[b]
Additionality	1	1	2	3	26	0	33	3.58
Transparency	0	0	0	14	19	0	33	3.58
Permanence	0	1	2	8	22	0	33	3.55
Verification and monitoring	0	0	3	9	21	0	33	3.55
Use of registry to avoid double-counting	0	0	4	12	16	1	33	3.38
Established ownership	0	2	6	10	15	0	33	3.15
Clear institutional arrangement	1	2	7	7	10	5	32	2.85
Reputation of offset provider	1	3	11	9	9	0	33	2.67

Source: GAO.

[a]The total column represents the number of stakeholders that answered each question with a single answer.

[b]The average column represents the average of the numerical ratings submitted by stakeholders for (0) Not at all important through (4) Extremely important. The average does not include responses for Don't know/ unsure, because this is not a numerical rating.

Table 5: Stakeholders' Rating of the Credibility of Different Types of Carbon Offset Projects

How credible, if at all, is each type of project?	(0) Not at all credible	(1) Slightly credible	(2) Moderately credible	(3) Very credible	(4) Extremely credible	Varies	Don't know/ unsure	Total responses[a]	Average[b]
Agriculture methane	0	1	1	8	12	9	0	31	3.41
Fuel switch	0	0	3	5	10	12	1	31	3.39
Landfill methane	0	1	3	6	10	10	1	31	3.25
Coal mine methane	0	4	2	4	7	10	4	31	2.82
Industrial gas	1	0	7	2	7	11	2	30	2.82
Non-REC renewable energy	1	2	3	8	4	11	1	30	2.67
Energy efficiency	2	2	5	6	6	10	0	31	2.57
Afforestation	2	1	4	5	4	14	1	31	2.5
Reforestation	2	2	5	3	6	13	0	31	2.5
Avoided deforestation	1	4	5	2	4	14	1	31	2.25
Agriculture soil carbon	0	10	5	5	1	9	1	31	1.86
Rangeland soil carbon	1	8	7	4	1	9	1	31	1.81
Renewable energy certificates (REC)	9	3	2	3	2	12	0	31	1.26

Source: GAO.

Notes: The answers provided by stakeholders represent their ratings at a particular point in time and may not reflect the development of new mechanisms to ensure the credibility of offsets. Several stakeholders commented that any project, properly constructed, can generate acceptable offsets. They said that there are issues that make some project types easier to develop than others, but that does not mean that acceptable quantification methodologies cannot or will not be developed.

[a]The total column represents the number of stakeholders that answered each question with a single answer.

[b]The average column represents the average of the numerical ratings submitted by stakeholders for (0) Not at all credible through (4) Extremely credible. The average does not include responses for Varies and Don't know/ unsure because these are not numerical ratings.

Appendix VI: Summaries of Selected International, Regional, and State Programs

California Global Warming Solutions Act (Assembly Bill [AB] 32)	On September 27, 2006, the California Global Warming Solutions Act was signed into law. The act requires the California Air Resources Board (ARB) to establish a program to reduce the state's emissions to 1990 levels by 2020. On June 26, 2008, ARB released a draft scoping plan for public comment that contains the strategies California will use to reduce emissions of greenhouse gases. The draft includes a discussion of the potential role of offsets in implementing AB 32. Specific commitments on the role of offsets in AB 32 will be available in a revised scoping plan that ARB will publish in early October 2008 for comment. This version of the plan will be presented to the Air Resources Board in November 2008 for possible adoption by the board. AB 32 requires the board to adopt a scoping plan by January 1, 2009. Regulations based on the final scoping plan must be adopted by January 1, 2011, and are to become effective on January 1, 2012. More information about implementation of the California Global Warming Solutions Act is available at http://www.arb.ca.gov/cc/cc.htm.
European Union Emissions Trading Scheme (EU ETS)	The European Union Emission Trading Scheme is a cap-and-trade system in which energy-intensive industries in the European Union buy or sell emission allowances to help meet member states' commitments under the Kyoto Protocol. The EU ETS covers over 11,000 electricity-generating facilities and energy-intensive installations, such as oil refineries and steel plants, in 27 member countries. The EU ETS enables regulated entities to use certain types of offsets for compliance. In some cases, regulated entities may choose to comply with emissions limits by purchasing offsets rather than by reducing their own emissions. Limits for the use of offsets vary by country, with a range from zero to 20 percent of a country's total cap, and an average limit of 11 percent. These limits apply to the current Phase II of the EU ETS and may change in Phase III, which begins in 2013. For more information about the EU ETS, see http://ec.europa.eu/environment/climat/emission.htm
Midwestern Greenhouse Gas Reduction Accord	The governors of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Ohio, South Dakota, and Wisconsin, and the premiers of the Canadian provinces of Manitoba and Ontario participate or observe in the Midwestern Greenhouse Gas Reduction Accord, an agreement to establish greenhouse gas reduction targets and time frames, and to develop market-based mechanisms to reach these targets. The accord was established in November 2007. An offsets subgroup is expected to make recommendations about the role of offsets in a regional emissions reduction program by September 2008, according the subgroup's work plan. More information about the Midwestern Greenhouse Gas Reduction Accord is available at http://www.midwesternaccord.org/.
Regional Greenhouse Gas Initiative (RGGI)	The Regional Greenhouse Gas Initiative is a cooperative effort by Northeast and Mid-Atlantic states to design a regional cap-and-trade program initially covering carbon dioxide emissions from power plants in the region. Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont are participating in the RGGI effort. The District of Columbia, Pennsylvania, Ontario, Quebec, the Eastern Canadian Provinces, and New Brunswick are observers in the process. On August 15, 2006, the participating states issued a model rule that details the proposed RGGI program. Offset projects included in the program are initially limited to five types of projects, including landfill methane capture and sequestration, because these types occur within the borders of the RGGI states, among other factors. The model rule specifies offset project requirements including criteria for additionality, quantification and verification of emissions reductions, independent verification, and accreditation standards for independent verifiers. Each source required to reduce emissions would generally be able to use offsets to comply with up to 3.3 percent of its obligation in a single compliance period. If the compliance price hits certain levels, the use of offsets may increase to 5 or 10 percent of required reductions. The first 3-year compliance period will begin January 1, 2009. More information about RGGI is available at http://www.rggi.org/index.htm.

United Kingdom Department for Environment, Food and Rural Affairs (DEFRA)	On February 19, 2008, the United Kingdom (UK) Department for Environment, Food and Rural Affairs announced the framework for the Code of Best Practice for Carbon Offsetting to provide UK consumers with guidance on carbon offsets. The code is designed to increase consumers' understanding of offsetting and its role in addressing climate change, increase consumer confidence in the integrity and value for money of the offset products available to them, and to provide signals to the UK offset sector on the quality and verification standards to which they should aspire. Offset products meeting the specifications of the code will be assigned with a certification mark, which providers may use on their Web sites and other materials. The code is voluntary and offset providers can choose whether to seek accreditation for all, or some, of their offsetting products. The code initially covers only Certified Emissions Reductions (CER), that are compliant with the Kyoto Protocol, because there is currently no definition or fully established common standard for voluntary offsets. DEFRA has asked the voluntary offset industry to jointly develop a standard that could be included in the code in the future. For more information about the DEFRA Code of Best Practice for Carbon Offsetting see http://www.defra.gov.uk/environment/climatechange/uk/carbonoffset/index.htm.
Western Climate Initiative (WCI)	The Western Climate Initiative was launched in February 2007 by the governors of Arizona, California, New Mexico, Oregon, and Washington to develop regional strategies to address climate change. Partners in the Initiative also include Montana, Utah, and the Canadian provinces of British Columbia, Ontario, Quebec, and Manitoba. Other U.S. and Mexican states have joined as observers. The WCI regional greenhouse gas emission reduction goal is an aggregate reduction of 15 percent below 2005 levels by 2020. On May 16, 2008, the WCI released recommendations about how to structure the region's cap-and-trade emissions reduction program, including a series of recommendations about how to incorporate offsets into such a program. A more detailed version of the draft offset recommendations was released in July 2008, and WCI is striving to reach a final agreement on overall program design in August 2008. More information about the WCI draft design recommendations on offsets is available at http://www.westernclimateinitiative.org/.

Source: GAO.

Appendix VII: Selected Carbon Offset

Standard	Description
The California Climate Action Registry	The California Registry serves as a voluntary greenhouse gas (GHG) registry to protect and promote early actions to reduce GHG emissions. The California Registry develops reporting standards and tools for organizations to measure, monitor, third party verify, and reduce their GHG emissions consistently across industry sectors and geographical borders. For more information about the California Registry, see http://www.climateregistry.org/.
The Carbon Neutral Protocol	The CarbonNeutral Protocol, a proprietary standard developed by The CarbonNeutral Company, describes the requirements for achieving “CarbonNeutral” status and the controls employed by The CarbonNeutral Company to ensure the correct use of CarbonNeutral logos. The protocol sets out the quality requirements for projects and schemes that produce offset credits that may be applied to make activities or entities CarbonNeutral under this program. For more information about the Carbon Neutral Protocol, see http://www.carbonneutral.com/pages/cnprotocol.asp.
Chicago Climate Exchange	CCX is a voluntary greenhouse gas reduction and trading system through which members make commitments to decrease their emissions. CCX participants may trade offsets generated from qualifying emissions reduction projects. CCX employs a central registry for recording emissions as well as holdings and transfers of its serialized emission units–Carbon Financial Instruments (CFI). The registry is linked with the CCX electronic trading platform. For more information about CCX, see http://www.chicagoclimatex.com/index.jsf.
Clean Development Mechanism	The Clean Development Mechanism (CDM) is part of the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC). CDM enables industrialized countries to achieve emissions reductions by paying developing countries for certified emission reduction credits. CDM projects must qualify through a registration and issuance process. The mechanism is overseen by the CDM Executive Board, answerable ultimately to the countries that have ratified the Kyoto Protocol. For more information about CDM, see http://cdm.unfccc.int/index.html.
Climate, Community, and Biodiversity Alliance	The Climate, Community, and Biodiversity Alliance (CCBA) is a partnership among companies, nongovernmental organizations, and research institutes seeking to promote integrated solutions to land management around the world. CCB standards are project design standards for evaluating land-based carbon mitigation projects in the early stages of development. For more information about the CCB standards, see http://www.climate-standards.org/.
Climate Leaders	Climate Leaders is an EPA industry-government partnership that works with companies to develop climate change strategies. EPA Climate Leaders, a voluntary emissions reduction program, provides technical assistance to companies on how to calculate and track greenhouse gas emissions over time, calculate emissions reductions from offsets, and incorporate offsets into emission reduction strategies. EPA has developed accounting methodologies for certain offset project types including landfill gas, manure management, afforestation, transportation, and boiler replacement projects. Project protocols are being developed for additional project types, including coal-bed methane, methane end use from landfill and manure management projects, and forest management. For more information about Climate Leaders offset methodologies, see http://www.epa.gov/climateleaders/resources/optional-module.html.

Standard	Description
Climate Neutral Network	The Climate Neutral Network is an alliance of companies and organizations committed to developing products, services, and enterprises that have a net-zero impact on global warming. The Climate Neutral Network certifies companies whose products, services, and/or enterprises have a net-zero impact on global warming. The Climate Neutral Network is closing as a nonprofit and transferring its certification program to another nonprofit. For more information about the Climate Neutral Network, see http://climateneutralnetwork.org/.
Gold Standard Voluntary Emissions Reduction (VER)	The Gold Standard offers a quality label to voluntary offset projects for renewable energy and energy efficiency projects with sustainable development benefits for the local community. Gold Standard projects are tested for environmental quality by third parties and the Gold Standard carbon credit label is granted after third party validation and verification of the offset project. For more information about the Gold Standard VER, see http://www.cdmgoldstandard.org/index.php.
United Kingdom Department for Environment, Food and Rural Affairs Code of Best Practice for Carbon Offsetting	On February 19, 2008, the United Kingdom Department for Environment, Food and Rural Affairs (DEFRA) announced the framework for the Code of Best Practice for Carbon Offsetting to provide consumers with guidance on carbon offsets. Offset products meeting the requirements of the code will be assigned a certification mark that providers may use on their Web sites and other materials. The code is voluntary, and offset providers can choose whether to seek accreditation for all, or some, of their offsetting products. For more information about the DEFRA Code of Best Practice for Carbon Offsetting see http://www.defra.gov.uk/environment/climatechange/uk/carbonoffset/index.htm.
Green-e Climate	Green-e Climate is a certification program for carbon offsets sold to consumers on the retail market. Green-e Climate sets consumer protection and environmental integrity standards and employs a three-step verification and certification service that ensures supply equals sales, offsets are independently certified, and consumer disclosures are accurate and follow program guidelines. For more information about Green-e Climate, see http://www.green-e.org/getcert_ghg.shtml.
Greenhouse Friendly™	Greenhouse Friendly is an Australian government initiative aimed at providing businesses and consumers with the opportunity to sell and purchase greenhouse neutral products and services. For more information about Greenhouse Friendly, see http://www.greenhouse.gov.au/greenhousefriendly/index.html.
ISO 14064	ISO 14064 is a three-part international standard that provides guidance on developing organization-level emissions inventories; quantifying, monitoring, and reporting greenhouse gas emissions reductions at the project level; and validating and verifying greenhouse gas emissions reduction projects. More information about ISO 14064 standards is available at http://www.iso.org/iso/home.htm.
Plan Vivo	Plan Vivo is a system for managing the supply of verifiable emission reductions from rural communities in a way that promotes sustainable livelihoods. Companies, individuals, or institutions wishing to offset greenhouse gas emissions can purchase voluntary emission reductions via a project trust fund in the form of Plan Vivo Certificates. Projects use the Plan Vivo management system to register and monitor carbon sequestration activities implemented by farmers. For more information about Plan Vivo, see http://www.planvivo.org/.
Social Carbon	Social Carbon has the objective of guaranteeing that the projects developed for the reduction of greenhouse gas emissions significantly contribute to sustainable development, incorporating transparent methods of access and measurement of the benefits that are returned to the parties involved and to the environment. The aim of the Social Carbon methodology is to provide offsets that also provide clear social and environmental benefits in the areas where projects operate. For more information about the Social Carbon methodology, see http://www.socialcarbon.com/

Standard	Description
VER+	The VER+ Standard provides a global standard for voluntary greenhouse gas emission reduction projects. The criteria of the VER+ Standard are streamlined with those of CDM, including the requirements of project additionality and corresponding tests that prove the project is not a business-as-usual scenario. For more information about the VER+ standard, see https://www.netinform.de/KE/Beratung/Service_Ver.aspx.
Voluntary Carbon Standard	The Voluntary Carbon Standard (VCS) was initiated by The Climate Group, the International Emissions Trading Association, and the World Economic Forum in late 2005 to standardize and provide transparency and credibility to the voluntary offset market, among other objectives. To recognize credible work that has gone into developing greenhouse gas programs around the world, the VCS Program has a process for recognizing programs that meet VCS criteria. For more information about the VCS, see http://www.v-c-s.org/index.html.
Voluntary Offset Standard	The International Carbon Investors and Services (INCIS) Voluntary Offset Standard (VOS) can be used as a minimum standard when purchasing verified emission reduction credits on behalf of organizations or individuals offsetting their greenhouse gas emissions. The Voluntary Offset Standard is intended to support the development of emerging carbon markets around the world, and support international policy convergence with a view to long-term carbon market integration. For more information about the VOS, see http://www.carboninvestors.org/documents.
Greenhouse Gas Protocol	The Greenhouse Gas Protocol, a partnership between the World Resources Institute and the World Business Council for Sustainable Development, provides an accounting framework for greenhouse gas standards, programs, and inventories around the world. For more information about the Greenhouse Gas Protocol, see http://www.ghgprotocol.org/.

Source: GAO analysis of offset standards cited by stakeholders and available market studies.

Notes: Registries for tracking the distribution of offsets are not included in this table. Certain standards require the use of specific registries.

This table summarizes and introduces the variety of standards available in the voluntary offset market. It is not an exhaustive list of standards, nor is it intended to provide precise descriptions.

We do not summarize or compare the criteria of these standards because they exist for different purposes and apply to different portions of the carbon offset supply chain. For more specific information, please see standard documentation available at the referenced Web sites, if available.

Appendix VIII: GAO Contact and Staff

GAO Contact

John B. Stephenson, (202) 512-3841 or stephensonj@gao.gov

Staff Acknowledgments

In addition to the contact named above, Michael Hix, Assistant Director; Janice Ceperich; Nancy Crothers; Cindy Gilbert; Richard Johnson; Ben Shouse; Ardith A. Spence; and Joseph Thompson made major contributions to this report. Richard Burkard, Terrell G. Dorn, Steve Gaty, Jim McDermott, Andy O'Connell, Dan Packa, Kate Robertson, Ray Rodriguez, Jena Sinkfield, and Sara Vermillion also made important contributions.

GAO's Mission

The Government Accountability Office, the audit, evaluation, and investigative arm of Congress, exists to support Congress in meeting its constitutional responsibilities and to help improve the performance and accountability of the federal government for the American people. GAO examines the use of public funds; evaluates federal programs and policies; and provides analyses, recommendations, and other assistance to help Congress make informed oversight, policy, and funding decisions. GAO's commitment to good government is reflected in its core values of accountability, integrity, and reliability.

Obtaining Copies of GAO Reports and Testimony

The fastest and easiest way to obtain copies of GAO documents at no cost is through GAO's Web site (www.gao.gov). Each weekday, GAO posts newly released reports, testimony, and correspondence on its Web site. To have GAO e-mail you a list of newly posted products every afternoon, go to www.gao.gov and select "E-mail Updates."

Order by Mail or Phone

The first copy of each printed report is free. Additional copies are $2 each. A check or money order should be made out to the Superintendent of Documents. GAO also accepts VISA and Mastercard. Orders for 100 or more copies mailed to a single address are discounted 25 percent. Orders should be sent to:

U.S. Government Accountability Office
441 G Street NW, Room LM
Washington, DC 20548

To order by Phone:	Voice:	(202) 512-6000
	TDD:	(202) 512-2537
	Fax:	(202) 512-6061

To Report Fraud, Waste, and Abuse in Federal Programs

Contact:

Web site: www.gao.gov/fraudnet/fraudnet.htm
E-mail: fraudnet@gao.gov
Automated answering system: (800) 424-5454 or (202) 512-7470

Congressional Relations

Ralph Dawn, Managing Director, dawnr@gao.gov, (202) 512-4400
U.S. Government Accountability Office, 441 G Street NW, Room 7125
Washington, DC 20548

Public Affairs

Chuck Young, Managing Director, youngc1@gao.gov, (202) 512-4800
U.S. Government Accountability Office, 441 G Street NW, Room 7149
Washington, DC 20548

PRINTED ON RECYCLED PAPER

13

Policies, Instruments and Co-operative Arrangements

Coordinating Lead Authors:

Sujata Gupta (India) and Dennis A. Tirpak (USA)

Lead Authors:

Nicholas Burger (USA), Joyeeta Gupta (The Netherlands), Niklas Höhne (Germany), Antonina Ivanova Boncheva (Mexico), Gorashi Mohammed Kanoan (Sudan), Charles Kolstad (USA), Joseph A. Kruger (USA), Axel Michaelowa (Germany), Shinya Murase (Japan), Jonathan Pershing (USA), Tatsuyoshi Saijo (Japan), Agus Sari (Indonesia)

Contributing Authors:

Michel den Elzen (The Netherlands), Hongwei Yang (PR China)

Review Editors:

Erik Haites (Canada), Ramon Pichs (Cuba)

This chapter should be cited as:

Gupta, S., D. A. Tirpak, N. Burger, J. Gupta, N. Höhne, A. I. Boncheva, G. M. Kanoan, C. Kolstad, J. A. Kruger, A. Michaelowa, S. Murase, J. Pershing, T. Saijo, A. Sari, 2007: Policies, Instruments and Co-operative Arrangements. In Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Table of Contents

EXECUTIVE SUMMARY

This chapter synthesizes information from the relevant literature on policies, instruments and co-operative arrangements, focusing mainly on new information that has emerged since the Third Assessment Report (TAR). It reviews national policies, international agreements and initiatives of sub-national governments, corporations and non-governmental organizations (NGOs).

National policies

The literature on climate change continues to reflect the wide variety of national policies and measures that are available to governments to limit or reduce greenhouse gas (GHG) emissions. These include regulations and standards, taxes and charges, tradable permits, voluntary agreements, subsidies, financial incentives, research and development programmes and information instruments. Other policies, such as those affecting trade, foreign direct investment, consumption and social development goals, can also affect GHG emissions. Climate change policies, if integrated with other government polices, can contribute to sustainable development in developed and developing countries alike.

Reducing emissions across all sectors and gases requires a portfolio of policies tailored to fit specific national circumstances. While the advantages and disadvantages of any one given instrument can be found in the literature, four main criteria are widely used by policymakers to select and evaluate policies: environmental effectiveness, cost-effectiveness, distributional effects (including equity) and institutional feasibility. Other more specific criteria, such as effects on competitiveness and administrative feasibility, are generally subsumed within these four.

The literature provides a great deal of information for assessing how well different instruments meet these criteria, although it should be kept in mind that all instruments can be designed well or poorly and to be stringent or lax and politically attractive or unattractive. In addition, all instruments must be monitored and enforced to be effective. The general conclusions that can be drawn from the literature are that:

- Regulatory measures and standards generally provide some certainty of emissions levels, but their environmental effectiveness depends on their stringency. They may be preferable when information or other barriers prevent firms and consumers from responding to price signals (*high agreement/much evidence*).
- Taxes and charges are generally cost-effective, but they cannot guarantee a particular level of emissions, and they may be politically difficult to implement and, if necessary, adjust. As with regulations, their environmental effectiveness depends on stringency (*high agreement/much evidence*).
- Tradable permits can establish a carbon price. The volume of allowed emissions determines the carbon price and the environmental effectiveness of this instrument, while the distribution of allowances can affect cost-effectiveness and competitiveness. Experience has shown that banking provisions can provide significant temporal flexibility (*high agreement/much evidence*). Uncertainty in the price of carbon makes it difficult to estimate the total cost of meeting emission reduction targets.

Voluntary agreements (VAs) between industry and governments, which vary considerably in scope and stringency, are politically attractive, raise awareness among stakeholders and have played a role in the evolution of many national policies. A few have accelerated the application of best available technology and led to measurable reductions of emissions compared to the baseline, particularly in countries with traditions of close cooperation between government and industry. However, there is little evidence that VAs have achieved significant reductions in emissions beyond business as usual (*high agreement/much evidence*). The successful programmes all include clear targets, a baseline scenario, third party involvement in design and review and formal provisions for monitoring.

- Financial incentives are frequently used by governments to stimulate the diffusion of new, less GHG-emitting technologies. While economic costs are generally higher for these than for other instruments, financial incentives are often critical to overcoming the barriers to the penetration of new technologies (*high agreement/much evidence*). Direct and indirect subsidies for fossil fuel use and agriculture remain common practice, although those for coal have declined over the past decade in many Organization for Economic Co-operation and Development (OECD) and in some developing countries.
- Government support through financial contributions, taxation measures, standard setting and market creation is important to the promotion of technology development, innovations and transfer. However, government funding for many energy research programmes has fallen off since the oil shock in the 1970s and stayed constant at this lower level, even after the United Nations Framework Convention on Climate Change (UNFCCC) was ratified. Substantial additional investments in – and policies for – Research and Development (R&D) are needed to ensure that technologies are ready for commercialization in order to arrive at a stabilization of GHGs in the atmosphere (see Chapter 3), as are economic and regulatory instruments to promote their deployment and diffusion (*high agreement/much evidence*).
- Information instruments, including public disclosure requirements, may affect environmental quality by promoting better-informed choices and lead to support for government policy. There is only limited evidence that the provision of information can achieve emissions reductions, but it can improve the effectiveness of other policies (*high agreement/medium evidence*).

In practice, climate-related policies are seldom applied in complete isolation, as they overlap with other national polices relating to the environment, forestry, agriculture, waste management, transport and energy and, therefore, in many cases require more than one instrument. For an environmentally effective and cost-effective instrument mix to be applied, there must be a good understanding of the environmental issue to be addressed, the links with other policy areas and the interactions between the different instruments in the mix. Applicability in specific countries, sectors and circumstances – particularly developing countries and economies in transition – can vary greatly, but may be enhanced when instruments are adapted to local circumstances (*high agreement/much evidence*).

International agreements

As precedents, the UNFCCC and Kyoto Protocol have been significant in providing a means to solve a long-term international environmental problem, but they are only first steps towards the implementation of an international response strategy to combat climate change. The Kyoto Protocol's most notable achievements are the stimulation of an array of national policies, the creation of a carbon market and the establishment of new institutional mechanisms. Its economic impacts on the participating countries are yet to be demonstrated. The Clean Development Mechanism (CDM), in particular, has created a large project pipeline and mobilized substantial financial resources, but it has faced methodological challenges in terms of determining baselines and additionality. The Protocol has also stimulated the development of emissions trading systems, but a fully global system has not been implemented. The Kyoto Protocol is currently constrained by the modest emission limits. It would be more effective if the first commitment period is followed-up by measures to achieve deeper reductions and the implementation of policy instruments covering a higher share of global emissions (*high agreement/much evidence*).

New literature highlights the options for achieving emission reductions both under and outside of the Convention and its Kyoto Protocol by, for example, revising the form and stringency of emission targets, expanding the scope of sectoral and sub-national agreements, developing and adopting common policies, enhancing international Research, Development and Demonstration (RD&D) technology programmes, implementing development-oriented actions and expanding financing instruments (*high agreement/much evidence*). An integration of diverse elements, such as international R&D co-operation and cap and trade programmes, within an agreement is possible, but any comparison of the efforts made by different countries would be complex and resource-intensive (*medium agreement/medium evidence*).

Recent publications examining future international agreements in terms of potential structure and substance report that because climate change is a global problem, any approach that does not include a larger share of global emissions will have a higher global cost or be less environmentally effective (*high agreement/much evidence*). The design of a future regime will have significant implications for global costs and the distribution of cost among regions at different points in time There is a broad consensus in the literature that a successful agreement will have to be environmentally effective and cost-effective, incorporate distributional considerations and equity and be institutionally feasible (*high agreement/much evidence*). Agreements are more likely to be effective if they include goals, specific actions, timetables, participation and institutional arrangements and provisions for reporting and compliance (*high agreement/much evidence*).

Goals determine the extent of participation, the stringency of the measures and the timing of the actions. For example, to limit the temperature increase to 2°C above pre-industrial levels, developed countries would need to reduce emissions in 2020 by 10–40% below 1990 levels and in 2050 by approximately 40–95%. Emissions in developing countries would need to deviate below their current path by 2020, and emissions in all countries would need to deviate substantially below their current path by 2050. A temperature goal of less than 2°C requires earlier reductions and greater participation (and vice versa) (*high agreement/much evidence*). Abatement costs depend on the goal, vary by region and depend on the allocation of emission allowances among regions and the level of participation.

Initiatives of local and regional authorities, corporations, and non-governmental organizations

Corporations, local and regional authorities and NGOs are adopting a variety of actions to reduce GHG emissions. Corporate actions range from voluntary initiatives to emissions targets and, in a few cases, internal trading systems. The reasons corporations undertake independent actions include the desire to influence or pre-empt government action, to create financial value, and to differentiate a company and its products. Actions by regional, state, provincial and local governments include renewable energy portfolio standards, energy efficiency programmes, emission registries and sectoral cap and trade mechanisms. These actions are undertaken to influence national policies, address stakeholder concerns, create incentives for new industries and/or to create environmental co-benefits. Non-government organizations promote programmes that reduce emissions through public advocacy, litigation and stakeholder dialogue. Many of the above actions may limit GHG emissions, stimulate innovative policies, encourage the deployment of new technologies and spur experimentation with new institutions, but they generally have limited impact on their own. To achieve significant emission reductions, these actions must lead to changes in national policies (*high agreement/medium evidence*).

Implications for global climate change policy

Climate change mitigation policies and actions taken by national governments, the private sector and other areas of civil society are inherently interlinked. For example, significant emissions reductions have occurred as a result of actions by governments to address energy security or other national needs (e.g. the switch in the UK to gas, the energy efficiency programmes of China and India, the Brazilian development of a transport fleet driven by bio-fuel or the trend in the 1970s and 1980s toward nuclear power). However, non-climate policy priorities can overwhelm climate mitigation efforts (e.g. decisions in Canada to develop the tar sands reserves, those in Brazil to clear forests for agriculture and in the USA to promote coal power to enhance energy security) and lead to increased emissions. New research to assess the interlinkages between climate change and other national policies and actions might lead to more politically feasible, economically attractive and environmentally beneficial outcomes and international agreements.

13.1 Introduction

Article 4 of the United Nations Framework Convention on climate change (UNFCCC) commits all Parties – taking into account their common but differentiated responsibilities and their specific national and regional priorities, objectives and circumstances – to formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures that will result in the mitigation of climate change by addressing anthropogenic emissions of greenhouse gases (GHGs) by sources and removals by sinks. The main purpose of this chapter is to discuss national policy instruments and their implementation, international agreements and other arrangements and initiatives of the private sector, local governments and non-governmental organizations (NGOs). This chapter expands on the literature that has emerged since the Third Assessment Report (TAR) – in particular, on aspects covered in Chapters 6 and l0 of the TAR. There is a relatively heavier focus given to publications proposing new approaches to possible future international agreements, alternative options for international cooperation and initiatives of local governments and the private sector. Wherever feasible, these agreements and arrangements are discussed in the context of criteria such as environmental effectiveness, cost-effectiveness, distributional considerations, institutional feasibility, among others. This chapter does not discuss in detail either sectoral policies, which can be found in other chapters of this report, or adaptation policies, as those may be found in IPCC (2007b).

13.1.1 Types of policies, measures, instruments and co-operative arrangements

A variety of policies, measures, instruments and approaches are available to national governments to limit the emission of GHGs; these include regulations and standards, taxes and charges, tradable permits, voluntary agreements (VAs), informational instruments, subsidies and incentives, research and development and trade and development assistance. Box 13.1 provides a brief definition of each instrument (Hahn, 2001; Sterner, 2003). Depending on the legal framework within which each individual country must operate, these may be implemented at the national level, sub-national level or through bi-lateral or multi-lateral arrangements, and they may be either legally binding or voluntary and either fixed or changeable (dynamic).

Box 13.1 Definitions of selected GHGs abatement policy instruments

Note: The instruments defined below to directly control GHG emissions; instruments may also be used to manage activities that indirectly lead to GHG emissions, such as energy consumption.

Regulations and Standards: These specify the abatement technologies (technology standard) or minimum requirements for pollution output (performance standard) that are necessary for reducing emissions.

Taxes and Charges: A levy imposed on each unit of undesirable activity by a source.

Tradable Permits: These are also known as marketable permits or cap-and-trade systems. This instrument establishes a limit on aggregate emissions by specified sources, requires each source to hold permits equal to its actual emissions and allows permits to be traded among sources.

Voluntary Agreements: An agreement between a government authority and one or more private parties with the aim of achieving environmental objectives or improving environmental performance beyond compliance to regulated obligations. Not all VAs are truly voluntary; some include rewards and/or penalties associated with participating in the agreement or achieving the commitments.[1]

Subsidies and Incentives: Direct payments, tax reductions, price supports or the equivalent thereof from a government to an entity for implementing a practice or performing a specified action.

Information Instruments: Required public disclosure of environmentally related information, generally by industry to consumers. These include labelling programmes and rating and certification systems.

Research and Development (R&D): Activities that involve direct government funding and investment aimed at generating innovative approaches to mitigation and/or the physical and social infrastructure to reduce emissions. Examples of these are prizes and incentives for technological advances.

Non-Climate Policies: Other policies not specifically directed at emissions reduction but which may have significant climate-related effects.

1 Voluntary Agreements (VAs) should not be confused with voluntary actions which are undertaken by govern-ment agencies at the sub-national level, corporations, NGOs and other organizations independent of national government authorities. See Section 13.4.

13.1.2 Criteria for policy choice

Four principal criteria for evaluating environmental policy instruments are reported in the literature; these are:

- Environmental effectiveness – the extent to which a policy meets its intended environmental objective or realizes positive environmental outcomes.
- Cost-effectiveness – the extent to which the policy can achieve its objectives at a minimum cost to society.
- Distributional considerations – the incidence or distributional consequences of a policy, which includes dimensions such as fairness and equity, although there are others.
- Institutional feasibility – the extent to which a policy instrument is likely to be viewed as legitimate, gain acceptance, adopted and implemented.

It has to be mentioned, however, that literature in the fields of economics and political science does not provide much guidance in terms of determing which evaluative criteria are the most appropriate for an analysis of environmental policy. However, many authors employ criteria similar to the ones listed above, and although other criteria may also be important in evaluating policies, the analysis presented in this chapter is limited to these four criteria. Criteria may be applied by governments in making ex ante choices among instruments and in ex post evaluation of the performance of instruments.

13.1.2.1 Environmental effectiveness

The main goal of environmental policy instruments and international agreements is to reduce the negative impact of human action on the environment. Policies that achieve specific environmental quality goals better than alternative policies can be said to have a higher degree of environmental effectiveness. It should be noted that although climate protection is the ostensible environmental goal for any climate policy, there may be ancillary environmental benefits (for example, those demonstrated by Burtraw *et al*. (2001a) for air pollution benefits; see also Section 4.5.2. for air quality co-benefits).

The environmental effectiveness of any policy is contingent on its design, implementation, participation, stringency and compliance. For example, a policy that seeks to fully address the climate problem while dealing with only some of the GHGs or some of the sectors will be relatively less effective than one that aims at addressing all gases and all sectors.

The environmental effectiveness of an instrument can only be determined by estimating how well it is likely to perform. Harrington *et al*. (2004) distinguish between estimating how effective an environmental instrument will be ex ante and evaluating its performance ex post. These researchers were able to find or recreate ex ante estimates of expected emissions reductions in a series of U.S. and European case studies. Their comparison of the ex ante and ex post observations suggests a reasonable degree of accuracy in the estimates, with those cases in which emissions reductions were greater than expected involving incentive-based instruments, while the cases in which reductions fell short of expectations involved regulatory approaches.

There are situations in which standards are proven to be effective. Regulators may be unduly pessimistic about the environmental performance of incentive-based instruments or unduly optimistic about the performance of regulatory approaches, or perhaps both. Recent evidence suggests that market-based approaches can provide equal if not superior environmental quality improvements over regulatory approaches (see Ellerman, 2006). As we discuss below, however, institutional constraints may alter the relative efficacy of market- and standards-based instruments.

13.1.2.2 Cost-effectiveness

The cost-effectiveness of a policy is a key decision parameter in a world with scarce resources. Given a particular environmental quality goal, the most cost-effective policy is the one which achieves the desired goal at the least cost. There are many components of cost, and these include both the direct costs of administering and implementing the policy as well as indirect costs, such as how the policy drives cost-reducing technological change.

Cost-effectiveness is distinct from general economic efficiency. Whereas cost-effectiveness takes an environmental goal as given, efficiency involves the process of selecting a specific goal according to economic criteria (Sterner, 2003). Consequently, the choice of a particular environmental goal will likely have dramatic impacts on the overall cost of a policy, even if that policy is implemented using the most cost-effective instrument.

Policies are likely to vary considerably in terms of cost-effectiveness, and any estimation of the costs involved can be challenging (Michaelowa, 2003b). While cost-effectiveness estimates traditionally include the direct expenditures incurred as a result of implementing any specific policy, the policy may also impose indirect social costs, which are more difficult to measure (Davies and Mazurek, 1998). Moreover, costs for which data are limited are often ignored. Harrington *et al*. (2000) provide a summary of commonly excluded costs as well as examples of efforts to estimate these.

Cost-effectiveness can be enhanced with low transaction costs for compliance. This implies limiting the creation of new institutions and keeping implementation procedures as simple as possible while still ensuring system integrity. Studies reported in the literature can be divided into two categories in terms of the economic impacts of the timing of reductions. While some researchers argue that reductions should be postponed until low-cost technologies are available, others argue that necessary decisions have to be made today to avoid a 'lock-in' to an emission intensive pathway that would be expensive to leave at a later time point (see also Chapter 11).

A common concern is that ex ante cost estimates may not reflect the actual costs of a policy when it is assessed from an ex post perspective. Harrington *et al*. (2000) show that the discrepancy between the actual and estimated total costs of 28 environmental regulations in the USA is relatively low and, if anything, that ex ante estimates tend to overstate total costs. While these authors do not systematically evaluate specific environmental instruments, they do find that estimates for market-based instruments tend to overstate unit costs, while unit-costs estimates for other instruments are neither under- nor overestimates.

13.1.2.3 Distributional considerations

Policies rarely apportion environmental benefits and costs evenly across stakeholders. Even if a policy meets an environmental goal at least cost, it may face political opposition if it disproportionately impacts – or benefits – certain groups within a society, across societies or across generations. From an economic perspective, a policy is considered to be beneficial if it improves social welfare overall. However, this criterion does not require that the implementation of that policy actually improves the specific situation of any one individual. Consequently, as Keohane *et al*. (1998) argue, distributional considerations may be more important than aggregate cost effectiveness when policymakers evaluate an instrument.

The distributional considerations of climate change policies relate largely to equity. Equity can be defined in a number of ways within the climate context (see IPCC, 2001). Equity and fairness may be perceived differently by different people, depending on the cultural background of the observer. For example, Ringius *et al*. (2002) view responsibility, capacity and need as the basic principles of fairness that seem to be sufficiently widely recognized to serve as a normative basis for a climate policy regime. These three principles have been used in the evaluation of potential international climate agreements (e.g. Torvanger *et al*., 2004).

A regulation that is perceived as being unfair or for which the incidence is unbalanced may have a difficult time making it through the political process.[2] However, distributional considerations are fundamentally subjective, and the most equitable policy may not be the most politically popular one. For example, a policy that focuses the regulatory burden on a low-income subpopulation or country but directs the benefits to a wealthy interest group may sail with ease through the political process. While highly inequitable in costs and benefits, such an instrument is occasionally attractive to politicians. Bulkeley (2001) describes the different interests in the Australian climate policy debate and suggests that industrial emitters managed to steer the country away from ambitious reduction target – and toward an emissions increase – at the third Conference of the Parties in Kyoto.

Due to the fact that there is little consensus as to what constitutes optimal distribution, it can be difficult to compare – let alone rank – environmental policies based on distributional criteria (Revesz and Stavins, 2006). One exception is provided by Asheim *et al*. (2001), who construct an axiom of equity which, they argue, can be used to evaluate sustainability.[3] However, while sustainability may be important when evaluating environmental policies, it only captures the inter-generational dimension of distribution and is imperfectly related to political acceptability.

13.1.2.4 Institutional feasibility

Institutional realities inevitably constrain environmental policy decisions. Environmental policies that are well adapted to existing institutional constraints have a high degree of institutional feasibility. Economists traditionally evaluate instruments for environmental policy under ideal theoretical conditions; however, those conditions are rarely met in practice, and instrument design and implementation must take political realities into account. In reality, policy choices must be both acceptable to a wide range of stakeholders and supported by institutions, notably the legal system. Other important considerations include human capital and infrastructure as well as the dominant culture and traditions. The decision-making style of each nation is therefore a function of its unique political heritage. Box 13.2 provides an example for one country, taken largely from OECD (2005c).

Certain policies may also be popular due to institutional familiarity. Although market-based instruments are becoming more common, they have often met with resistance from environmental groups. Market-based instruments continue to face strong political opposition, even in the developed world, as demonstrated by environmental taxes in the USA or Europe. Regulatory policies that are outside of the norm of society will always be more difficult to put into effect (e.g. speed limits in Germany, or private sector participation in water services in Bolivia).

Another important dimension of institutional feasibility deals with implementing policies once they have been designed and adopted. Even if a policy receives political support, it may be difficult to implement under certain bureaucratic structures.

2 The United States has acknowledged the role of distribution explicitly through Executive Order 12878 (1994), which requires federal agencies to address environmental justice in their missions and activities.
3 For a summary of the economic literature on sustainability and intergenerational equity, see Pezzey and Toman (2002).

Box 13.2 The UK climate change levy: a study in political economy

The UK has a tradition of action on climate change that dates from the early acceptance of the problem by the Conservative Prime Minister Margaret Thatcher in 1988. The Labour government in 1997 reaffirmed the commitment to act and to use market-based instruments wherever possible; however, it voiced concerns on two aspects of this commitment: Firstly, that such measures might have a disproportionate effect on the poor which, in turn, might affect the coal mining communities (an important constituency) and, secondly, that this commitment might perpetuate a perception that the Labour government was committed to high taxes.

A key element of the UK's climate policy is a climate levy. The levy is paid by energy users – not extractors or generators – is levied on industry only and aims to encourage renewable energy. An 80% discount can be secured if the industry in question participates in a negotiated 'climate change agreement' to reduce emissions relative to an established baseline. Any one company over-complying with its agreement can trade the resulting credits in the UK emissions trading scheme, along with renewable energy certificates under a separate renewable energy constraint on generators. However, a number of industrial emitters wanted a heavier discount and, through lobbying, they managed to have a voluntary emissions trading scheme established that enables companies with annual emissions above 10,000 tCO_2-eq to bid for allocation of subsidies. The "auction" offered payments of 360 million €and yielded a de-facto payment of 27 € per tonne of CO_2. Thus, the trading part of the scheme has design elements that strongly reflect the interest groups involved (Michaelowa, 2004). The levy itself has limited coverage and, consequently, households, and energy extractors and generators have no incentive to switch to low carbon fuels. However, its design does take household vulnerability, competitiveness concerns and the sensitivity of some sectoral interests into account. Thus, while the levy has contributed to emission reduction, it has not been as effective as a pure tax; a pure tax may not have been institutionally feasible.

13.2 National policy instruments, their implementation and interactions

The policy-making process of almost all governments consists of complex choices involving many stakeholders, including the potential regulated industry, suppliers, producers of complementary products, labour organizations, consumer groups and environmental organizations. The choice and design of virtually any instrument has the potential to benefit some of these stakeholders and to harm others. For example, permits allocated free to existing firms represent a valuable asset transferred from the government to industry, while auctioned permits and taxes generally impose heavier burdens on polluters. As a result, it is likely that a candidate instrument will likely face both support and opposition from the stakeholders. Voluntary measures are often favoured by industry because of their flexibility and potentially lower costs, but these are often opposed by environment groups because of their lack of accountability and enforcement. In practice, policies may be complementary or opposing; moreover, the political calculus used to choose a particular instrument differs for each government.[4]

In formulating a domestic climate policy programme, a combination of policy instruments may work better in practice than reliance on a single instrument. Furthermore, an instrument that works well in one country may not work well in another country with different social norms and institutions. When instruments are to be compared, it is important that the different levels of stringency be taken into consideration and adjusted, for all of the instruments described herein may be set at different levels of stringency. Regulations will also undoubtedly need to be adjusted over time. All instruments must be supplemented with a workable system of monitoring and enforcement. Furthermore, instruments may interact with existing institutions and regulations in other sectors of society.

13.2.1 Climate change and other related policies

In this section we consider a number of instruments that have been used to manage environmental problems in different parts of the world. Some of these tools have been used for climate policy, while others have not; however, experience from dealing with other pollutants suggests their applicability to climate. Mitigation options can range from the purely technological (such as fuel switching) to the purely behavioural (such as reducing vehicle kilometres travelled) as well as innumerable combinations of both technological and behavioural options. Policies, measures and instruments are tools to trigger the implementation of these options.

13.2.1.1 Regulations and standards

Regulatory standards are the most common form of environmental regulation, and they cover a wide variety of

4 The design of most instruments assumes effective compliance and penalty provisions.

approaches. A regulatory standard specifies with a certain degree of precision the action(s) that a firm or individual must undertake to achieve environmental objectives and can consist of such actions as specifying technologies or products to use or not use and/or more general standards of performance as well as proclaiming dictates on acceptable and unacceptable behaviour. Two broad classes of regulatory standards are technology and performance standards. Technology standards mandate specific pollution abatement technologies or production methods, while performance standards mandate specific environmental outcomes per unit of product. In this context, where a technology standard might mandate specific CO_2 capture and storage methods on a power plant, a performance standard would limit emissions to a certain number of grams of CO_2 per kilowatt-hour of electricity generated. A product standard would, for example, be the requirement that refrigerators operate minimally at a specified level of efficiency, while a technology-forcing standard would involve setting the refrigerator efficiency requirement slightly beyond present-day technological feasibility but announcing that the efficiency requirement will not go into effect until a number of years following the announcement.

The primary advantage of a regulatory standard is that it may be tailored to an industry or firm, taking into account the specific circumstances of that industry or firm. There is also a more direct connection between the regulatory requirement and the environmental outcome, which can provide some degree of certainty.

Technology standards involve the regulator stipulating the specific technology or equipment that the polluter must use. Technology standards are best used when there are few options open to the polluter for controlling emissions; in this case, the regulator is able to specify the technological steps that a firm should take to control pollution. The information requirements for technology standards are high: the regulator must have good and reliable information on the abatement costs and options open to each firm. Losses in cost effectiveness arise when regulators are less well informed; technology standards may then be applied uniformly to a variety of firms, rather than tailoring the standard to the actual circumstance of the firm. This raises costs without improving environmental effectiveness and is one of the main drawbacks to regulatory standards.

Performance standards can reduce these potential problems with technology standards by providing more flexibility (IPCC, 2001). Costs can generally be lower whenever a firm is given some discretion in how it meets an environmental target. Performance standards expand compliance options beyond a single mandated technology and may include process changes, reduction in output, changes in fuels or other inputs and alternative technologies. Despite this increased flexibility, performance standards also require well-informed and responsive regulators.

One problem with regulatory standards is that they do not provide polluters with the incentive(s) to search for better approaches to reducing pollution. Thus, they may not perform well in inducing innovation and technological change (Jaffe *et al*., 2003; Sterner, 2003). If a government mandates a certain technology, there is no economic incentive for firms to develop more effective technologies. Moreover, there may be a 'regulatory ratchet' whereby firms are discouraged from developing more effective technologies out of fear that standards will be tightened yet again (Harrington *et al*., 2004). Finally, although it may be possible to force some technological change through technology mandates, it is difficult for regulators to determine the amount of change that is possible at a reasonable economic cost. This raises the possibility of implementing either costly, overly stringent requirements or, alternatively, weak, unambitious requirements (Jaffe *et al*., 2003). Nevertheless, there are examples in the literature of technology innovations spurred by regulatory standards. For example, Wätzold (2004) reported innovative responses from pollution control vendors in Germany in response to standards for SO_2 control.

Although relatively few regulatory standards have been adopted with the sole aim of reducing GHG emissions, standards have been adopted that reduce these gases as a co-benefit. For example, there has been extensive use of standards to increase energy efficiency in over 50 nations (IPCC, 2001). Energy efficiency applications include fuel economy standards for automobiles, appliance standards, and building codes.[5] These types of policies are discussed in more detail in Chapters 5 and 6 of this report. Standards to reduce methane and other emissions from solid waste landfills have been adopted in Europe, the USA and other countries (see Chapter 10) and are often driven by multiple factors, including the reduction of volatile organic compound (VOC) emissions, improved safety by reducing the potential for explosions and reduced odours for local communities (Hershkowitz, 1998).

There are a number of documented situations in which regulatory standards have worked well (see Freeman and Kolstad, 2006; Sterner, 2003). Sterner (2003) reports several cases of such situations, including those in which firms are not responsive to price signals (e.g. in non-competitive settings or with state enterprises) and where monitoring emissions is difficult but tracking the installation of technology is easy. In situations where there is imperfect monitoring and homogeneous abatement costs between firms, Montero (2005) finds that standards may lead to lower emissions and may be economically more efficient than market-based instruments. Based on an analysis of the German SO_2 abatement programme, Wätzold (2004) concludes that a technology standard may be acceptable

5 For example, the Green Building Council in the United States of America.

Box 13.3 China mandates energy efficiency standard in urban construction

Approximately 2 billion m^2 of floor space is being built annually in China, or one half of the world's total. Based on the growing pace of its needs, China will see another 20–30 billion m^2 of floor space built between the present and 2020. Buildings consume more than one third of all final energy in China, including biomass fuels (IEA, 2006). China's recognition of the need for energy efficiency in the building sector started as early as the 1980s but was impeded due to the lack of feasible technology and funding. Boosted by a nationwide real estate boom, huge investment has flowed into the building construction sector in recent years.

On 1 January, 2006, China introduced a new building construction statute that includes clauses on a mandatory energy efficiency standard for buildings. The Designing Standard for Energy Conservation in Civil Building requires construction contractors to use energy efficient building materials and to adopt energy-saving technology in heating, air conditioning, ventilation and lighting systems in civil buildings. Energy efficiency in building construction has also been written into China's 11th Five-Year National Development Programme (2006–2010), which aims for a 50% reduction in energy use (compared with the current level) and a 65% decrease for municipalities such as Beijing, Shanghai, Tianjin and Chongqing as well as other major cities in the northern parts of the country. Whether future buildings will be able to comply with the requirements in the new statute will be a significant factor in determining whether the country will be able to realize the ambitious energy conservation target of a 20% reduction in energy per gross domestic product (GDP) intensity during the 11th Five-Year Plan of 2005–2010.

when only one technology exists to achieve an environmental result and, therefore, firms do not face differential abatement costs. Finally, standards may be desirable where there are informational barriers that prevent firms or individuals from responding solely to price signals. This may be particularly relevant for energy efficiency standards for household appliances and other similar applications (OECD, 2003d). Chapter 6 provides additional information on this subject.

A growing body of literature is focusing on whether regulatory standards or market-based instruments are preferable for developing countries. One common view is that technology standards may be more appropriate for building the initial capacity for emissions reduction because economic incentive programmes require more specific and greater institutional capacity, have more stringent monitoring requirements and may require fully developed market economies to be effective (IPCC, 2001; Bell and Russell, 2002). Willems and Baumert (2003) support this approach but also note that technology approaches, policies and measures may have greater applicability to the general capacity needs of developing countries interested in pursuing sustainable development strategies (See Box 13.3). Russell and Vaughan (2003) suggest that a transitional strategy is the appropriate approach for developing countries, whereby technology standards are introduced first, followed by performance standards and finally by experimentation with market-based instruments. An alternative view is that, in some cases, a performance standard at the facility level and an overall emissions cap could provide a more a more effective structure (Ellerman, 2002; Kruger *et al*., 2003). This type of approach could also facilitate a transition to a tradable permits programme as the institutions and economies develop over time.

13.2.1.2 Taxes and charges

An emission tax on GHG emissions requires individual emitters to pay a fee, charge or tax[6] for every tonne of GHG released into the atmosphere.[7] An emitter must pay this per-unit tax or fee regardless of how much emission reduction is being undertaken.[8] Each emitter weighs the cost of emissions control against the cost of emitting and paying the tax; the end result is that polluters undertake to implement those emission reductions that are cheaper than paying the tax, but they do not implement those that are more expensive, (IPCC, 1996, Section 11.5.1; IPCC, 2001, Section 6.2.2.2; Kolstad, 2000). Since every emitter faces a uniform tax on emissions per tonne of GHG (if energy, equipment and product markets are perfectly competitive), emitters will undertake the least expensive reductions throughout the economy, thereby equalizing the marginal cost of abatement (a condition for cost-effectiveness). Taxes and charges are commonly levelled on commodities that are closely related to emissions, such as energy or road use.

An emissions tax provides some assurance in terms of the marginal cost of pollution control, but it does not ensure a particular level of emissions. Therefore, it may be necessary to

6 No distinction is made here among the terms taxes, fees or charges. In actuality, the revenue from taxes may go into the general government coffers, whereas the revenue from fees or charges may be earmarked for specific purposes.
7 Because GHGs have different effects on atmospheric warming per unit of emissions, the use of carbon dioxide equivalents (CO_2-eq) is one way of measuring relative impact.
8 An alternative is the idea of threshold taxes, where the tax per unit of emissions is only assessed on emissions greater than a set threshold (Pezzey 2003). In other words, infra-marginal emissions would be tax-exempt. This type of tax would generate less revenue but could be more politically acceptable.

adjust the tax level to meet an internationally agreed emissions commitment (depending on the structure of the international agreement). Over time, an emissions tax needs to be adjusted for changes in external circumstances, such as inflation, technological progress and new emissions sources (Tietenberg, 2000). Fixed emissions charges in the transition economies of Eastern Europe, for example, have been significantly eroded by the high inflation of the past decade (Bluffstone and Larson, 1997). Innovation and invention generally have the opposite effect by reducing the cost of emissions reductions and increasing the level of reductions implemented. If the tax is intended to achieve a given overall emissions limit, the tax rate will need to be increased to offset the impact of new sources (Tietenberg, 2000).

Most environmentally related taxes with implications for GHG emissions in OECD countries are levied on energy products (150 taxes) and on motor vehicles (125 taxes), rather than on CO_2 emission directly. There is also a significant number of waste-related taxes in OECD countries (about 50 taxes in all), levied either on particular products that can cause particular problems for waste management (about 35 taxes) or on various forms of final waste disposal, including those on incineration and/or land-filling (15 taxes in all). A very significant share of all the revenues from environmentally related taxes originates from taxes on motor fuels. Such taxes were introduced in all member countries many decades ago – primarily as a means to raise revenue. Irregardless of the underlying reasoning for their implementation, however, they do impact on the prices (potential) car users are confronted with and thus have important environmental impacts.

However, there is some experience with the direct taxation of CO_2 emissions. The Nordic Council of Ministers (2002) notes that CO_2 emissions in Denmark decreased by 6% during the period 1988–1997 while the economy grew by 20%, but that they also decreased by 5% in a single year – between 1996 and 1997 – when the tax rate was raised. Bruvoll and Larsen (2004) analysed the specific effect of carbon taxes in Norway. Although total emissions did increase, these researchers found a significant reduction in emissions per unit of GDP over the period due to reduced energy intensity, changes in the energy mix and reduced process emissions. The overall effect of the carbon tax was, however, modest, which may be explained by the extensive tax exemptions and relatively inelastic demand in those sectors in which the tax was actually implemented. Cambridge Econometrics (2005) analysed the impacts of the Climate Change Levy in the UK and found that total CO_2 emissions were reduced by 3.1 MtC – or 2.0% – in 2002 and by 3.6 MtC in 2003 compared to the reference case. The reduction is estimated to grow to 3.7 MtC – or 2.3% – in 2010.

To implement a domestic emissions tax, governments must consider a number of issues, such as the level at which the tax should be set, particularly in the case of pre-existing taxes (e.g. taxes which already exist on energy), or other potential distortions (e.g. subsidies to certain industries or fuels). Consideration must also be given to how the tax is used, with such options as whether it goes directly into general government coffers, is used to offset other taxes (i.e. the double-dividend effect), is transferred across national boundaries to an international body, is earmarked for specific abatement projects, such as renewable energy, or is allocated to those most adversely impacted by either the costs of emission reduction or damage from climate change. Another important issue is the point at which the tax is should be levied. A tax on gasoline may be levied at the pump and collected directly from consumers or it may be levied on wholesale gasoline production and collected from oil companies. In either case, the final consumer ultimately pays most of this cost, but the administrative and monitoring costs may differ dramatically in the two cases.

Emission taxes do well in both cost effectiveness and environmental effectiveness. The real obstacles facing the use of emission taxes and charges are distributional and, in some countries, institutional. At the best of times, new taxes are not politically popular. Furthermore, emissions or energy taxes often fall disproportionately on lower income classes, thereby creating negative distributional consequences. In developing countries, institutions may be insufficiently developed for the collection of emission fees from a wide variety of dispersed sources. In many countries, state enterprises play a significant role; such public or quasi-private entities may not respond adequately to the incentive effects of a tax or charge.

13.2.1.3 Tradable permits

A steadily increasing amount of research is focusing on tradable permits in terms of, among others, efficiency and equity issues associated with the distribution of permits, implications of economy-wide versus sectoral programmes, mechanisms for handling price uncertainties, different forms of targets and compliance and enforcement issues.

Tradable permit systems can be designed to cover either emissions from a few sectors of the economy or those from virtually the entire economy.[9] A number of analyses have found that economy-wide approaches are superior to sectoral coverage because they equalize marginal costs across the entire economy. Using a variety of models, Pizer *et al*. (2006) report that in the USA significant cost savings are linked to an economy-wide programme when compared to a sectoral programme coupled with non-market-based policies.[10] Researchers have found similar results for the European Union

9 Thus far, emissions trading programmes, such as those for SO_2 and NO_x in the USA and that of the EU Emis-sions Trading System (EU ETS) for CO_2 have only covered certain sectors. In the case of the EU ETS, Chris-tiansen and Wettestad (2003) write that the EU restricted the sectors involved to ease implementation during the first phase of the programme.

Box 13.4 The EU Emission Trading System

The EU Emissions Trading System (EU ETS) is the world's largest tradable permits programme. The programme was initiated on January 1, 2005, and it applies to approximately 11,500 installations across the EU's 25 Member States. The system covers about 45% of the EU's total CO_2 emissions and includes facilities from the electric power sector and other major industrial sectors.

The first phase of the EU ETS runs from 2005 until 2007. The second phase will begin in 2008 and continue through to 2012, coinciding with the 5-year Kyoto compliance period. Member States develop National Allocation Plans, which describe in detail how allowances will be distributed to different sectors and installations. During the first phase, Member States may auction off up to 5% of their allowances; during the second phase, up to 10% of allowances may be auctioned off.

Market development and prices: A number of factors affect allowance prices in the EU ETS, including the overall size of the allocation, relative fuel prices, weather and the availability of certified emission reductions (CERs) from the Clean Development Mechanism (CDM) (Christiansen *et al*., 2005). The EU ETS experienced significant price volatility during its start-up period, and for a brief period in April 2006 prices rose to nearly 30 per tonne; however, prices subsequently dropped dramatically when the first plant-level emissions data from Member States were released. The sharp decline in prices focused attention on the size of the initial Phase I allocation. Analysts have concluded that this initial allocation was a small reduction from business as usual emissions (Grubb *et al*., 2005; Betz *et al*., 2004).

Consistency in national allocation plans: Several studies have documented differences in the allocation plans and methodologies of Member States (Betz *et al*., 2004; Zetterberg *et al*. 2004; Baron and Philibert, 2005; DEHSt, 2005). Researchers have looked at the impact on innovation and investment incentives of different aspects of allocation rules (Matthes *et al*., 2005; Schleich and Betz, 2005) and have found that these rules can affect technology choices and investment decisions. Ahman *et al*. (2006), Neuhoff *et al*. (2006) and Betz *et al*., (2004) find that when Member States' policies require the confiscation of allowances following the closure of facilities, this creates a subsidy for continued operation of older facilities and a disincentive to build new facilities. They further find that different formulas for new entrants can impact on the market.

Implications of free allocation on electricity prices: Sijm *et al*. (2006) report that a significant percentage of the value of allowances allocated to the power sector was passed on to consumers in the price of electricity and that this pass-through of costs could result in substantially increased profits by some companies. The authors suggest that auctioning a larger share of allowances could address these distributional issues. In a report for the UK government, IPA Energy Consulting found a similar cost pass-through for the UK and other EU Member States (IPA Energy Consulting, 2005).

and the EU ETS. (Babiker *et al*., 2003; Betz *et al*., 2004; Klepper and Peterson, 2004; Bohringer and Löschel, 2005).

Not only the coverage of sectors may vary in a tradable permits programme, but also the point of obligation. The responsibility for holding permits may be assigned directly to emitters, such as energy-using industrial facilities (downstream), to producers or processors of fuels (upstream) or to some combination of the two (a 'hybrid system').[11] The upstream system would require permits to be held at the level of fossil fuel wholesalers and importers (Cramton and Kerr, 2002).[12]

There are two basic options for the initial distribution of permits: (1) free distribution of permits to existing polluters or (2) auctions. Cramton and Kerr (2002) describe a number of equity benefits of auctions, including providing a source of revenue that could potentially address inequities brought about by a carbon policy, creating equal opportunity for new entrants and avoiding the potential for "windfall profits" that might accrue to emissions sources if allowances are allocated at no charge.[13] (See Box 13.4 for a discussion of this issue).

Goulder *et al*. (1999) and Dinan and Rogers (2002) find that recycling revenues from auctioned allowances can have economy-wide efficiency benefits if they are used to reduce certain types of taxes. Dinan and Rogers (2002) and Parry (2004) argue that free allocation of tradable permits may be regressive because this type of allowance distribution leads to income

10 However, they also find that the exclusion of certain sectors, such as residential and commercial direct use of fossil fuels, does not noticeably affect the cost of an otherwise economy-wide tradable permit system covering electricity production, industry and transportation.

11 See IPCC (2001b), Baron and Bygrave (2002), UNEP/UNCTAD (2002), and Baron and Philibert (2005) for a discussion of the advantages and disadvantages of these different approaches.

12 As the discussion below notes, the point of obligation is not necessarily the point at which all permits need be allocated.

13 A hybrid of free allocation and auctioning or emissions taxes is also possible (Pezzey 2003). Bovenburg and Goulder (2001) and Burtraw *et al*. (2002) find that allocating only a small portion of permits at no cost while auctioning the remainder can compensate industry for losses due to a carbon policy.

transfers towards higher income groups (i.e. shareholders) at the expense of households. In contrast, these authors find that government revenues from auctions may be used to address equity issues through reductions in taxes or other distributions to low-income households. Ahman *et al*. (2006) argue that a gradual transition from free allocation to auctioning might be a politically feasible manner to develop a fairer distribution of allowances.

To date, most emissions trading programmes have distributed emissions allowances almost entirely through free allocations.[14] Experience with the US SO_2 programme shows that the no-cost allocation of allowances was critical for gaining political acceptance for the emissions trading concept (Ellerman, 2005). Christiansen and Wettestad (2003) and Markussen and Svendsen (2005) discuss how interest group pressures led to a largely free allocation of allowances in the EU ETS. In a broader sense, the rationale for a policy allowing some free allocation of allowances based on historic emissions is based on the desire to compensate incumbent installations that are affected by the regulation (Tietenberg, 2003; Harrison and Radov, 2002, Ahman *et al*. 2006).

The number of publications exploring the efficiency, equity and competitiveness implications of allowance allocation approaches is continuing to grow. For example, Burtraw *et al*. (2001b) and Fischer (2001) found that periodic updates of allocations on the basis of production are economically inefficient. In an analysis of a potential emissions trading programme in Alberta, Canada, Haites (2003b) found that this type of periodic updating of allocations based on each source's output may reduce the decline in production for some sectors that may arise from an emissions cap but that it may also reduce profits and raise overall costs when compared to a fixed allocation. Demailly and Quirion (2006) find that under certain assumptions, an output-based allocation in the European cement industry would reduce leakage with limited impacts on production. See Chapter 11, Section 11.7.4 for a more extensive discussion on competitiveness issues.

A final issue associated with the distribution of allowances is whether excessive market power can distort prices. Maeda (2003) examines how the initial distribution of permits affects the potential emergence of firms with market power. Tietenberg (2006) summarizes research on market power, including studies on whether different auction designs or initial permit allocation can lead to price manipulation by dominant firms. He concludes that in practice, market power 'typically has not been a problem in emissions trading.' There has yet to be an overall assessment of market power in the EU ETS.

Several authors have compared the advantages and disadvantages of absolute targets (i.e., mass emissions limits on a sector or economy) to those of intensity targets (i.e. limits on emission per unit of GDP).[15] Ellerman and Wing (2003) and Kolstad (2006) find that intensity targets can reduce the uncertainties associated with the cost of emission reduction under uncertain economic growth levels. Pizer (2005b) finds that intensity targets may be more appropriate if the short-term objective is to slow, rather than halt, emissions growth, while Ellerman and Wing (2003) show that an intensity target may be set so stringently that it can halt or reverse growth. Dudek and Golub (2003) argue that absolute targets have more certain environmental results and lower transaction costs for emissions trading, thereby creating stronger incentives for technological change. Kuik and Mulder (2004) find that, for the EU, an intensity or relative target would avoid negative effects on competitiveness but would not reduce emissions at the lowest costs. In contrast, an absolute target combined with permit trading leads to efficient emissions reduction, but its overall macroeconomic costs may be significant. Finally, Quirion (2005) argues that, in the most plausible cases, an emissions tax and an absolute target are superior to an intensity target and that the welfare gaps between the two types of targets are very small. Overall, intensity targets are less effective than absolute targets if the goal is to achieve a certain level of emissions reduction, but they may be more effective at addressing costs when economic growth is uncertain.

Although a tradable permits approach can ensure that a certain quantity of emissions will be reduced, it does not provide any certainty of price. Price uncertainty may be addressed by a 'price cap' or 'safety valve' mechanism, which guarantees that the government will sell additional permits if the market price of allowances hits a certain price (Pizer, 2002; McKibbon and Wilcoxen; 2002, Jacoby and Ellerman; 2004).[16] The underlying reasoning is that GHGs become the focus of concern as they accumulate over an extended period in the atmosphere. There may therefore be less concern about short-term increases in CO_2 as long as the overall trajectory of CO_2 emissions is downward over an extended period (Newell and Pizer, 2003). While the safety valve mechanism shares some advantages with price-based mechanisms, such as a tax, the former may have the added political advantage of providing emitters with an additional allocation of allowances (Pizer, 2005a). A safety valve mechanism does not provide any certainty that a particular emissions level will be met, and it requires additional administrative complexity to link a domestic programme with a safety valve to a programme without a safety valve or with a different safety valve price.

14 The US SO_2 trading programme contains a small reserve auction, which was valuable for price discovery during the early years of the programme (Ellerman *et al*., 2000). Revenue from this auction was returned to the companies affected in the programme. Only four EU Member States (Denmark, 5%; Hungary, 2.5%; Ireland, 0.75%; Lithuania, 1.5%) decided to auction off parts of their ET budget in the first phase of the EU ETS scheme (Betz *et al*., 2004).

15 Intensity targets are also known as "rate-based", "dynamic," "indexed," and "relative" targets.

16 It is also possible to have a "price floor" to ensure that prices don't go below a certain level. For example, Hepburn *et al*. (2006) discuss how a coordinated auction measure for the EU ETS could be used to support a minimum price.

Experience with trading programmes in the USA has shown significant benefits can be derived from the temporal flexibility provided by banking provisions in cases where the exact timing of emission reductions is not critical to environmental effectiveness (Ellerman *et al*., 2000; Stavins, 2003). Allowance banking can create a cushion that will prevent price spikes and can hedge uncertainty in allowance prices (Jacoby and Ellerman, 2004).[17] A banking provision allows the arbitrage between actual marginal abatement costs in one phase of a programme and the expected abatement costs in a future phase of a programme. The temporal flexibility of banking is particularly useful for companies facing large capital expenditures because it provides some flexibility in the timing of those expenditures (Tietenberg, 2003). In some emission markets in the USA, banking has been restricted where there was concern about short-term increases in emissions (Tietenberg, 2006). Banking was also restricted between Phase I and Phase 2 in the EU ETS to avoid a large bank that would make it more difficult to meet Kyoto targets.

Several critical elements of an effective enforcement regime for emissions trading have been described in the literature. First, if the goal is strict adherence to the emission limits implied by the number of permits, then excess emissions penalties should be set at levels substantially higher than the prevailing permit price in order to create the appropriate incentives for compliance (Swift, 2001; Stranland *et al*., 2002).[18] A second component of an enforcement regime is reasonably accurate emissions monitoring (Stranland *et al*., 2002; Stavins, 2003). San Martin (2003) and Montero (2005) report that incomplete monitoring can undermine the efficiency of trading programmes. Tietenberg (2003) and Kruger *et al*. (2000) emphasize that public access to emissions and trading data provides an additional incentive for compliance.

Finally, there have been several experiments with tradable permits for conventional pollution control in developing countries and economies in transition (Bygrave, 2004; US EPA, 2004). For example, Montero *et al*. (2002) evaluate an experiment with tradable permits for total suspended particulates (TSP) in Santiago, Chile and find that permit markets are underdeveloped due to high transaction costs, uncertainty and poor enforcement. However, they also find an improved documentation of historic emissions inventories and an increased flexibility to address changing market conditions. S. Gupta (2003b) and Wang *et al*. (2004) suggest strengthening the monitoring and enforcement capacity that would be required to implement conventional pollution trading programmes in India and China, respectively. Several authors have concluded that tradable permit programmes may be less appropriate for developing countries due to their lack of appropriate market or enforcement institutions. (Blackman and Harrington, 2000, Bell and Russell, 2002)

13.2.1.4 Voluntary agreements

Voluntary agreements are agreements between a government authority and one or more private parties to achieve environmental objectives or to improve environmental performance beyond compliance to regulated obligations. Voluntary agreements are playing an increasingly important role in many countries as a means to achieve environmental and social objectives. They tend to be popular with those directly affected and can be used when other instruments face strong political opposition (Thalmann and Baranzini, 2005). Box 13.5 provides examples of VAs. See Chapter 7, Section 7.9.2 for additional information.

Voluntary agreements can take on many forms with varying levels of stringency. While all VAs are ‘voluntary’ insofar as firms are not compelled to join, some may involve incentives (rewards or penalties) for participation. Firms may agree to direct emissions reductions or to indirect reductions through changes in product design (see Chapter 6, Section 6.8.2.2.). Agreements may be stand-alone, but they are often used in conjunction with other policy instruments. Voluntary agreements are also a subset of a larger set of ‘voluntary approaches’ in which industry may first negotiate standards of behaviour with other firms or private groups and then allow third parties to monitor compliance. This larger set also includes unilateral voluntary actions by industry. See Section 13.4, Box 13.5, and Chapter 7, Section 7.9.2 for more information on voluntary actions.

The benefits of VAs for individual companies and for society may be significant. Firms may enjoy lower legal costs, enhance their reputation and improve their relationships with society on a whole and shareholders in particular. Societies gain to the extent that firms translate goals into concrete business practices and persuade other firms to follow their example. The negotiations involved to develop VAs raise awareness of climate change issues and potential mitigative actions within industry (Kågeström *et al*., 2000), establish a dialogue between industry and government and help shift industries towards best practices.

Evaluating the effectiveness of VAs is not easy. The standard approach is first to measure the environmental performance of a group of firms participating in a VA and then to compare the performance to that of a typical non-participating firm or firms. One problem with this approach is selection bias: it is often the best-performing firms that enter into a VA. A second and related problem is the counterfactual: it is difficult to know what a firm might have done had they not entered into the VA. Very few studies have attempted to evaluate VAs by taking into account both of these issues. Studies which do not take these factors into account can produce an overly optimistic view of the performance of a VA.

17 Price uncertainty may also be addressed by “borrowing” of allowances, i.e. using allowance allocations from future years.

18 The addition of a “make good” provision – that is, the requirement stating that allowances from a subsequent compliance year or period are surrendered for any excess emissions – is a further design element used to ensure that an absolute emissions target is met (Betz and MacGill, 2005).

The environmental effectiveness of VAs is the subject of much discussion. Some governments – as well as industry – believe that VAs are effective in reducing GHG emissions (IAI, 2002; OECD, 2003c). Rietbergen *et al*. (2002) investigated whether the voluntary agreements in The Netherlands have resulted in improvements in energy efficiency beyond what would have occurred in the absence of such agreements. They estimate that, on average, between 25% and 50% of the energy savings in the Dutch manufacturing industry can be attributed to the policy mix of the agreements and supporting measures.

Others are more sceptical about the efficacy of VAs in reducing emissions. Independent assessments of VAs – while acknowledging that investments in cleaner technologies have resulted in absolute emission improvements – indicate that there is little improvement over business-as-usual (BAU) scenarios, as these investments would have probably happened anyway (Harrison, 1999; King and Lenox, 2000; Rietbergen and Blok, 2000; OECD, 2003e; Rivera and deLeon, 2004). The economic efficiency of VAs can also be low, as they seldom incorporate mechanisms to equalize marginal abatement costs between different emitters (Braathen, 2005).

There are a limited, although increasing, number of comprehensive reviews of the effectiveness of VAs, but any comparison of these reviews and assessments is difficult because of the different metrics and evaluative criteria employed (Price, 2005). In general, studies of the design and efficacy of VAs assess only a single programme (e.g. Arora and Cason, 1996; Khanna and Damon, 1999; King and Lenox, 2000; Welch *et al*., 2000; Rivera, 2002; Croci, 2005). Based on her evaluation of the French experience, Chidiak (2002) suggests that the reductions in GHG emissions cannot necessarily be seen as a direct consequence of the commitments within the agreements and argues that, in actual fact, these improvements have been triggered largely as a result of other environmental regulations and cost reduction efforts. Johannsen (2002) and Helby (2002) present similar results for programmes in Denmark and Sweden, respectively. They note that reductions in specific emissions correspond with industry's BAU behaviour, thereby suggesting that the stated objectives in the agreements were not sufficiently ambitious. In particular, Helby concludes that EKO-Energi, which sought to highlight a new level of best practice and thus pose a challenge to other firms, was 'at best a very modest success,' resulting in a small overall direct effect on total industrial energy consumption. Interestingly, Chidiak also finds that the agreements did not foster intra-industry networking and information exchange on energy management and suggests that their failure to achieve more ambitious goals is a result of the lack of a well-articulated policy-mix. Other analyses indicate that VAs work best as part of a policy package, rather than as a stand-alone instrument (Krarup and Ramesohl, 2002; Torvanger and Skodvin, 2002). OECD (2003e) and Braathen (2005) note that many of the current VAs would perform better if there were a real threat of other instruments being used if targets are not met.

The US Government Accountability Office (2006), in its review of the US Climate Vision and Leaders Programmes, which are supported by the Environmental Protection Agency (EPA) and Department of Energy (DOE), finds that emission reduction goals were set for only 38 of 74 participants, that some goals are intensity-based and others emission-based and that programmes vary in terms of how they are measured, the time periods covered, the requirements for reporting and the means of tracking progress. Brouhle *et al*. (2005) note that the difficulties in evaluating US programmes is associated to the many different programmes and their goals that need be sorted, the availability of adequate data and the measuring of achievement relative to a baseline. Jaccard *et al*. (2006) review various Canadian voluntary programmes that have been in existence for 15 years and report that during that period emissions have grown by 25%.

Darnall and Carmin (2003) review 61 governmental, industry and third-party general environmental agreements, mainly in the USA (see also Lyon and Maxwell, 2000). Overall, their results demonstrate that the voluntary programmes had low programme rigour in that they had limited levels of administrative, environmental and performance requirements. For example, two thirds did not require participants to create environmental targets and to demonstrate that the targets were met. Similarly, almost 50% of the programmes had no monitoring requirements. Compared to government programmes, industry programmes had stronger administrative requirements and third party programmes had yet even slightly stronger requirements. According to Hanks (2002) and OECD (2003e), the best VAs include: a clear goal and baseline scenario; third party participation in the design of the agreement; a description of the parties and their obligations; a defined relationship within the legal and regulatory framework; formal provisions for monitoring, reporting and independent verification of results at the plant level; a clear statement of the responsibilities expected to be self-financed by industry; commitments in terms of individual companies, rather than as sectoral commitments; references to sanctions or incentives in the case of non-compliance.

It must be acknowledged that VAs fit into the cultural traditions of some countries better than others. Japan, for example, has a history of co-operation between government and industry that facilitates the operation of "voluntary" programmes. Some examples of VAs in various countries are provided in Box 13.5.

13.2.1.5 Subsidies and incentives

Direct and indirect subsidies can be important environmental policy instruments, but they have strong market implications and may increase or decrease emissions, depending on their nature. Subsidies aimed at reducing emissions can take different forms, ranging from support for Research and Development

Box 13.5 Examples of national voluntary agreements

- **The Netherlands Voluntary Agreement on Energy Efficiency:** A series of legally binding long-term agreements based on annual improvement targets and benchmarking covenants between 30 industrial sectors and the government with the objective to improve energy efficiency.
- **Australia "Greenhouse Challenge Plus" programme:** An agreement between the government and an enterprise/industry association to reduce GHG emissions, accelerate the uptake of energy efficiency, integrate GHG issues into business decision making and provide consistent reporting.[19] See http://www.greenhouse.gov.au/challenge.
- European Automobile Agreement: An agreement between the European Commission and European, Korean and Japanese car manufacturing associations to reduce average emissions from new cars to 140 gCO_2/km by 2008–2009. See http://ec.europa.eu/environment/CO_2/CO_2_agreements.htm.
- **Canadian Automobile Agreement:** An agreement between the Canadian government and representatives of the domestic automobile industry to a reduce emissions from cars and light-duty trucks by 5.3 $MtCO_2$-eq by 2010. The agreement also contains provisions relating to research and development and interim reduction goals.
- **Climate Leaders:** An agreement between US companies and the government to develop GHG inventories, set corporate emission reduction targets and report emissions annually to the US EPA. See: http://www.epa.gov/climateleaders/.
- **Keidaren Voluntary Action Plan:** An agreement between the Japanese government and 34 industrial and energy-converting sectors to reduce GHG emissions. A third party evaluation committee reviews the results annually and makes recommendations for adjustments.[20] See http://www.keidanren.or.jp

(R&D), investment tax credit, and price supports (such as feed-in tariffs for renewable electricity).[21] Subsidies that increase emissions typically involve support for fossil fuel production and consumption. They tend to expand the subsidized industry, relative to the non-subsidy case. If the subsidized industry is a source of GHG emissions, subsidies may result in higher emissions. Subsidies to the fossil fuel sector result in over-use of these fuels with resulting higher emissions; subsidies to agriculture can result in the expansion of agriculture into marginal lands and corresponding increases in emissions. Conversely, incentives to encourage the diffusion of new technologies, such as those for renewables or nuclear power, may promote emissions reductions.

One of the significant advantages of subsidies is that they have politically positive distributional consequences. The costs of subsidies are often spread broadly through an economy, whereas the benefits are more concentrated. This means that subsidies may be easier to implement politically than many other forms of regulatory instruments. Subsidies do tend to take on a life of their own, which makes it difficult to eliminate or reduce them, should that be desired.

The International Energy Agency (IEA) estimates that in 2001 energy subsidies in OECD countries alone were approximately 20–80 billion US$ (IEA, 2001). The level of subsidies in developing and transition economy countries is generally considered to be much higher. One example is low domestic energy prices that are intended to benefit the poor, but which often benefit high users of energy. The result is increased consumption and delayed investments in energy-efficient technologies. In India, kerosene and liquefied petroleum gas (LPG) subsidies are generally intended to shift consumption from biomass to modern fuels, reduce deforestation and improve indoor air quality, particularly in poor rural areas. In reality, these subsidies are largely used by higher expenditure groups in urban areas, thus having little effect on the use of biomass. Nevertheless, removal of subsidies would need to be done cautiously, in the absence of substitutes, as some rural households use kerosene for lighting (Gangopadhyay *et al*., 2005).

OECD countries are slowly reducing their subsidies to energy production or fuel (such as coal) or changing the structure of their support to reduce the negative effects on trade, the economy and the environment. Coal subsidies in OECD countries fell by 55% between 1991 and 2000 (IEA, 2001).[22] (See Chapter 7 for additional information.)[23] About 460 billion US$ is spent on agricultural subsidies, excluding water and fisheries (Humphreys *et al*., 2003), with OECD

19 As of 1 July 2006, participation in the programme is a requirement for Australian companies receiving fuel tax credits of more than 3 million US$.
20 This programme is a cross between a mandatory and voluntary programme; see Saito (2001), Yamaguchi (2003) and Tanikawa (2004) for additional information. The special relationship between the government and industry as well as unique societal norms make this voluntary initiative unique. In the context of Japan there is de facto enforcement.
21 One way of promoting the use of renewable sources of electricity is for the government to require electric power producers to purchase such electricity at favourable prices. The US Public Utility Regulatory Policy Act of 1978 required electric utilities to buy renewable energy at "avoided cost". In Europe, specific prices have been set at which utilities must purchase renewable electricity – these are referred to as "feed-in tariffs." These tariffs have been effective at promoting the development of renewable sources of electricity (Ackermann *et al*., 2001; Menanteau *et al*., 2003).
22 Calculated using producer subsidy equivalents.
23 It should be noted that a comprehensive analysis of subsidies requires the net effect of subsidies and taxes, including their point of allocation, to be considered.

countries accounting for about 318 billion US$ or 1.2% of the GDP. These subsidies result in the expansion of this sector with associated GHG implications (OECD, 2001, 2002).

Many countries provide financial incentives, such as tax credits for energy-efficient equipment and price supports for renewable energy, to stimulate the diffusion of technologies. In the USA, for example, the Energy Policy Act of 2005 contains an array of financial incentives for various advanced technologies; these financial incentives have been estimated at 11.4 billion US$ over a 10-year period.

One of the most effective incentives for fostering GHG reductions are the price supports associated with the production of renewable electricity, which tend to be set at attractive levels. These price supports have resulted in the significant expansion of the renewable energy sector in OECD countries due to the requirement that electric power producers purchase such electricity at favourable prices. The US Public Utility Regulatory Policy Act of 1978 requires electric utilities to buy renewable energy at "avoided cost". In Europe, specific prices have been set at which utilities must purchase renewable electricity – these are referred to as 'feed-in tariffs'. These tariffs have been effective at promoting the development of renewable sources of electricity (Ackermann *et al*., 2001; Menanteau *et al*., 2003). As long as renewables remain a relatively small portion of overall electricity production, consumers see only a small increase in their electricity rates. Incentives therefore have attractive properties in terms of environmental effectiveness, distributional implications and institutional feasibility. The main problem with them is cost-effectiveness: They are costly instruments, particularly in the long-run as interests and industries grow to expect the continuation of subsidy programmes. See Chapter 4.5 for a more extensive discussion.

13.2.1.6 Research and Development[24]

The role of R&D in changing the trajectory of energy economy is unquestionable – new technologies have played a large role in the evolution of the energy sector over the last century. Moreover, the rate at which low emission technologies will improve during the next 20–30 years will be an important determinant of whether low emission paths can be achieved in the long term.

Policy uncertainties, however, often hinder investment in R&D and the dissemination of new technology, although different types of polices may be needed to address different types of investment. Hamilton (2005) notes that investors prefer a policy environment which is 'loud, long and legal'. A number of authors note that long-term policy targets or clear foresight on carbon taxes can overcome social inertia and reduce uncertainty for investors in R&D (Blyth and Yang, 2006; Edenhofer *et al*., 2006; Reedman, Graham and Coombes, 2006).

Nearly 600 billion US$ was expended worldwide on R&D in all sectors in 2000, with approximately 85% of that amount being spent in only seven countries.[25] Over the last 20 years, the percentage of government-funded R&D has generally declined, while industry-funded R&D has increased in these countries. In a historic context, R&D expenditures as a percentage of GDP have gone up and down in cycles as government priorities have changed over the last 50 years, although in some instances comparisons over time are difficult (US-NSF, 2003; OECD, 2005a; US-GAO, 2005).

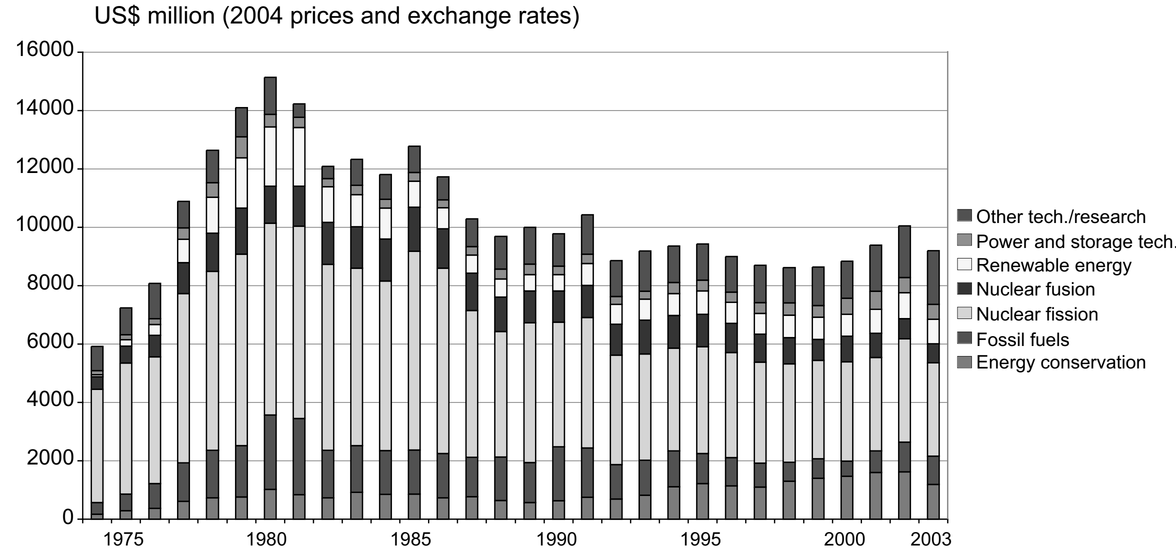
Total public funding for energy technologies in IEA countries during the period 1987–2002 was 291 billion US$, with 50% of this allocated to nuclear fission and fusion, 12.3% to fossil fuels and 7.7% to renewable energy technologies (IEA, 2004; see Figure 13.1).[26] Funding has dropped after the initial interest created through the oil shock in the 1970s and has stayed constant, even after the UNFCCC was ratified. Nemet and Kammen (2006) suggest that for the USA a change in direction is warranted and that a five- to tenfold increase in public funding is feasible.

The USA and Japan, the two largest investors in energy R&D, spent on average of 3.38 and 2.45 billion US$, respectively, between 1975 and 1999. However, such figures mask important underlying trends. For example, a large percentage of the funding designated for energy R&D has gone into nuclear power – nearly 75% in the case of Japan (Sagar and van der Zwaan 2006). The support of the US government for R&D declined by 1 billion US$ from 1994 to 2003, with reductions implemented in nearly all energy technologies, while R&D investments in other areas grew by 6% per year. Between the 1980s and 2003, private sector energy R&D declined from nearly 50% of that of government funding to about 25% (Nemet and Kammen, 2006).

Many countries pursue technological (R&D) advancements as a national policy for a variety of different reasons: for example, to foster the development of innovative technologies or to assist domestic industries in being competitive. Countries also chose to co-operate with each other in order to share costs, spread risks, avoid duplication, access facilities, enhance domestic capabilities, support specific economic and political objectives, harmonize standards, accelerate market learning and create goodwill. Cooperation, however, may increase

24 As used in this section, the term R&D generally refers to research, development and demonstration.
25 Canada, France, Germany, Italy, Japan, the UK and the USA.
26 In year-2000 US$ and exchange rates.

13.1 (a). RD&D budgets for energy



13.1(b). RD&D budgets for renewable energy

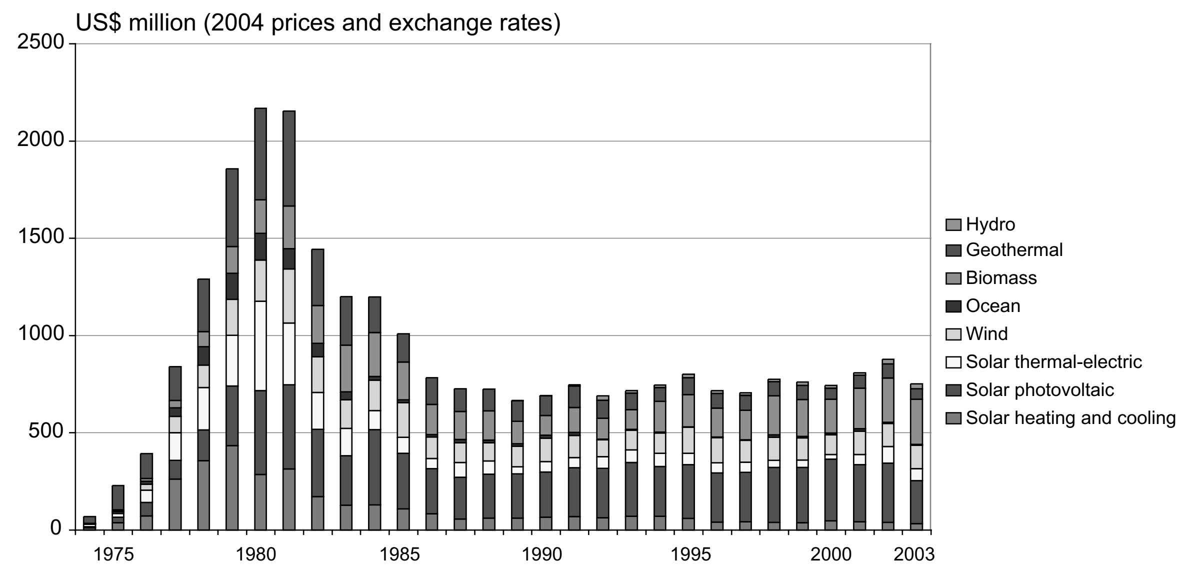


Figure 13.1: *Public funded Research and Development (R&D) expenditures for energy (A) and renewable energy technologies (B) by International Energy Agency (IEA) member countries.*

Source: IEA, 2004, 2005.

transaction costs, require extensive coordination, raise concerns over intellectual property rights and foreclose other technology pathways (Fritsche and Lukas, 2001; Sakakibara, 2001; Ekboir, 2003; Justice and Philibert, 2005). Governments use a number of tools to support R&D, such as grants, contracts, tax credits and allowances and public/private partnerships. The effect of these tools on public budgets and their effectiveness in stimulating innovation will vary as a function of how they are structured and targeted. For example, in the USA, R&D tax credits to industry totalled an estimated 6.4 billion US$ in 2001; however, industries associated with high GHG emissions did not take advantage of this opportunity in that the utility industry received only 23 million US$.[27]

There are different views on the role of R&D, its links to the overall energy innovation system and processes underlying effective learning. Sagar and van der Zwaan (2006) examined the trends in major industrialized countries and report that public R&D spending does not correlate with changes in national energy intensity or carbon emissions per unit of energy

27 http://www.nsf.gov/statistics/inbrief/nsf/nst05316

consumption. For a more extensive discussion of technological learning, energy supply models and the link to R&D, see Chapter 3, Section 3.4.2 and Chapter 11, Section 11.3.3. Watanabe (1999) argues that government R&D can play a role in achieving breakthroughs in some areas, induce investments by industry in R&D and generate trans-sectoral spill over effects. Others have noted, however, that the benefits of R&D may not be realized for two to three decades, which is beyond the planning horizons of even the most forward-looking companies (Anderson and Bird, 1992) and that, for a variety of reasons, industry can only appropriate a fraction of the benefits of R&D investments (Margolis and Kammen ,1999). In the energy sector in particular, technology 'spill over' to competitors is large; as a result, firms under-invest in R&D (Azar and Dowlatabadi 1999) and face difficulties in evaluating intangible R&D outputs (Alic *et al*. 2003).[28] In addition, regulatory interventions can cap profits in the case of path-breaking research success (Foxon and Kemp, 2004; Grubb, 2004).[29] Goulder and Schneider (1999) argue that increasing R&D expenditures in carbon-free technologies could crowd out R&D in the rest of the economy and therefore reduce overall growth rates. However, Azar and Dowlatabadi (1999) counter that radical technological change will trigger more research overall and therefore increase economy-wide productivity rates.

The OECD (2005b) finds that obligations/quotas, price guarantees and tax preferences have had the most influence on innovation and patent activities in the renewable energy sector and that while public subsidies for R&D have not played a role, the overall level of investment in R&D within the economy of a country has been important. Sathaye *et al*. (2005) observe that government-funded research at government-owned facilities, private companies and universities may help identify patentable technologies and processes. They reviewed the process of allocating patent rights in four OECD countries and found that intellectual property rights (IPR) regimes have changed since the ratification of the UNFCCC, with diffusion typically taking place along a pathway of licensing or royalty payments rather than unrestricted use in the public domain. Popp (2002) also examined patent citations and found that the level of energy-saving R&D depends not only on energy prices, but also on the quality of the accumulated knowledge available to inventors. He finds evidence for diminishing returns to research inputs – both across time and within a given year – and notes that government patents filed in or after 1981 are more likely to be cited. Popp (2004) notes that when in terms of the potential for technology to help solve the climate problem, two market failures lead to underinvestment in climate-friendly R&D: environmental externalities and the public goods nature of the new knowledge. As a result, government subsidies to climate-friendly R&D projects are often proposed as part of a policy solution.

Policies that directly affect the environmental externality have a much larger impact on both atmospheric temperature and economic welfare. Fischer and Newell (2004) examine several policy options to promote renewables and indicate that research subsidies are the most expensive approach to achieve emission reductions – in the absence of higher prices. They note that the process of technological change is less important than the implementation of direct incentives to reduce emission intensity or overall energy use. A more specific example arises from the Danish experience with wind technologies. Meyer (2004) notes that despite significant support for wind energy R&D during the 1980s, wind power only boomed in Denmark when favourable feed-in tariffs were introduced, procedures for construction allowances were simplified and priority was given for green electricity. This is supported by Nemet (2005), who found that the ability to raise capital and take risks has played a much larger role in the recent expansion of the photovoltaic industry than other factors, such as learning by experience.

In summary, national programmes and international cooperation relating to R&D are essential long-term measures to stimulate technological advances. Substantial additional investments in and policies for R&D are needed, depending on the specific goals: for example, if high stabilization levels are desired (e.g. 750 ppmv CO_2-eq, which is scenario category D of Chapter 3 of this report), a technology-focused approach that defers emissions reduction to the future would be sufficient; for low stabilization goals (e.g. 450 ppmv CO_2-eq, which is category A1, or 550 ppmv CO_2-eq, which is category B), strong incentives for short-term emission reductions would be necessary in addition to technological development and deployment programmes. See Section 13.3 for a discussion of goals.

13.2.1.7 Information instruments

Information instruments – such as public disclosure requirements and awareness/education campaigns – may positively affect environmental quality by allowing consumers to make better-informed choices. When firms or consumers lack the necessary information about the environmental consequences of their actions, they may act inefficiently. While some research indicates an information provision can be an effective environmental policy instrument, we know less about its efficacy in the context of climate change. Examples of information instruments include labelling programmes for consumer products, information disclosure programmes for firms and public awareness campaigns.

Article 6 of the UNFCCC on Education, Training and Public Awareness calls on governments to promote the development

28 An assessment of private public research partnership under the Advanced Technology Programme in the USA indicates that 'Time lags, along with the difficulty inherent in retrospective evaluation of factors affecting the timing and character of innovations, make it difficult to attribute specific commercial advantages to funding awarded much earlier.' In general, companies shift funds away from basic research towards product modifications and extensions.

29 Renewable energy technologies compete in electricity wholesale markets that are frequently exposed to regulations, such as price caps, which reduce incentives for private investment in long-term R&D.

and implementation of educational and public awareness programmes, promote public access to information and public participation and promote the training of scientific, technical and managerial personnel. With decision 11/CP.8, the Conference of the Parties (COP) launched a 5-year country-driven work programme to engage stakeholders in information/education activities. The UNFCCC secretariat notes that there is a general lack of resources, limited technical skill and poor regional coordination relating to information and education campaigns (UNFCCC 2006a).

Information instruments can often be used to improve the effectiveness of other instruments. Another feature common to all information instruments that makes them unique from other environmental policies is that they do not impose penalties for environmentally harmful behaviour per se. A disclosure programme, such as the Toxics Release Inventory (TRI), requires only that firms document and report their emissions; it does not place limits on how much pollution they can emit.

Kennedy *et al*. (1994) demonstrate that environmental externalities can be at least partially corrected through information provision. However, they also point out that when other corrective instruments, such as taxes, are available, these measures are preferable to information policies. Based on a recent theoretical study, Petrtakis *et al*. (2005) reports that information provision can be more effective than tax instruments, especially when the information can be provided at low cost. Osgood (2002) provides limited empirical support in the context of weather information programmes in Mexico and California.

Evidence-to-date suggests that while disclosure mandates may be effective at changing a firm's environmental practices, other information instruments, such as advisory programmes, have less effect on consumer behaviour (Konar and Cohen, 1997). Firms whose stock price declined significantly when pollution data became publicly available reduced their emissions more than other firms in the same industry. Firms may view information policies as overly burdensome and argue that voluntarily provided information is sufficient (Sterner, 2003). Certainly, there is a cost to disclosure and labelling policies, and costs depend on the level of information required by a policy (Beierle, 2004). A firm may have to collect and disseminate information they would not otherwise have gathered, and government agencies must be able to verify that the information is accurate.

13.2.1.8 Non-climate policies

There are a number of non-climate national policies that can have an important influence on GHG emissions. These include policies focused on poverty, land use and land use change, energy supply and security; international trade, air pollution, structural reforms and population policies. Only a few types of 'non-climate policies' are touched upon in this section.

The literature available on this topic indicates that poverty reduces the resilience of vulnerable populations and makes them more at risk to the potential impacts of climate change, but it also leads communities to take measures that may increase emissions. Heemst and Bayangos (2004) note that if poverty can be reduced without raising emissions, then a strategy to reduce poverty can be seen as a way to reduce emissions as well as enhance resilience. Typical areas of synergy include small-scale renewables (Richards, 2003) and community forestry (Smith and Scherr, 2002), both of which may benefit the poor.

Land use policies (or the lack thereof), whether terrestrial (agriculture, forestry, nature), aquatic (wetlands) or urban, can lead to enhanced emissions. Verhagen *et al*. (2004) note that policies aimed at integrating climate change concerns with the specific concerns of local people may yield major synergies. For example, within the Netherlands, a major programme is currently underway to understand how spatial planning and climate change policy can be effectively linked. Regional (acid rain abatement), local and indoor air pollution policies can also have climate change co-benefits (Bakker *et al*., 2004).

The consumption of natural resources varies significantly between developed and developing countries and is ultimately one of the major drivers of global emissions. The global population and income levels affect the consumption of natural resources, particularly those of energy, food and fibre, and hence can also affect GHG emissions. Policies that increase consumption of natural resources have implications for GHG emissions.

13.2.2 Linking national policies

13.2.2.1 National policy interactions/linkages and packages

Single instruments are unlikely to be sufficient for climate change mitigation, and it is more likely that a portfolio of policies will be required (see IPCC, 2001). Examples of areas where there are potential synergies include water management strategies, farm practices, forest management strategies and residential building standards. Instruments that maximize potential synergies could become socially and economically efficient and may offer opportunities for countries to achieve sustainable development targets, even in the face of uncertainties. This is especially important given the limited financial and human resources in developing countries (Dang *et al*., 2003). Climate change considerations also provide both developing and developed countries with an opportunity to look closely at their respective development strategies from a new perspective. Fulfilling development goals through policy reforms in such areas as energy efficiency, renewable energy, sustainable land use and/or agriculture will often also generate benefits related to climate change objectives.

A key synergy is that between adaptation and mitigation policies. Climate policy options can include both mitigation and adaptation (see Chapter 17 of IPCC (2007b) for a discussion on adaptation policies and Chapter 18 for a detailed analysis of interaction between mitigation and adaptation). Many adaptation options are consistent with pathways towards effective and long-term mitigation and, in turn, several mitigation options can facilitate planned adaptation.

In theory, a perfectly functioning market would need only one instrument (e.g. a tax) to address a single environmental problem, such as climate change. In such a situation, the application of two or more overlapping instruments could diminish economic efficiency while increasing administrative costs. In practice, however, there are market failures that may make a mix of instruments desirable. This section describes some of these cases and addresses situations in which multiple or overlapping objectives might justify a mix of policies.

Climate-related policies are seldom applied in complete isolation: in a large number of cases one or more instruments will be applied. The mere existence of an instrument mix, however, is clearly not 'proof' of its environmental effectiveness and economic efficiency. A rather obvious first requirement for applying an environmentally and economically effective instrument mix is to have a good understanding of the environmental issue to be addressed. In practice, many environmental issues can be complex. While a tax can affect the total demand for a product and the choice between different product varieties, it is less suited to address, for example, how a given product is used and when it is used. Hence, other instruments could be needed. A second requirement for designing efficient and effective policies is to have a good understanding of the links with other policy areas: not only do different environmental policies need to be co-ordinated, but co-ordination with other related policies is also necessary. A third requirement is to have a good understanding of the interactions between the different instruments in the mix.

Several authors describe situations in which a combination of policies might be desirable. Johnstone (2002) argues that the price signal from a tradable permits or tax system may not be sufficient to overcome barriers to technological development and diffusion and that additional policies may be warranted. These barriers include: (1) credit market failures that discourage lenders from providing capital to firms for high-risk investments associated with R&D and even the implementation of new technologies and (2) reduced incentives for private investment in R&D if firms can not prevent other firms from benefiting from their investments (i.e. 'spill-over' effects).[30] Fischer and Newell (2004) find that the combination of a technology policy, such as government sponsored R&D, with a tax or tradable permit instrument could help overcome this type of market imperfection.

A second market failure that may require more than one instrument is the lack of information among consumers on the environmental or economic attributes of a technology. In such a case, a price signal alone may not sufficiently spur the diffusion of these types of technologies. One solution to this type of barrier is an eco-labelling system, which can help increase the effectiveness of a price instrument by providing better information on relevant characteristics of the product (OECD, 2003b; Braathen, 2005). Sijm (2005) notes that this type of market failure may exist for households who may lack the relevant information to invest in energy efficiency measures and may not respond to a price signal. Another market failure in the residential sector may be caused by split incentives where neither the landlord nor tenant has an incentive to invest in energy efficiency measures (Sorrell and Sijm, 2003).

With the implementation of the EU ETS, particular attention has been given to the interaction between a tradable permits mechanism and other policies. Sijm (2005) and Sorrell and Sijm (2003) argue that an emissions trading scheme can co-exist with other instruments as long as these other instruments improve the efficiency of the trading mechanism by addressing market failures or contributing to some other policy objective. However, they argue that the combination of an emissions trading scheme with other instruments could also lead to "double regulation", reduced efficiency and increased costs if policies are not designed carefully. NERA (2005) and Morthorst (2001) assess the interaction of renewable energy policies with tradable permits programmes and conclude that if not designed properly, these policies can lower allowance prices but raise the overall costs of the programme.

There may be cases where a package of CO_2 mitigation policies is justified if these policies serve multiple policy objectives. Sijm (2005) gives several examples of policies and objectives that may be compatible with the EU ETS, including direct regulation that also reduces local environmental effects from other pollutants. Renewable energy policies can be used to expand energy supply, increase rural income and reduce conventional pollutants. Policies that encourage bio-fuel production and automobile fuel efficiency have also been advocated for their advantages in encouraging energy security and fuel diversity as well as GHG mitigation. In the USA, these types of energy policies have been proposed in conjunction with a tradable permits system as part of a package to address energy, security and environmental objectives (NCEP, 2004).

13.2.2.2 Criteria assessment

Any evaluation of the instruments based on the criteria discussed herein is challenging for two reasons. First, practitioners must be able to compare potential instruments based on each of the evaluative criteria. Unfortunately, in many cases it can be difficult if not impossible to rank instruments in an objective manner. For example, Fischer *et al*. (2003) conclude that it is not possible to rank environmental policy

30 For a more extensive discussion of these issues, see Jaffe *et al*., 2003.

Table 13.1: *National environmental policy instruments and evaluative criteria* [a]

Instrument	Criteria			
	Environmental effectiveness	**Cost-effectiveness**	**Meets distributional considerations**	**Institutional feasibility**
Regulations and standards	Emissions level set directly, though subject to exceptions. Depends on deferrals and compliance.	Depends on design; uniform application often leads to higher overall compliance costs.	Depends on level playing field. Small/new actors may be disadvantaged.	Depends on technical capacity; popular with regulators in countries with weakly functioning markets.
Taxes and charges	Depends on ability to set tax at a level that induces behavioural change.	Better with broad application; higher administrative costs where institutions are weak.	Regressive; can be ameliorated with revenue recycling.	Often politically unpopular; may be difficult to enforce with underdeveloped institutions.
Tradable permits	Depends on emissions cap, participation and compliance.	Decreases with limited participation and fewer sectors.	Depends on initial permit allocation. May pose difficulties for small emitters.	Requires well functioning markets and complementary institutions.
Voluntary agreements	Depends on programme design, including clear targets, a baseline scenario, third party involvement in design and review and monitoring provisions.	Depends on flexibility and extent of government incentives, rewards and penalties.	Benefits accrue only to participants.	Often politically popular; requires significant number of administrative staff.
Subsidies and other incentives	Depends on programme design; less certain than regulations/standards.	Depends on level and programme design; can be market distorting.	Benefits selected participants, possibly some that do not need it.	Popular with recipients; potential resistance from vested interests. Can be difficult to phase out.
Research and development	Depends on consistent funding; when technologies are developed and polices for diffusion. May have high benefits in the long term.	Depends on programme design and the degree of risk.	Benefits initially selected participants; potentially easy for funds to be misallocated.	Requires many separate decisions. Depends on research capacity and long-term funding.
Information policies	Depends on how consumers use the information; most effective in combination with other policies.	Potentially low cost, but depends on programme design.	May be less effective for groups (e.g. low-income) that lack access to information.	Depends on cooperation from special interest groups.

Note:
[a] Evaluations are predicated on assumptions that instruments are representative of best practice rather than theoretically perfect. This assessment is based primarily on experiences and published reports from developed countries, as the number of peer reviewed articles on the effectiveness of instruments in other countries is limited. Applicability in specific countries, sectors and circumstances – particularly developing countries and economies in transition – may differ greatly. Environmental and cost effectiveness may be enhanced when instruments are strategically combined and adapted to local circumstances.

instruments based on their technology-stimulating effects. Consequently, it will be difficult to determine which of the available instruments is the most cost-effective. Distributional considerations are also particularly difficult to evaluate. Revesz and Stavins (2006) provide a discussion of the difficulties involved in evaluating instruments based on distribution or equity. They also cite a number of authors that propose different approaches to evaluating policies.

Nevertheless, it is possible to make general statements about each instrument according to the criteria we have selected. For example, it is generally believed that market-based instruments will be more cost effective than regulations and standards (Wiener, 1999). However, this belief implicitly assumes that a country has well-functioning institutions, the lack of which can result in a market-based instrument being more costly to implement (Blackman and Harrington, 2000). Table 13.1 summarizes the seven instruments presented in this chapter for each of the four criteria we discuss. Sterner (2003) and Harrington *et al*. (2004) provide similar summaries for other instruments.

Second, policymakers must determine how much weight to assign each of the evaluative criteria. Consider two instruments that are equally environmentally effective and both institutionally feasible, but one has unfavourable distributional implications while the other is less cost-effective. In order to choose one instrument over the other, one must assess the relative importance of distribution versus cost-effectiveness. However, the determination of just what weight should be given to each evaluative criterium is a subjective question and one left to policymakers to decide. Some authors do provide some guidelines on how policymakers can determine which evaluative criteria are the most important. Sterner (2003) argues that distributional considerations will likely be less important in an economy with relatively less inequality than in countries with large income disparities and also provides additional guidance on other criteria, including institutional flexibility and incentive compatibility. Bell (2003) and Bell and Russell (2002) argue that institutional feasibility is of critical importance in developing countries, where environmental effectiveness and cost-effectiveness may be determined in large part by a government's institutional capacity. In general, the criteria that receive the most weight will be those that are assessed to be the most important in terms of each country's specific circumstances.

13.3 International climate change agreements and other arrangements

The context of and reasons for an international agreement were relatively well covered in IPCC (2001). The authors of more recent reports cite the reasons presented in older publications for the necessity of agreements – namely, the global nature of the problem and the fact that no single country emits more than approximately 20% of global emissions. This situation means that successful solutions will need to engage multiple countries. Similarly, the fact that no one sector is responsible for more than about 25% of global emissions (the largest sector is that of electricity generation and heat production at 24% of the global, six-gas total; see Baumert *et al*., 2005a) implies that no single sector will be uniquely required to act.

13.3.1 Evaluations of existing climate change agreements

In contrast, the more recent publications have devoted considerable attention to the limitations of existing international agreements in addressing the climate change. In fact, there are no authoritative assessments of the UNFCCC or its Kyoto Protocol that assert that these agreements have succeeded – or will succeed without changes – in fully solving the climate problem. As its name implies, the UNFCCC was designed as a broad framework, and the Kyoto Protocol's first commitment period for 2008–2012 has been its first detailed step. Both the Convention and the Kyoto Protocol include provisions for further steps as necessary.

A number of limitations and gaps in existing agreements are cited in the literature, namely:

- The lack of an explicit long-term goal means countries do not have a clear direction for national and international policy (see, for example, Corfee-Morlot and Höhne, 2003);
- The targets are inadequately stringent (Den Elzen and Meinshausen, 2005, who argue for more stringent targets);
- The agreements do not engage an adequate complement of countries (see Baumert *et al*. 1999, who suggest a need to engage developing as well as developed countries, or Bohringer and Welsch 2006, who suggest that with the US withdrawal, the Kyoto Protocol's effect is reduced to zero);
- The agreements are too expensive (Pizer, 1999, 2002);
- The agreements do not have adequately robust compliance provisions (Victor, 2001; Aldy *et al*., 2003);
- The agreements do not adequately promote the development and/or transfer of technology (Barrett, 2003);
- The agreements, as one consequence of failing to solve the problem, do not adequately propose solutions that will facilitate adaption to the forthcoming changes (Muller, 2002).

Reviews of the current agreements take several forms. Some (e.g. Depledge, 2000) provide detailed article-by-article reviews of the existing agreements, seeking to interpret the legal language as well as to provide a better understanding of their historical derivations. In this manner, they offer insight into how future agreements might be developed. Other studies assess the effect of the emission reductions required by the Kyoto Protocol on global GHG concentrations and conclude that although the effect is currently small (Manne and Richels, 1999), it may be large in the future as present-day emission reductions set the stage for future reduction efforts, which would not have happened otherwise (Höhne and Blok, 2006). Some researchers (e.g. Cooper, 2001; Michaelowa *et al*., 2005a) evaluate the basic underpinnings of the two climate agreements, looking at problems associated with establishing binding targets and differentiating between countries as well as difficulties in operationalizing the concept of emissions markets. These kinds of assessments – by far the most common – not only assess current limitations but usually proceed to put forth counter-arguments, outline improvements that should be made and propose alternative mechanisms for addressing the climate problem. See the following sections for responses and alternatives to solving the climate problem.

13.3.2 Elements of international agreements and related instruments

The majority of elements identified in the literature draw on existing multilateral agreements, in particular, the UNFCCC and its Kyoto Protocol. Agreements related to climate change, but not specifically focused on GHG mitigation, are less extensively analysed in the climate literature. These include energy policy and technology agreements (see, for example, publications the IEA evaluating their "Implementing Agreements") and the evaluation of VAs with the auto sector (see, for example, Sauer *et al*., 2005 on the European Automobile Manufacturers Association (ACEA) agreement between the European, Japanese and Korean auto manufacturers). Based on the literature in Table 13.2, it is possible to derive some common elements of international climate change agreements. These are listed in Box 13.6, and expanded upon in the section below.

13.3.3 Proposals for climate change agreements

The literature on climate change contains a large number of proposals on possible future international agreements. Table 13.2 provides a summary review of recent proposals for international climate agreements as reported in the literature (see also Bodansky, 2004; Kameyama, 2004; Philibert, 2005a), although not all proposals cover all elements that are necessary

Box 13.6 Elements for climate change agreements[31]

A number of elements are commonly incorporated in existing – and proposals for new – international climate change agreements. These include:

Goals: Most agreements establish objectives that implementation is supposed to achieve. In the climate context, a variety of goals have been proposed, including those related to emissions reductions, stabilization of GHG concentrations, avoiding "dangerous" interference with climate, technology transfer and sustainable development. Goals can be set at varying degrees of specificity.

Participation: All agreements are undertaken between specific groups of participants. Some have a global scope while others focus on a more limited set of parties (e.g. regional in nature or limited to arrangements between private sector partners). Obligations can be uniform across participants, or differentiated among them.

Actions: All agreements call for some form of action. Actions vary widely and can include national caps or targets on emissions, standards for certain sectors of the economy, financial payments and transfers, technology development, specific programmes for adaptation and reporting and monitoring. The actions can be implicitly or explicitly designed to support sustainable development. The timing for actions varies considerably, from those taking effect immediately, to ones that may take effect only over the longer term; actions may be taken internally (within contracting Parties) or with others (both with non-Parties as well as non-State actors).

Institutions and compliance provisions: Many agreements contain provisions for establishing and maintaining supporting institutions. These perform tasks as varied as serving as repositories for specific, agreement-related data, facilitating or adjudicating compliance, serving as clearing houses for market transactions or information flows, to managing financial arrangements. In addition, most agreements have provisions in case of non-compliance. These include binding and non-binding consequences and may be facilitative or more coercive in nature.

Other elements: Many (although not all) agreements contain additional elements, including, for example, "principles" and other preambular language. These can serve to provide context and guidance for operational elements, although they may be points of contention during negotiations. In addition, many agreements contain provisions for evaluating progress – with a timetable for reviewing the adequacy of efforts and evaluating whether they need to be augmented or modified.

to describe a full regime. The list of proposals is grouped around the following themes: national emission targets and emission trading, sectoral approaches, policies and measures, technology, development-oriented actions, adaptation, financing and proposals focusing on negotiation process and treaty structure.

13.3.3.1 Goals

Most agreements (including those on climate change such as the UNFCCC and the Kyoto Protocol), include specific goals to guide the selection of actions and timing as well as the selection of institutions. Goals can provide a common vision about both the near-term direction and the longer term certainty that is called for by business. In this discussion, goals are distinguished from targets: the former are long-term and systemic, while the latter relate to actions that are near-term and specific. Targets are described under the 'Targets' section (13.3.3.4.1) below.

The choice of the long-term ambition level significantly influences the necessary short-term action and, therefore, the design of the international regime. For example, if the goal is set at high stabilization levels (e.g. stabilizing concentrations at 750 ppmv CO_2-eq, scenario category D of Chapter 3 of this report), a technology-focused approach that defers emissions reduction to the future would be sufficient for the time being. For low stabilization goals (e.g. 450 ppmv CO_2-eq, category A1, or 550 ppmv CO_2-eq, category B), short-term emission reductions would be necessary in addition to technological development programmes.

International regimes can incorporate goals for the short and medium term and for the stabilization of GHG concentrations. One option is to set a goal for long-term GHG concentrations or a maximal temperature rise (such as the 2°C goal proposed by the EU). Such levels might be set based on an agreement of impacts to be avoided (see Den Elzen and Meinshausen, 2005) or on the basis of a cost-benefit analysis (see Nordhaus, 2001). A number of authors have commented on the advantages and disadvantages of setting long-term goals. Pershing and Tudela (2003) suggest that it may be difficult to gain a global agreement on any 'dangerous' level due to political and technical difficulties. Conversely, Corfee-Morlot and Höhne

31 While not an element, agreements often contain specific information as to the time for initiating actions and, often, a date by which actions are to be completed. In addition, many agreements contain provisions for evaluating progress – with a timetable for reviewing the adequacy of efforts and evaluating whether they need to be augmented or modified.

Table 13.2: *Overview of recent proposals for international climate agreements.*

		Name (reference)	**Description**
National emission targets and emission trading			
National emission targets and emissions trading	Staged systems	Staged systems	
		Multistage with differentiated reductions: Gupta, 1998; Berk and den Elzen, 2001; Blanchard et al., 2003; Criqui *et al*., 2003; Gupta, 2003a; Höhne et al., 2003; Höhne *et al*., 2005; Michaelowa *et al*., 2005b; den Elzen and Meinshausen, 2006, den Elzen *et al*., 2006a	Countries participate in the system with different stages and stage-specific types of targets; countries transition between stages as a function of indicators; proposal specify stringency of the different stages
		Differentiating groups of countries: Storey, 2002; Ott *et al*., 2004	Countries participate in the system with different stages and stage-specific types of targets
		Converging markets: Tangen and Hasselknippe, 2005	Scenario with regional emission trading systems converging to a full global post 2012 market system
		Three-part policy architecture: Stavins, 2001	All nations with income above agreed threshold take on different targets (fixed or growth); long-term targets (flexible but stringent); short-term (firm, but moderate); and market-based policy instruments, e.g., emissions trading.
	Allocation methods	Allocation methods	
		Equal per capita allocation: Baer *et al*, 2000; Wicke, 2005	All countries are allocated emission entitlements based on their population.
		Contraction and convergence: GCI, 2005	Agreement on a global emission path that leads to an agreed long-term stabilization level for greenhouse gas concentrations (‘Contraction’). Emission targets for all individual countries set so per-capita emissions converge (‘Convergence’).
		Basic needs or survival emissions: Aslam, 2002; Pan, 2005	Emission entitlements based on an assessment of emissions to satisfy basic human needs.
		Adjusted per capita allocation: Gupta and Bhandari, 1999	Allocation of equal per capita emissions with adjustments using emissions per GDP relative to Annex I average.
		Equal per capita emissions over time: Bode, 2004	Allocation based on (1) converging per capita emissions and (2) average per capita emissions for the convergence period that are equal for all countries.
		Common but differentiated convergence: Höhne *et al*., 2006	Annex I countries’ per capita emissions converge to low levels within a fixed period. Non-Annex I countries converge to the same level in the same timeframe, but starting when their per capita emissions reach an agreed percentage of the global average. Other countries voluntarily take on “no lose” targets.
		Grandfathering: Rose *et al*., 1998	Reduction obligations based on current emissions.
		Global preference score compromise: Müller, 1999	Countries voice preference for either per capita allocation or allocation based on current national emissions.
		Historical responsibility – the Brazilian proposal: UNFCCC, 1997b; Rose *et al*., 1998; Meira Filho and Gonzales Miguez, 2000; Pinguelli Rosa *et al*., 2001; den Elzen and Schaeffer, 2002; La Rovere *et al*., 2002; Andronova and Schlesinger, 2004; Pinguelli *et al*., 2004; Trudinger and Enting, 2005; den Elzen and Lucas, 2005; den Elzen *et al*., 2005c; Höhne and Blok, 2005; Rive *et al*., 2006	Reduction obligations between countries are differentiated in proportion to those countries’ relative share of responsibility for climate change – i.e. their contribution to the increase of global-average surface temperature over a certain period of time.
		Ability to pay: Jacoby *et al*., 1998; Lecoq and Crassous, 2003	Participation above welfare threshold. Emission reductions as a function of ability to pay (welfare).
		Equal mitigation costs: Rose et al., 1998; Babiker and Eckhaus, 2002	Reduction obligations between countries are differentiated so that all participating countries have the same welfare loss.
		Triptych: Blok et al., 1997; den Elzen and Berk, 2004; Höhne *et al*., 2005	National emission targets based on sectoral considerations: Electricity production and industrial production grow with equal efficiency improvements across all countries. “Domestic” sectors converge to an equal per-capita level. National sectoral aggregate levels are then adopted.
		Multi-sector convergence: Sijm *et al*., 2001	Per-capita emission allowances of seven sectors converge to equal levels based on reduction opportunities in these sectors. Countries participate only when they exceed per capita threshold.
		Multi-criteria: Ringius *et al*., 1998; Helm and Simonis, 2001; Ringius *et al*., 2002	Emission reduction obligations based on a formula that includes several variables, such as population, GDP and others.

Table 13.2: *Continued.*

		Name (reference)	Description
National emission targets and emission trading			
National emission targets and emissions trading	Alternative types of emission targets for some countries	Alternative types of emission targets for some countries	
		Dynamic targets: Hargrave *et al*., 1998; Lutter, 2000; Müller *et al*., 2001; Bouille and Girardin, 2002; Chan-Woo, 2002; Lisowski, 2002; Ellerman and Wing, 2003; Höhne *et al*., 2003; Müller and Müller-Fürstenberger, 2003; Jotzo and Pezzey, 2005; Philibert, 2005b; Pizer, 2005b; Kolstad, 2006	Targets are expressed as dynamic variables – including as a function of the GDP ("intensity targets") or variables of physical production (e.g. emissions per tonne of steel produced).
		Dual targets, target range or target corridor: Philibert and Pershing, 2001; Kim and Baumert, 2002	Two emission targets are defined: (1) a lower "selling target" that allows allowance sales if national emissions fall below a certain level; (2) a higher "buying target" that requires the purchase of allowances if a certain level is exceeded.
		Dual intensity targets: Kim and Baumert, 2002	A combination of intensity targets and dual targets.
		"No lose", "non-binding", one-way targets: Philibert, 2000	Emission rights can be sold if the target is reached, while no additional emission rights would have to be bought if target is not met. Allocations are made at a BAU level or at a level below BAU. Structure offers incentives to participate for countries not prepared to take on full commitments but still interested in joining the global trading regime.
		Growth targets, headroom allowances, premium allocation: Frankel, 1999; Stewart and Wiener, 2001; Viguier, 2004	Participation of major developing countries is encouraged by unambitious allocations relative to their likely BAU emissions. To ensure benefit to the atmosphere, a fraction of each permit sold can be banked and definitely removed.
		Action targets: Goldberg and Baumert, 2004	A commitment to reduce GHG emission levels below projected emissions by an agreed date through "actions" taken domestically, or through the purchases of allowances.
		Flexible binding targets: Murase, 2005	A framework for reaching emission targets modelled after the WTO/GATT (World Trade Organization/General Agreement on Tariffs and Trade) scheme for tariff and non-tariff barriers; targets negotiated through rounds of negotiations.
	Modifications to the emission trading system or alternative emission trading system	Modifications to the emission trading system or alternative emission trading system	
		Price cap, safety valve or hybrid trading system: Pizer, 1999; Pizer, 2002; Jacoby and Ellerman, 2004.	Hybrid between a tax and emission trading: after the initial allocation, an unlimited amount of additional allowances are sold at a fixed price.
		Buyer liability: Victor, 2001b	If the seller of a permit did not reduce its emissions as promised, the buyer could not claim the emission credit. Enforcement is more reliable as buyers deal with developed countries with more robust legal procedures.
		Domestic hybrid trading schemes: McKibbin and Wilcoxen, 1997; McKibbin and Wilcoxen, 2002	Two kinds of emissions permits valid only within the country of origin. (1) long-term permits entitle the permit owner to emit 1 tC every year for a long period; permits are distributed once. (2) Annual permits allow 1 tC to be emitted in a single year. An unlimited number of these permits are given out at a fixed price (price cap). Compliance is based on either unit.
		Allowance purchase fund: Bradford, 2004	Countries contribute to an international fund that buys/retires emission reduction units. Countries can sell reductions below their BAU levels.
		Long-term permits: Peck and Teisberg, 2003	Long-term permits could be used once at any time between 2010 and 2070. Depending on the time of emission they are depreciated 1% annually for atmospheric decay of CO_2. The permit would allow the emission of 1 tC in 2070, 1.01 tC in 2069 and 1.0160 (1.71) tons in 2010.

Table 13.2: *Continued.*

Name (reference)		Description
Sectoral approaches	Sectoral approaches	
	Sector Clean Development Mechanism, sector Crediting Mechanism : Philibert and Pershing, 2001; Samaniego and Figueres, 2002; Bosi and Ellis, 2005; Ellis and Baron, 2005; Sterk and Wittneben, 2005	Sectoral crediting schemes based on emission reductions below a baseline. Excess allowances can be sold.
	Sector pledge approach: Schmidt et al., 2006	Annex I countries have emission targets, with the ten highest-emitting developing countries pledging to meet voluntary, “no-lose” GHG emissions targets in the electricity and major industrial sectors. Targets are differentiated, based upon national circumstances, and sector-specific energy-intensity benchmarks are developed by experts and supported through a Technology Finance and Assistance Package.
	Caps for multinational cooperation: Sussman *et al*., 2004	A cap/and trade system associated with the operations of associated enterprises in developing and developed countries.
	Carbon stock protocol: WBGU, 2003	A protocol for the protection of carbon stocks based on a worldwide system of “non-utilization obligations” to share the costs of the non-degrading use of carbon stocks among all states.
	“Non-binding” targets for tropical deforestationa: Persson and Azar, 2004	Non-binding commitments for emissions from deforestation under which reduced rates of deforestation could generate emissions allowances.
Policies and measures	Policies and measures	
	Carbon emission tax: Cooper, 1998; Nordhaus, 1998; Cooper, 2001; Nordhaus, 2001; Newell and Pizer, 2003	All countries agree to a common, international GHG emission tax; several of the proposals suggest beginning with a carbon tax limited to emissions from fossil fuel combustion.
	Dual track: Kameyama, 2003	Countries choose either non-legally binding emission targets based on a list of policies and measures or legally-binding emission caps allowing international emissions trading.
	Climate “Marshall Plan”: Schelling, 1997, 2002	Financial contributions from developed countries support climate friendly development; similar in scale and oversight to the Marshall Plan.
Technology	Technology	
	Technology research and development: Edmonds and Wise, 1999; Barrett, 2003	Enhanced coordinated technology research and development.
	Energy efficiency standards: Barrett, 2003; Ninomiya, 2003	International agreement on energy efficiency standards for energy-intensive industries.
	Backstop technology protocol: Edmonds and Wise, 1998	New power plants installed after 2020 must be carbon neutral. New synthetic fuels plants must capture CO_2. Non-Annex I countries participate upon reaching Annex I average GDP in 2020.
	Technology prizes for climate change mitigation: Newell and Wilson, 2005	Incentive or inducement prizes targeted at applied research, development and demonstration.
Development-oriented actions	Development-oriented actions	
	Sustainable development policies and measures: Winkler *et al*., 2002b; Baumert *et al*., 2005b	Countries integrate policies and measures to reduce GHG emissions into development plans (e.g. developing rural electrification programmes based on renewable energy, or mass transit systems in placed of individual cars).
	Human development goals with low emissions: Pan, 2005	Elements include: identification of development goals/basic human needs; voluntary commitments to low carbon paths via no-regret emission reductions in developing countries conditional to financing and obligatory discouragement of luxurious emissions; reviews of goals and commitments; an international tax on carbon.

Table 13.2: *Continued.*

Name (reference)		Description
Adaptation	Adaptation	
	UNFCCC impact response instrument: Müller, 2002	A new "impact response instrument" under the auspices of the UNFCCC for disaster relief, rehabilitation and recovery.
	Insurance for adaptation; funded by emission trading surcharge: Jaeger, 2003	A portion of the receipts from sales of emissions permits would be used to finance insurance pools.
Financing	Financing	
	Greening investment flows: Sussman and Helme, 2004	Investments through Export Credit Agencies are conditional on projects that are "climate friendly".
	Quantitative finance commitments: Dasgupta and Kelkar, 2003	Annex I countries take on quantitative financial commitments – e.g. expressed as a percentage of the GDP – in addition to emission reduction targets.
Negotiation process and treaty structure	Negotiation process and treaty structure	
	Bottom-up or multi-facet approach, pledge (with review) and review: Reinstein, 2004; Yamaguchi and Sekine, 2006	Each country creates its own initial proposal relating to what it might be able to commit to. Individual actions accumulate one by one. The collective effect of proposals is periodically reviewed for adequacy and – if necessary – additional rounds of proposals are undertaken.
	Portfolio approach: Benedick, 2001	A portfolio including: emission reduction policies, government research/development, technology standards and technology transfer.
	A flexible framework: PEW, 2005	A portfolio including: aspirational long-term goals, adaptation, targets, trading, policies, and technology cooperation.
	Orchestra of treaties: Sugiyama et al., 2003	A system of separate treaties among like-minded countries (emission markets, zero emission technology, climate-wise development) and among all parties to UNFCCC (monitoring, information, funding).
	Case study approach: Hahn, 1998	Multiple case studies of coordinated measures, emissions tax, tradable emission permits and a hybrid system in industrialized countries to learn by doing.

Note:

a There is some potential conflict with the terminology here: "non-binding" targets may be interpreted by some as restricting the capacity of countries to trade as they do not necessarily set up caps that impose prices and thus established tradable commodities.

Source: Earlier overviews by Bodansky, 2004; Kameyama, 2004; Philibert, 2005a

(2003) believe such goal-setting is desirable as it helps structure commitments and institutions, provides an incentive to stimulate action and helps establish criteria against which to measure the success of implementing measures.

An alternative to agreeing on specific CO_2 concentration or temperature levels is an agreement on specific long-term actions (such as a technology-oriented target, such as 'eliminating carbon emissions from the energy sector by 2060'). An advantage of such a goal is that it might be linked to specific actions. While links between such actions, GHG concentrations and climate impacts can be made, there are uncertainties in the precise correlation between them. Additionally, several different targets would have to be set to cover all climate-relevant activities (Schelling, 1997; Pershing and Tudela, 2003).

Another option would be to adopt a 'hedging strategy' (IPCC, 2001, chapter 10), which is defined as a shorter term goal on global emissions, from which it is still possible to reach a range of desirable long-term goals. One example of such a strategy is the California goal of reducing emissions to 1990 levels by 2020, and then reducing them to 80% below 1990 levels by 2050. Once the short-term goal is reached, decisions on subsequent steps can be made in light of new knowledge and decreased levels of uncertainty. To implement this option, the international community could agree on a maximum quantity of permissible GHG emissions in, for example, 2020 (Corfee-Morlot and Höhne, 2003; Pershing and Tudela, 2003; Yohe *et al*., 2004).

Another proposal would be to aim at formulating reductions step by step, based on the willingness of countries to act, without explicitly considering a long-term perspective. While such an approach does meet political acceptability criteria, it poses the risk that the individual reductions may not add up to the level required for certain stabilization levels. Some stabilization options may then be out of reach in the near future (see Chapter 3.3, Figure 3.19).

13.3.3.2 Participation

The participation of states in international agreements can vary. At one extreme, participation can be universal; at the other extreme, participation can be limited to just two countries. Many studies propose that participation can be differentiated in different tiers (see Staged systems in Table 13.2). States participating in the same tier would have the same

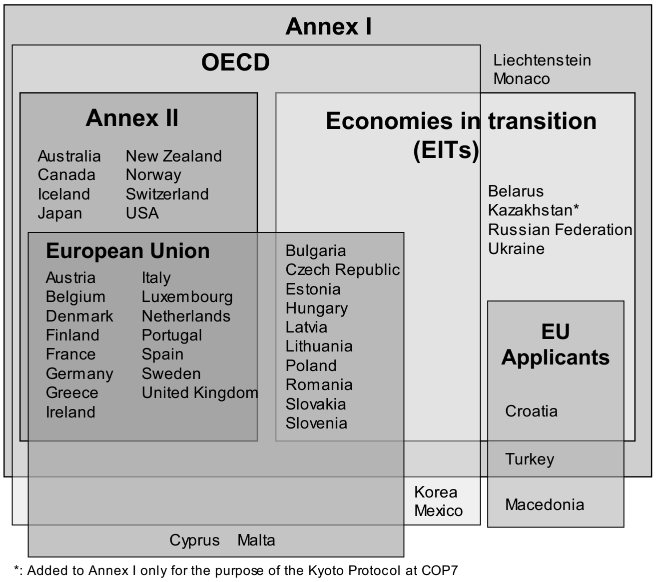


Figure 13.2: *Current country groupings under the UNFCCC, OECD and EU.*
Source: Höhne et al. (2005).

type of commitments (i.e. in the UNFCCC regime). The most important tiers are Annex I and non-Annex I, but there are also special arrangements for economies in transition as well as for least developed countries. Figure 13.2 shows the groupings of countries under the UNFCCC, OECD and EU. The allocation of states into tiers can be made according to quantitative or qualitative criteria or 'ad hoc' (see Table 13.2). According to the principle of sovereignty, states may also choose the tier in which they want to be grouped, provided their choice is accepted by other countries (see Kameyama, 2003; Reinstein, 2004).

Participation in the agreement can be static[32], or it may change dynamically over time. In the latter case, states can "graduate" from one tier of commitments to the next. Graduation can be linked to the meeting of quantitative thresholds for certain parameters (or combinations of parameters) that have been predefined in the agreement, such as emissions, cumulative emissions, GDP per capita, relative contribution to temperature increase or other measures of development, such as the human development index (see Berk and Den Elzen (2001), Gupta (1998, 2003a) and Höhne *et al*. (2003) for a review of per-capita emissions thresholds; Criqui *et al*. (2003) and Michaelowa *et al*. (2005b) for discussion of a composite index using the sum of per-capita emissions and per-capita GDP and Torvanger *et al*. (2005) for further composite indices). Qualitative thresholds such as adherence to certain country groupings (OECD, Economies in Transition) are already in use. Ott *et al*. (2004) combine quantitative and qualitative thresholds. Thresholds can be derived from agreed-upon GHG concentration targets or global emissions paths or be based on other parameters, such as willingness or capacity to pay.

Some have argued that an international agreement needs to include at least the major emitters to be effective, since the largest 15 countries (the EU25 is considered here to be one country) produce as much as 80% of global GHG emissions (Baumert *et al*., 2005a; PEW, 2005; Stewart and Weiner, 2003; Torvanger *et al*., 2005; Schmidt *et al*., 2006). A similar approach has been taken by authors comparing climate change agreements to other multilateral instruments, including disarmament treaties and the Antarctic Treaty (see Murase, 2002a). In these analyses, the authors assert that success can only be achieved if the major stakeholders act. Thus, for example, a nuclear disarmament treaty would be meaningless if it was not ratified by those States with nuclear weapons, even if it was ratified by the 180 non-nuclear States. By analogy, a climate change treaty is meaningful only if commitments are adopted and implemented by the major emitters – noting that the benefits of participation accrue to all countries, including those not taking part in the agreement. Murase (2002a) suggests that a future regime after 2012 thus needs to include key countries or groups such as the USA, EU, Japan, China, India, Korea, Mexico, Brazil, Indonesia, South Africa and Nigeria.

Much of the literature on game theory suggests that the conditions necessary for achieving large-scale stable coalitions mean that relatively modest emissions reductions will be achieved (e.g. Carraro and Siniscalco, 1993; Hoel and Schneider, 1997). Cooperative game theory emphasizes the prospect of building stable coalitions if a transfer scheme (e.g. by emissions trading) can allocate the gains from cooperation in proportion to the benefits from reduced climate impacts (e.g. Chander and Tulkens, 1995; Germain *et al*., 1998; Germain *et al*., 2003). Eykmans and Finus (2003) note that much of the literature focuses on a 'grand (all party) coalition, analyses stability in terms of the aggregate payoff to coalitions and rests on very strong assumptions about implicit punishment of any free-riding countries.' A more extensive discussion of the issues of free-riding is contained in Chapter 10 of the TAR.

Alternative assumptions can provide a richer understanding of possible factors relevant to an agreement by relating relate to the response to payoffs from cooperation, including spillover and trade effects, allowing for the development of multiple coalitions and recognizing trade and the role of technology transfer as well as the potential for other transfer schemes (Tol *et al*., 2000; Finus, 2002; Kemfert *et al*., 2004). They also increase the possibility that partial cooperation (including involving more than one coalition) can close the gap between the global optimum (full cooperation) and "no cooperation" by a substantial amount. While this is essentially a theoretical conclusion (based in some cases on modelling reflecting some empirical evidence), it provides some basis for suggesting that it is too restrictive to assume that a single, all-encompassing global intergovernmental agreement is a *necessary* condition

32 For example, participation in the tiers of commitments of the Kyoto Protocol can only be changed by an amendment which has to be ratified by all parties. As this is extraordinarily difficult, membership in the tiers is essentially fixed.

for effective mitigation action.

Some authors (see, for example, Muller, 2002; Jaeger, 2003) suggest that a climate regime is not exclusively about mitigation but that it also encompasses adaptation and, as such, far wider arrays of countries are vulnerable to climate and must be included in any agreement. Further, several authors (e.g. Meira Filho and Gonzales, 2000; Pan, 2005) argue that even if the majority of emissions are the responsibility of only a few nations, all countries must share the commitments to reduce these for reasons of equity and fairness (recognizing that such actions should be differentiated according to responsibility and capability). Other rationales for global engagement are also used, including that if only some major countries participate, the emissions of non-participating countries could increase by the migration of emission-intensive industries. Therefore, most proposals aim to provide incentives for countries to participate. Some aim at pull incentives, such as temporary over-allocation or no regret structures; others mention push incentives, such as trade sanctions or border tax adjustments (Kuik, 2003; Biermann and Brohm, 2005).

Other authors argue that countries have differentiated historical responsibility and that such a sub-global participation can be effective: Grubb *et al*. (2002) argue that under some scenarios one can expect that technology development driven by the international climate regime in Annex I countries could offset some or all emissions leakage in non-Annex I countries. Sijm (2004) notes that a number of policies could promote this spillover effect in the longer term. These types of policies include international cooperation on Research, Development and Demonstration (RD&D), promoting open trade or using the Clean Development Mechanism. Others argue that with the participation of some large countries, other countries cannot lag behind and that the climate regime should look for that 'tipping point' (Barrett, 2003).

In general, the literature suggests that actions can occur in parallel and that international agreements could have multiple components, since national circumstances are so diverse. However, the suggestion is also made that care should be taken, particularly for countries with limited institutional capacity, to avoid creating too many simultaneous international activities.

13.3.3.3 Implications of regime stringency: linking goals, participation and timing

Several studies have analysed the regional emission allocations or requirements on emission reductions and time of participation in the international climate change regime with the aim of being able to ensure different concentration or temperature stabilization targets (Berk and den Elzen, 2001; Blanchard, 2002; Winkler *et al*., 2002a; Criqui *et al*., 2003; WBGU, 2003; Bollen *et al*., 2004; Groenenberg *et al*., 2004; Böhringer and Löschel, 2005; den Elzen and Meinshausen, 2005; den Elzen and Lucas, 2005, den Elzen *et al*., 2005c; Höhne *et al*., 2005; Michaelowa *et al*., 2005a; Böhringer and Welsch, 2006; Höhne, 2006; Persson *et al*., 2006). A large variety of system designs for allocating emission allowances/permits were analysed, including contraction and convergence, multistage, Triptych and intensity targets. The studies cover a broad spectrum of parameters and assumptions that influence these results, such as population, GDP development of individual countries or regions, global emission pathways that lead to climate stabilization (including overshooting the desired concentration level), parameters for the thresholds for participation and ways to share emission allowances. For example, the studies include very stringent requirements for developed countries with more lenient requirements for developing countries as well as less stringent requirements for developed countries and more ambitious constraints for developing countries within a plausible range. The conclusions of these studies and their implications for international regimes can be summarized as follows:

- Under regime designs for low and medium concentration stabilization levels (i.e. 450 and 550 ppm CO_2-eq, category A and B; see Chapter 3, Table 3.10) GHG emissions from developed countries would need to be reduced substantially during this century. For low and medium stabilization levels, developed countries as a group would need to reduce their emissions to below 1990 levels in 2020 (on the order of –10% to 40% below 1990 levels for most of the considered regimes) and to still lower levels by 2050 (40% to 95% below 1990 levels), even if developing countries make substantial reductions. The reduction percentages for individual countries vary between different regime designs and parameter settings and may be outside of this range. For high stabilization levels, reductions would have to occur, but at a later date (see Box 13.7).
- Under most of the considered regime designs for low and medium stabilization levels, the emissions from developing countries need to deviate – as soon as possible – from what we believe today would be their baseline emissions, even if developed countries make substantial reductions. For the advanced developing countries, this occurs by 2020 (mostly Latin America, Middle East and East Asia). For high stabilization levels, deviations from the reference level are necessary only at a later date.
- Reaching lower levels of GHG concentrations requires earlier reductions and faster participation compared to higher concentrations.
- For many countries, the overall target set is critical; it dictates the emissions reduction requirements more specifically than does the approach chosen to meet that target.
- The wide diversity of approaches means that not all countries participate under all regimes – even if an identical concentration target is achieved. Obviously, required national actions differ enormously, depending on whether a country participates in a system. However, the difference in reductions required between the various approaches is small for participating countries.

Box 13.7 The range of the difference between emissions in 1990 and emission allowances in 2020/2050 for various GHG concentration levels for Annex I and non-Annex I countries as a group[a]

Scenario category	Region	2020	2050
A-450 ppm CO_2-eq[b]	Annex I	–25% to –40%	–80% to –95%
	Non-Annex I	Substantial deviation from baseline in Latin America, Middle East, East Asia and Centrally-Planned Asia	Substantial deviation from baseline in all regions
B-550 ppm CO_2-eq	Annex I	-10% to -30%	-40% to -90%
	Non-Annex I	Deviation from baseline in Latin America and Middle East, East Asia	Deviation from baseline in most regions, especially in Latin America and Middle East
C-650 ppm CO_2-eq	Annex I	0% to -25%	-30% to -80%
	Non-Annex I	Baseline	Deviation from baseline in Latin America and MIddle East, East Asia

Notes:

[a] The aggregate range is based on multiple approaches to apportion emissions between regions (contraction and convergence, multistage, Triptych and intensity targets, among others). Each approach makes different assumptions about the pathway, specific national efforts and other variables. Additional extreme cases – in which Annex I undertakes all reductions, or non-Annex I undertakes all reductions – are not included. The ranges presented here do not imply political feasibility, nor do the results reflect cost variances.

[b] Only the studies aiming at stabilization at 450 ppm CO_2-eq assume a (temporary) overshoot of about 50 ppm (See Den Elzen and Meinshausen, 2006).

Source: See references listed in first paragraph of Section 13.3.3.3

Several studies have gone one step further and have, based on emission allocations, calculated emission reduction costs and possible trades of emission allowances at a regional level for different concentration or temperature stabilization targets (Criqui *et al*., 2003; WBGU, 2003; Bollen *et al*., 2004; Böhringer and Welsch, 2004, 2006; Böhringer and Löschel, 2005; den Elzen and Lucas, 2005; den Elzen *et al*., 2005c; Persson *et al*., 2006). Researchers have also analysed a large variety of system designs. With cost analysis even more assumptions are relevant, such as detailed assumptions on emission reduction costs per sector and region. Costs have been calculated using a variety of models, ranging from those with detailed sectoral representation focussing on the technological aspects to macroeconomic models focussing on the economy as a whole. How (and what) costs are calculated plays a role. Some studies present annual direct mitigation costs (only direct abatement costs) or energy costs, such as mitigation costs and costs of losses of fossil fuel exports or gains from increased exports of biofuels. Other studies present full macro-economic costs, calculated as (cumulative) GDP losses in a specific target year. The cumulative impact of climate policies on GDP may be lower than expected from the annual abatement costs levels due to the fact that climate policy leads mostly to the substitution of investments and activities and much less to an overall reduction of the GDP. The conclusions of these studies on costs can be summarized as follows:

Global costs

- The total global costs are highly dependent on the baseline scenario, marginal abatement costs estimates, the participation level in emission trading and the assumed concentration stabilization level (see also Chapter 11).
- The total global costs does not vary significantly for the same global emission level; however, costs will vary with the degree of participation in emission trading (how and when allowances are allocated). If, for example, some major emitting regions do not participate in the reductions and in emission trading immediately, the global costs of the participating regions may be higher (see also Chapter 3, e.g. Bollen *et al*., 2004; den Elzen *et al*., 2005c).

Regional costs

- Regional abatement costs are largely dependent on the assumed stabilization level and baseline scenario. The allocation regime is also an important factor, although in most countries the extent of its effect is less than that of the stabilization level (see Criqui *et al*., 2003; den Elzen and Lucas, 2005; den Elzen *et al*., 2006b). The allocation parameter having the largest effect is the timing of participation. Under a staged approach, whether a region participates early or late is of great importance. If, for example, convergence of the per capita emissions were to occur by the end of this century, developing regions

would incur high costs relative to what might occur in the reference or baseline cases. Conversely, if convergence were to occur by the middle of the century, developed countries would incur higher costs relative to what they might incur in a reference or baseline case (see Nakicenovic and Riahi, 2003; den Elzen *et al*., 2005a; Persson *et al*., 2006).
- Abatement costs (only costs from reducing emissions) as a percentage of GDP vary significantly by region for allocation schemes that ultimately lead to convergence in per capita emissions by the middle of this century. The costs are above the global average for the Middle East and the Russian Federation, including surrounding countries, and – to a lesser extent – for Latin America. The costs are near the world average for the OECD regions and below the world average for China. The other developing regions, such as Africa and South-Asia (India), experience low costs or even gains as a result of financial transfers from emission trading. (Criqui *et al*., 2003; den Elzen and Lucas, 2005).
- In addition to the abatement costs of reducing emissions, other costs arise from changes in international trade. Fossil fuel-exporting regions are also likely to be affected by losses in coal and oil exports compared to the baseline, while some regions could experience increased bio-energy exports (i.e. the Russian Federation and South America) (see Nakicenovic and Riahi, 2003; van Vuuren *et al*., 2003; Persson *et al*., 2006; and also Chapter 11).
- The economic impacts in terms of welfare changes show a similar pattern for different allocation schemes. For example, allocation schemes based on current emissions (sovereignty) lead to welfare losses for the developing countries. Allocation schemes based on a per capita convergence lead to welfare gains for developing countries, without leading to excessive burdens for industrialized countries. (Böhringer and Welsch, 2004)

13.3.3.4 Actions

13.3.3.4.1 Targets

While many types of commitments are identified in the literature on climate change, the most frequently evaluated commitment is that of the binding absolute emission reduction target as included in the Kyoto Protocol for Annex I countries. The broad conclusion that can be drawn from the literature is that such targets provide certainty about future emission levels of the participating countries (assuming targets will be met). These targets can also be reached in a flexible manner across GHGs and sectors as well as across borders through emission trading and/or project-based mechanisms (in the Kyoto Protocol case, this is referred to as Joint Implementation (JI) and as the Clean Development Mechanism (CDM).

One crucial element is defining and agreeing on the level of the emission targets. Examples of processes to agree on a target include:

- Participating countries make proposals (pledges) for individual reductions on a bottom-up basis. This approach has the risk that proposed reductions may not be adequate to lead to the desired stabilization levels.
- A common formula can be agreed upon for determining the emission targets. This rule could lead to reduction percentages for each individual country (which could subsequently be modified by negotiations).
- An overall target can be given to a group of countries, with the group deciding internally on how to share the target amongst the participants. This approach has been applied to the EU for the purpose of the Kyoto Protocol. It could, in principle, also be applied to any other group of countries.

Many authors have raised concerns that the absolute or fixed targets may be too rigid and cap economic growth (Philibert and Pershing, 2001; Höhne *et al*., 2003; Bodansky, 2004). To address these concerns, a number of more flexible national emission targets have been proposed (see alternative types of emission targets in Table 13.2). These options aim at maintaining the advantages of international emissions trading while providing more flexibility to countries to avoid extremely high costs and, thereby, potentially allowing for the adoption of more stringent targets. However, this flexibility reduces the certainty that a given emission level will be reached. Thus, there is a trade-off between costs and certainty in achieving an emissions level (see Jotzo and Pezzey, 2005). Other disadvantages that have been mentioned are adding to the complexity of the system or, in the case of intensity targets, the difficulty in coping with economic recession as well as the potential for creating ambiguity for market investors.

Additional understanding comes from the political science literature which emphasizes the importance of analysing the full range of factors bearing on decisions by nation states, including domestic pressures from the public and affected interest groups, the role of norms and the contribution of NGOs (environment, business and labour) to the negotiation processes. Studies of the European Acid Rain Regime have revealed, for example, that although agreements on an ambitious target can serve as a driver for policy implementation, they may not necessarily result in a good environmental consequence if the countries involved do not have the capacity to comply with what they have committed themselves to in good faith (Victor, 1998). While such case study-based analyses yield conclusions that are dependent on the choice of cases and the manner in which the analysis is carried out, they can provide insights which are more accessible to policymakers than more quantitative economic analyses.

13.3.3.4.2 Flexibility provisions

Many environment agreements seek to address complex issues by allowing for additional flexibility as a means to achieve their goals. Flexibility has been suggested as to ‘how’, ‘when’, ‘where’ and ‘what’ emissions are to be reduced. In the climate change context, emission reductions under an international agreement can conceptually be achieved any 'where' on the globe. It is also possible to shift the timing ('when') of emission reductions (depending on the emission pathway), the 'how' (i.e. choice of policy instrument) and the 'what' in terms of the specific emission source or sink that is the target of the policy.

The Kyoto Protocol incorporates three articles that provide flexibility as to 'where' emission reductions occur, namely, through provisions on international emission trading, JI and the CDM. Under Kyoto's international ETS, emission allowances may be traded between governments of Annex B parties if a surplus occurs in one country. Emission reductions achieved through projects between Annex I countries are called JI, while emission reduction projects located in non-Annex I countries are called CDM projects. Extensive rules have been agreed upon to ensure that credits created under these project mechanisms actually represent the emissions reduced.

International Emissions Trading

Emissions' trading has become an important implementation mechanism for addressing climate change in many countries. The overall value of the global carbon market was over 10 billion US$ in 2005, and in the first quarter of 2006 the transaction level reached 7.5 billion US$ (World Bank and IETA, 2006). The most advanced ETS is that developed by the EU. While this system is an international one, it bears many of the characteristics of a national programme, with oversight by the European Commission and a centralized regulatory and review mechanism (see Box 13.4 for details, including those on trading prices and volumes). A larger global system of international trading is slowly developing through emission credits generated by the project-based mechanisms[33]. Theoretically, a fully global ETS would provide market players and policymakers with information thus far absent from decision-making: the actual, unfettered, global cost of GHG mitigation in a range of economic activities. In this context, at the international level, such a regime would mirror the information provided by national trading programmes at a global scale.

Lecocq and Capoor (2005) note that while the international GHG emissions market remains fragmented, trading activity has increased substantially during the last 5 years. According to their analysis, regional, national and sub-national trading programmes are all operating under different rules, which could inhibit 'market convergence' and increase the costs of trading. Others indicate that a global market can incorporate diverse domestic and regional systems despite differences in design; they reiterate the point made by others that such a system may be significantly less efficient that a single globally optimized regime (Baron and Philibert, 2005).

A full assessment of the elements required to link multiple regimes is provided by Haites (2003a), who identifies only a few situations that might prevent linkages (a formal prohibition in one system to allow links, and circumstances where a single firm's membership in multiple programmes creates the potential for double counting). However, issues that could complicate links between two or more emissions trading programmes include concerns on the effectiveness of compliance enforcement and on whether the linked regimes provide adequate protection of either system's environmental objectives. As Bygrave and Bosi (2004a,b) note, links do not need to be formal; market arbitrage can provide opportunities for purchasing allowances in multiple markets even if there is no specific recognition of one system's permits under another's structure.

Various authors have analysed the size of the allowance surplus of the countries in transition, barriers to accessing allowances, the potential market power of cartels and links to energy security. Such surpluses can alter the overall costs of compliance with the Kyoto commitments – but only if trade in such surplus allowances is undertaken. Victor *et al*. (2001a) estimated the joint Russian and Ukrainian surplus at 3.7 billion tCO_2 for the entire commitment period 2008–2012. Berkhout and Smith (2003) estimate the surplus level of the former Soviet Union through to 2030 and state that it could only cover half of an assumed 30% reduction target for a 28-member state EU. Golub and Strukova (2004) see the Russian surplus as being up to 3 billion tCO_2, arguing that due to barriers in the Russian capital market, forward trading with OECD countries represents the only opportunity to raise initial capital to mobilize no-regret and low-cost GHG reductions. Maeda (2003) shows that permits for surplus emissions in the international emissions trading regime may affect the economic efficiency of the Kyoto mechanism and suggests that considerable market power exerted by sellers could affect the price (e.g. if all of the economies in transition form a cartel, if Ukraine forms a cartel with Russia or even if Russia acts alone). Kuik (2003) sees a trade-off between economic efficiency, energy security and carbon dependency with respect to the EU acquisition of Russian and Ukrainian assigned amount units. One proposal for reducing concerns over trading in surplus allowances is that of the 'Green Investment Scheme', in which revenues from sales of surplus allowances are spent on national policies, programmes and projects to further reduce emissions; this option is explained further below.

Project-based mechanisms (Joint Implementation and the Clean Development Mechanism)

The earliest project-based mechanism of the UN Climate Convention process was the pilot phase of 'Activities Implemented Jointly' (AIJ). Most of the 150 AIJ projects were small, and many were only partially implemented due to the lack of financing that resulted from the lack of emissions credits. Only half a dozen investor countries and even fewer host countries developed real, national AIJ programmes. Selection criteria for AIJ programmes often delayed the acceptance of

33 The EU ETS has also an international component as it involves cross-border trades and transactions between national allowance registries.

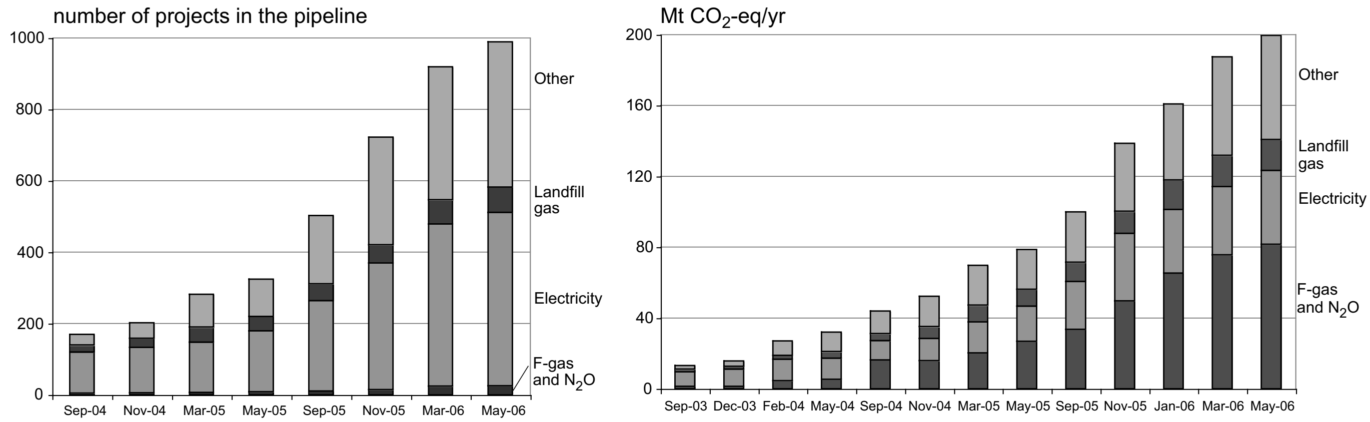


Figure 13.3: *Evolution of the Clean Development Mechanism portfolio in terms of CO_2 -equivalents per year and number of projects.*
Source: Ellis and Karousakis (2006).

projects, and most that were undertaken were commercially viable only if additional financing was provided by a separate investment subsidy (Michaelowa, 2002).

Since 2000, the CDM has allowed crediting of project-based emission reductions in developing countries; this is the first of the Kyoto Protocol's market mechanisms to be implemented. A number of analysts have estimated CDM volume and price. Chen (2003) derived prices of 2.6–4.9 US\$/tCO_2 and annual volumes of approximately 600–1000 million certified emissions reductions (CERs). Jotzo and Michaelowa (2002) and Michaelowa and Jotzo (2005) model an annual CER demand of 360 million tCO_2 and a price of 3.6 €/tCO_2. Springer and Varilek (2004) predict a likely CER price of less than 10 US\$/tCO_2 in 2010. CER prices increased from approximately 3 €/tCO_2 in 2003 to more than 20 €/ton in early 2006 (at the time of peak prices in the EU ETS); as of October 2006, they had declined to about 13 €/tCO_2. CER prices have been relatively closely tied to EU ETS prices over time.

As of May 2006, the volume of CERs estimated from nearly 1000 proposed projects in 69 countries was 200 MtCO_2-eq/year in 2008–2012 and 330 Mt MtCO_2-eq/year in the pre-2008 period (Ellis and Karousakis, 2006; specific project information can be found at http://cdm.unfccc.int; recent updates on the CDM/JI pipeline can also be found at the UNEP/RISO site, www.cd4cdm.org/publications/CDMpipeline.xls) (See Figure 13.3). While not all projects will be implemented, the UNFCCC cites 491 registered projects and estimates CERs equal to 740 MtCO_2-eq from those projects through to the end of 2012.[34] Ellis and Karousakis (2006) also indicate that almost half of the proposed CDM projects are in the electricity sector and that many are small renewable projects occurring in 40 countries. However, the majority of credits have come from CDM projects reducing nitrous oxide (N_2O), trifluoromethane (HFC-23) and, to a lesser extent, methane (CH_4). Projects that have not yet had methodologies approved will be under-represented in the project mix – even if they represent opportunities for significant emissions reductions at the national or global level. Publicly committed budgets for CER acquisition stood at approximately 7.5 billion US\$ (World Bank, 2006) (See Figure 13.4). At such a scale, the CDM begins to reach the same order of magnitude as Global Environment Facility (GEF) and Official Development Assistance (ODA) resources.

It was initially assumed that CDM projects would be undertaken as bilateral arrangements between Annex I and non-Annex I convention Parties (and private sector companies in those countries). As of October 2006, 56% of registered projects were being undertaken unilaterally, indicating that companies in developing countries are procuring the financing to implement projects and sell the CERs to industrialized countries.[35]

A CDM project has to go through an elaborate project cycle that includes external validation and which has been defined by a decision of the 7th Conference of the Parties to the UNFCCC (2001) and is in keeping with the decisions of the CDM Executive Board that is overseeing the project cycle (see, for example, UNFCCC, 2003a–c). As CDM projects are implemented in countries without emissions targets, project 'additionality' becomes important to avoid generating fictitious emission reduction credits through 'business as usual' activities. Several tests of additionality have been discussed in the literature; these include investment additionality (see Greiner and Michaelowa, 2003) and environmental additionality (see Shrestha and Timilsina, 2002). The CDM Executive Board has developed an additionality tool that project proponents can use to test and demonstrate the additionality of a CDM project (http://cdm.unfccc.int/methodologies/PAmethodologies/Additionality_tool.pdf).

34 As of January 22, 2007. See: http://cdm.unfccc.int
35 The CDM Executive Board at its 18th meeting decided that registration can take place without an Annex I Party being involved at the time of registration. An Annex I partner would need to issue a letter of approval after registration in order to receive the CERs.

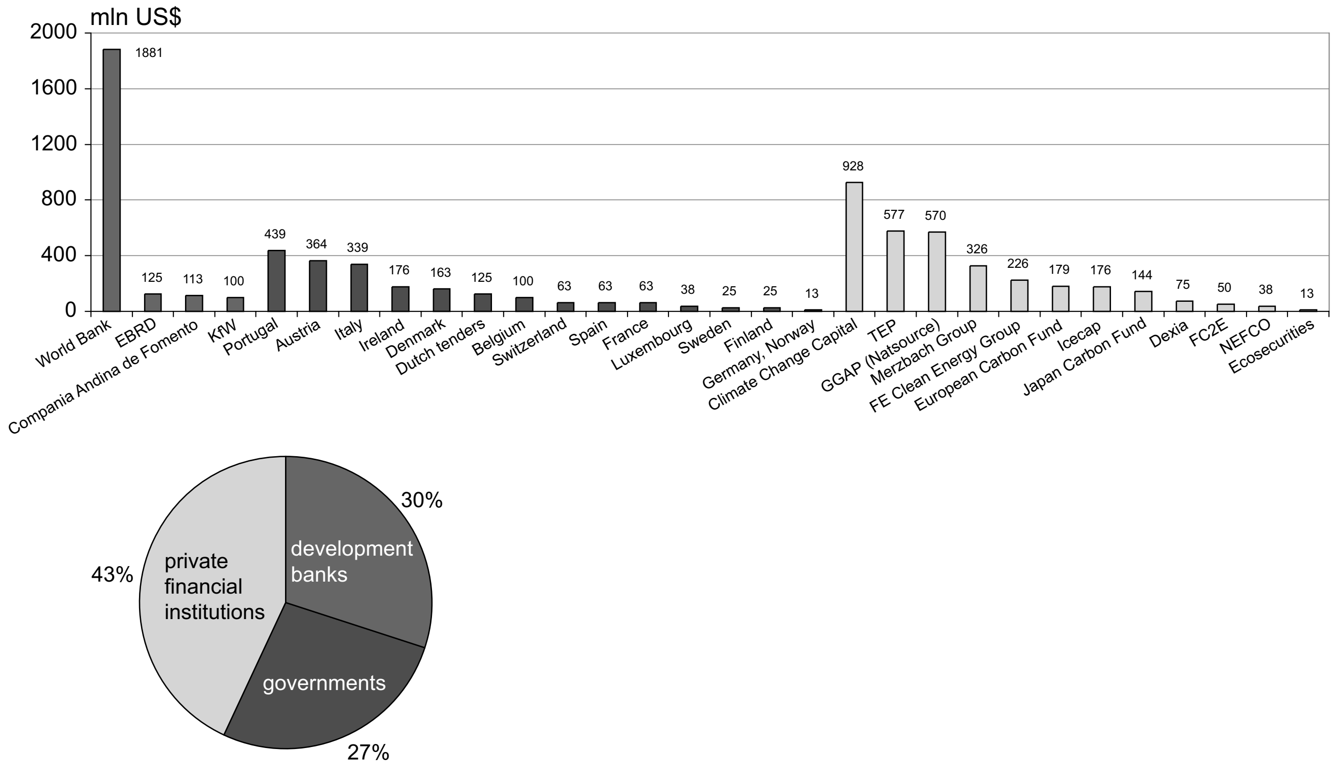


Figure 13.4: *Budgets for the acquisition of certified emissions reductions (CERs) and emission reductions units (ERUs).*

Note: Status as of October 10, 2006 at which time the total budget was almost € 6 billion.

If a project is additional, the next step is to determine a 'baseline' – the emissions that would have occurred if the project had not taken place. One potential risk is the overestimation of baseline emissions, which is a major problem as all participants profit from an overestimate as there is then no incentive to correct it. Stringent rules and modalities are required for determining baselines affecting the efficient processing of the CDM (Bailey *et al*., 2001). Fischer (2006) argues that due to pressure from industry, rules for standard emission rates are likely to be systematically biased to over-allocation and also risk creating inefficient investment incentives. Alternatively, Broekhoff (2004) focuses on costs and efficiency, arguing that the availability of data and the level of data aggregation determine to a large extent the cost of deriving multi-project baselines. Other authors examine specific baseline issues in the energy sector, particularly the use of models, the need to consider size, vintage, generation type and operational characteristics and issues relating to technology and sectoral approaches (see Fichtner *et al*., 2001; Zhang *et al*., 2001; Spalding-Fecher *et al*., 2002; Begg and Van der Horst, 2004; Illum and Meyer, 2004; Kartha *et al*., 2004; Rosen *et al*., 2004; Sathaye *et al*., 2004).

In order to account for any emissions that occur outside of the CDM project boundary but which are a consequence of the CDM project – emissions referred to a 'carbon leakage' – a CDM project should also include a leakage estimate. According to the UNFCCC CDM glossary of terms, leakage is defined as the net change of anthropogenic emissions by sources of GHGs that occur outside the project boundary and which is measurable and attributable to the activity of the CDM project. Leakage issues have been discussed by a number of authors (see, for example, Geres and Michaelowa (2002) and Kartha *et al*. (2002) for the electricity sector and the Working Group on Baseline for CDM/JI Project (2001)). There is a general consensus that the determination of project boundaries is critical to any evaluation of leakage.

The coverage of forestry and forest-related projects is a contentious issue under the CDM. The problems primarily relate to the impermanence of the forest and to leakage to other regions. Dutschke (2002) suggests leasing CDM credits to address the non-permanence of forestry sinks. The CDM has addressed the issue of non-permanence through the creation of separate CDM credits, which are called temporary CERs. According to Nelson and de Jong (2003), development priorities can be lost. This is illustrated by the case of a forestry project in Chiapas in which Mexico shifted from a development emphasis with multiple species to two species when the focus changed to carbon sales by individual farmers. Data (or its scarcity) as well as price uncertainty also pose problems. Vöhringer (2004) notes that establishing historical deforestation rates is a major problem in Costa Rica. Van Vliet *et al*. (2003) analysed six proposed plantation forestry projects in Brazil for uncertainty and, based on their results, they suggest that fluctuations in product prices cause variations of up to 200% in CERs and net present value, leading to difficulties in determining the additionality of such projects, thereby making five of the six projects ineligible for CDM.

Perhaps the most critical issue in the context of the viability of the CDM over the longer term is whether there will be an ongoing price signal that encourages both emission reduction commitments and a market demand – over the longer term. This will clearly depend on the shape of both international agreements and evolving national programmes that might support project offsets. Independent of the market demand issues, an important suggestion to enhance the CDM relates to improving the sustainable development benefits of a CDM. One proposal[36] for doing this is the 'Gold Standard', which calls for enhanced environmental assessment, stakeholder consultations and the use of a qualitative sustainability matrix, expanding the CDM regime to allow programmes and policies to be credited – a concept elaborated on in a decision by the first meeting of the Kyoto Parties in 2005, and analysed by Ellis (2006) – and extending CDM project incentives beyond 2012.

Joint Implementation has been much less extensively researched than the CDM. Its later start date and unclear international rules (for example, the 'second track' rules were only agreed upon in October 2006) have generated considerable uncertainty with regard to implementation. Transactions under JI are seen as both cumbersome and beset with institutional obstacles (Korppoo, 2005). In addition, several authors have argued that JI projects will potentially be 'double counted' – given credit under both the project mechanism as well as under the rules for EU ETS. A number of proposals have been made to address this issue. Koch and Michaelowa (1999) and Moe *et al*. (2003) have suggested a 'Green Investment Scheme' (GIS) in which revenues from sales of Assigned Amount Units (AAU) are allocated to projects that reduce GHG emissions. Blyth and Baron (2003) suggest that the scale of a GIS in Russia could reach as much as € 1.25–3.5 billion per annum. This is a very approximate figure and depends on the balance of supply and demand and the prevailing allowance price. Fernandez and Michaelowa (2003) discuss the impact of defining the 'acquis communautaire' as the baseline for JI projects in the new EU Member States and stress the need to establish a predictable legal framework in the host countries, while Van der Gaast (2002) sees a reduced scope for JI in Eastern Europe due to the 'acquis' which could also be increased by using a GIS.

National institutions for project-based mechanisms have been slow to develop. The institutional problem is often exacerbated in countries with unstable economies and institutions and by project developers who often have very short time horizons, are unwilling to wait for the revenues and who cannot provide regular and ongoing monitoring and verification reports of emission reductions (see Michaelowa (2003a) for an overview of such issues in CDM host countries, Korppoo (2005) for specific issues related to the Russian Federation and Figueres (2004) for issues specific to Latin America).

Sectoral approaches

A number of researchers have suggested that sectoral approaches may provide an appropriate framework for post-Kyoto agreements (see sectoral approaches in Table 13.2). Under such a system, specified targets could be set, starting with specific sectors or industries that are particularly important, politically easier to address, globally homogeneous and/or relatively insulated from competition with other sectors. Such an approach may be binding (e.g. such as an agreement in the International Civil Aviation Organization) or voluntary (such as an agreement through the International Standardization Organization). Targets may be fixed or dynamic, and 'no-lose', binding or non-binding (Philibert and Pershing, 2001; Samaniego and Figures, 2002; Bodansky, 2004). Bosi and Ellis (2005) and Baron and Ellis (2006) have explored different design options for sectoral crediting, including policy, rate-based and fixed limit approaches, and Ellis and Baron (2005) have assessed how these options could be applied to the aluminium and electricity sectors.

Sectoral commitments have the advantage of being able to be specified on a narrower basis than total national emissions. Baumert *et al*. (2005b) consider specific options in aluminium, cement, iron and steel, transportation and electricity generation and conclude that while not all sectors are amenable to such approaches, considerable precedent already exists for agreement both between companies and by governments. Sectoral approaches provide an additional degree of policy flexibility and make the comparison of efforts between countries within a sector a relatively easy process – although comparing efforts across sectors may be difficult (see Philibert, 2005a). An additional disadvantage to sectoral approaches is that they may create economic inefficiency. Trading across all sectors will inherently be at a lower cost than trading only within a single sector.

13.3.3.4.3 Coordination/harmonization of policies

As an alternative to or complementary to internationally agreed caps on emissions, it has been proposed that countries agree to coordinated policies and measures that reduce the emission of GHGs. A number of policies that would achieve this goal have been discussed in the literature, including taxes (such as carbon or energy taxes), trade coordination/liberalization, R&D, sectoral policies and policies that modify foreign direct investment (FDI). Sectoral policies have been discussed above, R&D is discussed in Section 13.2.1.6 and FDI is discussed below on financing. This discussion focuses on harmonized taxes as well on as trade and other policies.

36 This is already being applied for some projects on a voluntary basis. See: http://www.cdmgoldstandard.org.

Box 13.7 Climate change and the World Trade Organization (WTO)

There is a history of international cooperation between environmental agreements and the WTO (see, for example, Frankel and Rose, 2003). However, there is also literature pointing to potential conflicts. To date, disputes between climate and trade agreements have not been legally tested. Should a complaint arise, the attitude of a WTO panel may depend on whether the disputed trade measure stems from a treaty obligation or a national policy. Neither the UNFCCC nor the Kyoto Protocol has been formulated in language that can reasonably be interpreted to require or authorize a trade measure as a strategy to promote membership, make the climate regime more effective or enforce the treaty. Thus, any use of a climate trade measure would be considered to be a national-level action (see Fischer *et al*., 2002).

Two examples help demonstrate the range of possible pitfalls:

- In 1998, Japan introduced the 'top-runner' programme as part of its domestic efforts to implement the Kyoto Protocol. This legislation was intended to ensure that automobiles and other manufactured products would be more energy efficient; it required new appliance and manufactured goods be as efficient as the 'top-runner' in the same category. The legislation raised concern among other automobile-exporting countries, most notably the USA and the EU, which feared that the measures might have adverse effects on their exports; consequently, the latter suggested that the legislation was not compatible with WTO rules on free trade. Conversely, according to Yamaguchi (2004), the Japanese legislation provides for objective standards that would be applied equally to domestic and imported cars and, accordingly, there would be no discriminatory treatment as a matter in law. After discussions between all parties over several years, no formal appeal was ever submitted under the General Agreement on Tariffs and Trade (GATT) or the Technical Barriers to Trade (TBT) Agreement (see Murase, 2004).
- Murase (2002b) considers potential conflicts between the use of the Kyoto Protocol's project-based flexibility mechanisms (CDM and JI) and various trade agreements. Inasmuch as project-based offsets represent foreign direct investment (FDI), they may run counter to both the GATT and Subsidies and Countervailing Measures Agreement as well as the common practice application of the Trade Related Investment Measures (TRIMs) and Agriculture Agreements. Adding an additional point of complexity, Werksman *et al*. (2001) suggest that the effective functioning of the CDM may require investor discrimination in a manner prohibited by the Most Favored Nation (MFN) clause of international investment agreements.

Assunção and Zhang (2002) explore other areas of interaction between domestic climate policies and the WTO, such as the setting of energy efficiency standards, the requirement for eco-labels and the implemention of targeted government procurement programmes. They suggest that an early process of consultation between WTO members and the Parties to the UNFCCC may be necessary to enhance synergies between the trade and climate regimes. To this end, they recommend the establishment of a joint WTO/Framework Convention on Climate Change (FCCC) working group that would specifically focus on greater coherence between trade, climate change and development policy.

One of the leading proponents of a harmonized tax has been Cooper (1998, 2001). Under his proposals, all participating nations – industrialized and developing alike – would tax their domestic carbon usage at a common rate, thereby achieving cost-effectiveness. Aldy *et al*. (2003) have suggested a number of problems with Cooper's proposals, including issues of fairness (whether developed and developing countries should have identical tax rates given the relative welfare and relative responsibilities), whether any incentive exists for developed countries to adopt a tax and how to manage gaming behaviour (in which a government may change tax codes to neutralize its effects or to benefit certain economic sectors). Additional criticism of a common tax structure comes from the modelling community: Babiker *et al*. (2003) note that while an equal marginal abatement cost across countries is economically efficient, it may not be politically feasible in the context of existing tax distortions. They also note that many countries which currently apply such taxes have exempted certain industries, thereby significantly increasing the overall costs of the tax regime. In addition, competitive concerns can arise if one country adopts a tax and a trading partner does not. Several solutions have been proposed, including the use of trade bans or tariffs to induce action. Governments may also seek to use border tax adjustments under such circumstances (Charnovitz, 2003). However, it has been argued that such a measure could be as disadvantageous to a target foreign country as a trade measure. To date, World Trade Organization (WTO) case law has not provided specific rulings on climate-related taxes. Any proposed border adjustments would need careful design and also take WTO law into account (Biermann and Brohm, 2005) (see Box 13.7).

The importance of harmonizing environmental standards – including those related to climate change – has been evaluated by Esty and Ivanova (2002), who conclude that both economic and ecological interdependence demand coordinated national policies and international collective action. To this end, they propose the creation of a Global Environmental Mechanism to help manage the environmental components of a globalizing world, primarily through information and analysis and the creation of a policy space for environmental negotiation and bargaining.

Other fora, in addition to the WTO, also offer opportunities to exchange information and coordinate climate-related policies and activities. For example, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) offers an opportunity to unite efforts in a common cause to both protect endangered species and the climate. Similarly, meetings of Asia Pacific Economic Cooperation (APEC) provide a platform for regional economies to take steps that meaningfully address the adverse impact of climate change (Ivanova and Angeles, 2005). The APEC Virtual Center (APEC-VC) for region-wide Environmental Technology Exchange launched by the Asia-Pacific economies provides information on environmental technology gathered by regional and local governmental authorities as well as by companies and environment-related organizations. The North American Commission on Environmental Cooperation (the NACEC or CEC), which was created within the North America Free Trade agreement (NAFTA), offers another model: Canada, Mexico and the USA signed an agreement to cooperate on reducing the threat of global change. The trilateral agreement is the basis for public-private partnerships to reduce GHG emissions in North America and to boost investment in green technology. It should be acknowledged that the NACEC could not prevent the detrimental decline in the Mexican environment during their participation in NAFTA (Gallagher, 2004); therefore, some caution must be exercised with regard to the environment when engaging in trade agreements.

13.3.3.4.4 Technology

A number of issues related to technology research, development and deployment (including transfers and investment) have been explored in the literature on climate change. Many authors have asserted that a key element of a successful climate change agreement will be its ability to stimulate the development and transfer of technology – without which it may be difficult or impossible to achieve emissions reductions at a significant scale (Edmonds and Wise, 1999; Barrett, 2003; Pacala and Socolow, 2004).

Technology agreements

The studies reported in the literature make it very clear that R&D support, price signals and other arrangements can all contribute to technology development and diffusion. Financial and human resources, often scarce in developing countries, will be needed to promote R&D, while monetary and political incentives as well as institutional arrangements will be required to promote diffusion (see IPCC (2000) which contains a comprehensive review of technology transfer issues, including proposals for improving international agreements.) Technology agreements may also seek to address barriers in technology research, development and diffusion. (For additional details on specific sectors and technologies, see Chapters 4–10).

One variant of a technology agreement is formulated by Barrett (2001, 2003) in a proposal which emphasizes both common incentives for climate-friendly technology research and development (R&D) and technology protocols (common standards) rather than targets and timetables. While this proposal could potentially be environmentally effective, depending on the payoffs to the cooperative R&D efforts and the rate of technology deployment, Barrett notes that the system would neither be efficient nor cost-effective, not least because the technology standards would not apply to every sector of the global economy and may entail some technological lock-in. However, Barrett assumes that if standards are set in enough key countries, a ‘tipping effect’ is created which ultimately would lead to widespread global adoption. In reviewing Barrett’s assessment, Philibert (2004) expresses doubts as to whether such a tipping effect would be applicable and suggests, alternatively, that for some technologies (e.g. CO_2 capture and storage), cost constraints may be more critical than acceptability in determining market penetration.

The concept of regional technology-specific agreements has also been explored by Sugiyama and Sinton (2005), who suggest that they may offer an interim path to promote cooperation and develop new, lower cost options to mitigation climate change – allowing any future negotiations on emission caps to proceed more smoothly. Box 13.8 lists some examples of existing international technology coordination programmes.

Technology transfer

One mechanism for technology transfer is through the establishment of – and subsequent contributions to – special funding agencies that disburse money to finance emissions reduction projects or adaptation activities. The UNFCCC and the Kyoto Protocol already include provisions for establishing and funding project activities, although contributions to and participation in these are mostly voluntary. UNFCCC also includes provisions for technology transfer under Article 4.5. The CDM could also be a vehicle for technology transfer, but the effects are unclear at this point.

As part of the Marrakesh Accords, at the seventh Conference of the Parties (COP 7), Parties were able to reach an agreement to work together on a set of technology transfer activities, which were grouped under a framework for meaningful and effective actions to enhance the implementation of Article 4.5 of the Convention. This framework[37] has five main themes:

1. Technology needs and needs assessments;
2. Technology information;
3. Enabling environments;
4. Capacity building;
5. Mechanisms for technology transfer.

37 See UNFCCC decision 4/COP 7 on the Development and Transfer of Technologies

Box 13.8 Examples of coordinated international R&D and technology promotion activities

- **International Partnership for a Hydrogen Economy:** Announced in April 2003, the partnership consists of 15 countries and the EU, working together to advance the global transition to the hydrogen economy, with the goal of making fuel cell vehicles commercially available by 2020. The Partnership will work to advance the research, development and deployment of hydrogen and fuel cell technologies and to develop common codes and standards for hydrogen use. See: www.iphe.net.
- **Carbon Sequestration Leadership Forum:** This international partnership was initiated in 2003 and has the aim of advancing technologies for pollution-free and GHG -free coal-fired power plants that can also produce hydrogen for transportation and electricity generation. See: www.cslforum.org.
- **Generation IV International Forum:** This is a multilateral partnership fostering international cooperation in research and development for the next generation of safer, more affordable and more proliferation-resistant nuclear energy systems. This new generation of nuclear power plants could produce electricity and hydrogen with substantially less waste and without emitting any air pollutants or GHG emissions. See: http://nuclear.energy.gov/genIV/neGenIV1.html.
- **Renewable Energy and Energy Efficiency Partnership:** Formed at the World Summit on Sustainable Development in Johannesburg, South Africa, in August 2002, the partnership seeks to accelerate and expand the global market for renewable energy and energy-efficiency technologies. See : http://www.reeep.org
- **Asia-Pacific Partnership on Clean Development and Climate:** Inaugurated in January 2006, the aim of this partnership between Australia, China, India, Japan, Republic of Korea and USA is to focus on technology development related to climate change, energy security and air pollution. Eight public/private task forces are to consider (1) fossil energy, (2) renewable energy and distributed generation, (3) power generation and transmission, (4) steel, (5) aluminium, (6) cement, (7) coal mining and (8) buildings and appliances. See: http://www.asiapacificpartnership.org.

Actions to implement the framework include the organization of meetings and workshops, the development of methodologies to undertake technology needs assessment plans, the development of a technology transfer information clearinghouse, including a network of technology information centres, actions by governments to create enabling environments that will improve the effectiveness of the transfer of environmentally sound technologies and capacity building activities for the enhancement of technology transfer under the Convention. Funding for technology needs assessments has been provided, and further funds for technology may become available from the UNFCCC's Special Climate Change Fund.

Other international efforts have also been undertaken to promote technology transfer in support of climate change mitigation efforts, including those by the UN Industrial Development Organization (UNIDO) and by the Climate Technology Initiative (CTI) of the IEA. As noted by the US National Research Council, additional work is particularly needed to assist poor countries as these lack scientific resources and economic infrastructure as well as the appropriate technologies to reduce their vulnerabilities to potential climate changes (NRC, 2003).

The distinction between public financing for climate change mitigation and private financing for technology investment is often blurred: Clean energy projects are frequently a blend of the two, with public financing used to leverage private investment. For example, the International Finance Corporation (IFC) clean energy financing projects in Eastern Europe, Russia, China and the Philippines use technical assistance funds to train commercial banks in energy efficiency while concurrently lending partial risk guarantees and offering credit lines to encourage banks to provide loans. In this manner public funds are heavily leveraged and provide a source financing for clean energy investments.[38]

Development oriented actions

A 'Sustainable Development Policies and Measures' (SDPAMS) approach proposed by Winkler *et al*. (2002b) and further elaborated by Bradley *et al*. (2005) focuses on linking climate mitigation and adaptation to priority development needs. In its standard form, such an approach would be domestic and unilateral and – with its focus on developmental needs – would also bring GHG benefits. However, the authors also suggest that simultaneous SDPAMS pledges (and possibly harmonized pledges) could be made by both developing and developed countries. However, Bradley *et al*. (2005) do note several limits to this approach and suggest that it may not be suitable for developed countries, nor for every technology or policy. Finally, they note that SDPAMS may not attract the necessary funding for it to be implemented on the scale required for global climate change mitigation.

13.3.3.5 Financing

Funding sources for GHG mitigation in developed and developing countries is a crucial issue in the international debate on tackling climate change. Financing is categorized in the literature in terms of public flows (including Development

38 See www.ifc.org/CEEF.

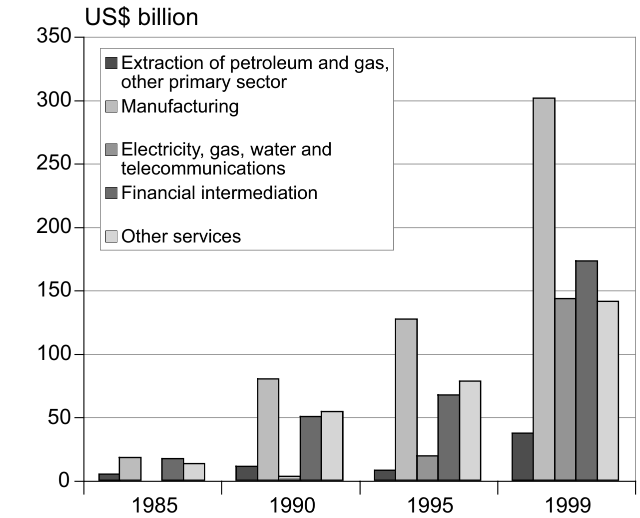


Figure 13.5: *Total OECD foreign direct investment (FDI) outflows to selected sectors.*
Source: OECD (1999)

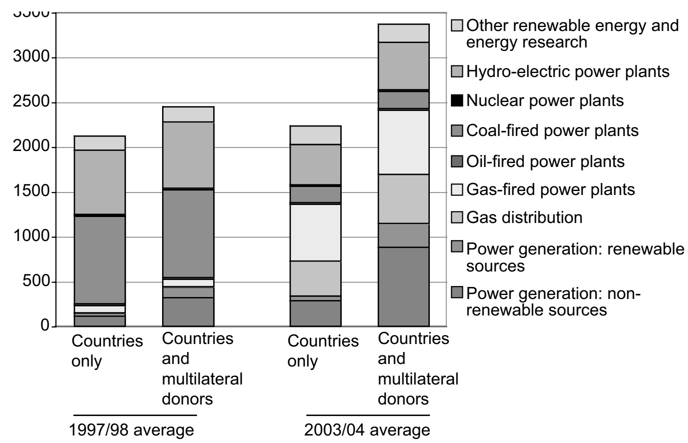


Figure 13.6: *Development assistance for energy*
Source: OECD.

Assistance and government loan guarantees through export credit agencies), private flows or foreign direct investment (FDI) and financing from multilateral institutions, including the Global Environment Facility (GEF) and international financial institutions. Public financing is the main form of assistance for developing country climate change mitigation, while the private sector provides the technology investments. CDM resources are significant when compared with GEF funding, but small in comparison to FDI resources (Ellis *et al*., 2007). In addition to these instruments, a World Bank survey of contingent financing and risk mitigation instruments for clean infrastructure projects describes the characteristics and potential use of other instruments, such as insurance, reinsurance, loan guarantees, leases and credit derivatives[39] (IPCC, 2000; World Bank, 2003). A small percentage of public funds are used to leverage private investment in clean energy projects.

13.3.3.5.1 Foreign direct investments

OECD trade and FDI have grown strongly in relation to GDP during the past decade: cumulative net FDI outflows between 1995 and 2005 amounted to 1.02 trillion US$. As a share of GDP, outward FDI grew from 1.15% of the GDP in 1994 to 2.02% in 2004. However, while the total sums grew, only 35% went to non-Annex I countries – and of that, nearly 70% went to five countries, namely China (including Hong Kong), Brazil, Mexico, Singapore and South Korea.[40] See also OECD (2005 d) for trends in FDI relative to ODA.

One common assertion in international environmental negotiations is that FDI promotes sustainable development as multinational corporations (MNCs) transfer both cleaner technology and better environmental management practices. However, empirical studies find little evidence that MNCs transfer either significant cleaner technology or better practices. In statistical studies of Mexico (manufacturing) and Asia (pulp and paper), foreign firms and plants performed no better than domestic companies (Zarsky and Gallagher, 2003). According to Jordaan (2004) the externalities from the presence of foreign-owned firms do not occur automatically, but are dependant on underlying characteristics of the industries and manufacturing firms.

Most FDI in developing countries is targeted to activities such as the extraction of oil and gas, manufacturing and electricity, gas and water, which have the aim to improve economic development but also to increase GHG emissions (Figure 13.5). Maurer and Bhandari (2000) report that during the mid- to late-1990s the major developed countries co-financed energy-intensive projects and exports valued at over 103 billion US$ through their export credit agencies (ECAs). These projects and exports included oil and gas development, fossil fuel power generation, energy-intensive manufacturing, transportation infrastructure and civilian aircraft sales. These countries accounted for 90% of the co-financing provided by ECAs to these energy-intensive exports and projects. By comparison, industrialized countries have directed just a fraction of their ECA financing to renewable energy projects. Between 1994 and 1999 ECAs supported a total of 2 billion US$ in renewable energy projects.

13.3.3.5.2 Direct international transfers

Official development assistance (ODA) remains an important source of financing for those parts of the world and sectors

39 See the website of the World Bank carbon finance unit for additional information on financial instruments: http://carbonfinance.org.
40 See UNCTAD, Foreign Direct Investment Database: http://www.unctad.org/Templates/Page.asp?intItemID=1923&lang=1.

where private flows are comparatively low, although this is a modest financial resource relative to global private direct investment, which was 106 billion US$ in 2005. Data from the OECD suggest that development assistance for energy projects (approximately 3.2 billion US$ in 2004) from bilateral sources has remained relatively flat over the last 6 years.. There has been a shift in support away from coal technologies to those of gas and some extent renewables[41] (see Figure 13.6).

The effectiveness of ODA depends on various factors, the most important of which are good governance, policy and institutional frameworks that encourage private investment (macroeconomic and political stability, respect for human rights and the rule of law), minimum levels of investment in human capital (education, good health, nutrition, social safety nets) and policies and institutions for sound environmental management.

13.3.3.5.3 GEF and the multilateral development banks (MDBs)

The GEF, established in 1991, provides support to developing countries for projects and programmes that protect the global environment. Jointly implemented by the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP) and the World Bank, GEF provides grants to fund projects related to biodiversity, climate change, international waters, land degradation, the ozone layer and persistent organic pollutants.[42]

Compared to the magnitude of the environmental challenges facing recipient countries, GEF efforts are relatively modest in scope. From 1991 to 2004, GEF allocated 1.74 billion US$ to climate change projects and activities; even when this amount is matched by the more than 9.29 billion US$ in co-financing, the overall scale of the GEF is small.[43] Funding is given to five project types, namely renewable energy, energy efficiency, sustainable transportation, adaptation, low GHG energy technologies and enabling activities. Hall (2002) analysed the GEF portfolio and noted the focus on incremental, one-time investments in mitigation projects that test and demonstrate a variety of financing and institutional models for promoting technology diffusion. He suggests that this approach should help contribute to a host country's ability to understand, absorb and diffuse technologies.

According to a review of the GEF by the World Bank (2006), 'the GEF's track record in reducing the long-term cost of new low GHG-emitting technologies has not been encouraging'. The continued effectiveness of GEF project funding for technology project types will depend on factors such as the duplication of successful technology transfer models, enhanced links with multilateral banks and co-ordination with other activities that support national systems of innovation and international technology partnerships. It has been suggested that GEF reform will be needed to enhance its effectiveness and transparency, particularly with respect to determining contributions and for evaluating priorities for disbursements (Grafton *et al*., 2004).

The World Bank (2004a) review of its investments in extractive industries determined that in the future it would be more selective, with a greater focus on the needs of poor people and a stronger emphasis on good governance and on the promotion of environmentally and socially sustainable development. The IFC has revised its performance standards in 2006 to require the reporting of GHG emissions for projects with both direct and indirect emissions of greater than 100,000 tonnes annually. The standards also require the consideration of alternatives or improvements to the energy efficiency of energy intensive projects (see http://www.ifc.org/ifcext/enviro.nsf/Content/ENvSocStandards). However, Sohn *et al*. (2005) note that the World Bank has continued to both support traditional CO_2-intensive fossil fuels projects and provide relatively limited resources to renewable and low CO_2-emitting energy alternatives. They suggest that Governments may use their leverage to direct the activities of multilateral development banks through their respective Boards and Councils in order to strengthen MDB programmes to account for the environmental consequences of their lending; develop programmatic approaches to lending that remove institutional barriers and create enabling environments for private technology transfers.

The higher perceived risk in developing countries, as reflected in sovereign credit ratings, can be compounded further by including new and emerging technologies. International or regional financing institutions can play a critical role in lowering the risk and leveraging private finance into the sector. MDBs have responded to this challenge by establishing several new initiatives. For example, the European Bank for Reconstruction and Development's (EBRD) new Sustainable Energy Initiative was launched in May 2006 to address the wasteful and polluting use of energy. The EBRD plans to invest up to € 1.5 billion in energy efficiency, renewables and clean energy projects over the next 3 years, which could lead to up to € 5 billion of total investment. The Asian Development Bank (ADB) launched the Energy Efficiency Initiative (EEI) in July 2005, the core objective of which is to expand ADB's investments in energy efficiency projects (including renewable energy), with an indicative annual lending target of 1 billion US$ between 2008 and 2010. The World Bank has announced the establishment of the Clean Energy Fund Vehicle with a capitalization of 10 billion US$ and an annual disbursement of 2 billion US$ to accelerate the transition to a low carbon economy.

41 See OECD website for information on development activities, including statistics, data, indicators and methods for accessing data: http://www.oecd.org/topicstatsportal/0,2647,en_2825_495602_1_1_1_1_1,00.html
42 See the website of the Global Environment Facility for additional information: http://www.gefweb.org/
43 http://www.gefweb.org/Projects/focal_areas/focal_areas.html#cc

13.3.3.6 Capacity building

The literature on climate change has not addressed capacity building to any extent, despite its critical relevance to the climate change issue. Part of the solution to the climate change problem has been cast in terms of helping developing countries with technology transfer and assistance. The importance of this is recognized in the text of the UNFCCC and Kyoto Protocol as well as in the more detailed implementing framework of the Marrakech Accords.

The capacity building framework within the climate change regime focuses on developing the capacity in developing countries to implement decisions. Capacity building has been defined historically as the formal training of employees, technological gate-keeping and learning-by-doing, with the recognition that this is a slow and complex process. According to Yamin and Depledge (2004), the Marrakesh Accords have been partially successful in bringing some additional coherence, coordination and prioritization into the process of capacity building. These authors argue that the effort to promote country-driven and contextually tailored efforts that are both iterative and involve learning-by-doing are appropriate.

Other ideas on capacity building also abound. Sagar (2000) argues that it may be more relevant to strengthen the domestic capacity for undertaking policy research and innovation as well as for managing technological and institutional change rather than merely creating the capacity for implementing policies developed elsewhere. This proposal is based on the idea that only context-relevant policy instruments are likely to work within the specific domestic circumstances of the relevant countries.

A number of recent analyses carried out on this subject have questioned whether capacity building can be initiated from outside a country. Since capacity issues are embedded in local contexts, the OECD has argued that it may be a mistake to assume that capacity building can be easily accomplished from outside this context.

Najam *et al*. (2003) note the importance of capacity building for developing countries and require that it be an integral part of any future agreement if it is to have wide support from this group. In particular, they argue that inasmuch as efforts to combat climate change and promote sustainable development are ‘two sides of the same coin’ enhancing the capacities of communities and countries to fight climate change will have multiple benefits. They also make the case that the most pressing need in this context is to strengthen the social, economic and technical resilience of the poorest and most vulnerable countries against extreme climatic events.

13.3.3.7 Compliance

Using game theory, Hovi and Areklett (2004) argue that a compliance system has to meet several criteria: (1) consequences of non-compliance have to be more than proportionate; (2) punishment needs to take place when behaviour is suboptimal; (3) an effective enforcement system must be able to curb collective as well as individual incentives to cheat. The compliance system agreed under Kyoto is viewed as only partially fulfilling these criteria. For example, Nentjes and Klaassen (2004) note that the obligation to fully restore any excess emissions in subsequent periods does not exclude the option of postponing restoration forever. If such an outcome occurs, the trading mechanisms under the Protocol may be substantially weakened. However, it is pointed out that introducing adversarial elements (such as sanctions) into the system are highly undesirable in view of the fact that the Kyoto Protocol currently covers only one third of the total GHG emissions of the world (Murase, 2005).

There are two schools of thought regarding the appropriate response to non-compliance contemplated under the Kyoto Protocol (see Murase, 2002b). One view advocates ‘soft’ compliance-management, which favours primarily facilitative and promotional approaches by rendering assistance to non-compliant States; those holding this view often refer to ‘the non-compliance procedure’ used under the Montreal Protocol. The other view takes a ‘hard’ enforcement approach in order to coerce compliance by imposing penalties or sanctions on non-complying parties. Financial penalties and economic or trade sanctions have been proposed along these lines. However, it has been suggested that such measures could be in conflict with WTO/GATT rules on trade liberalization (Mitchell, 2005).

A more nuanced view is provided by Wettestad (2005), who concludes that there are eight lessons to be learnt from other regimes. These include the need for an institutional warm-up period, wise institutional engineering, moderate expectations from the verification process, increased transparency, efforts to maintain close cooperation between the Facilitative and Enforcement Branch of the Compliance Committee, the search for opportunities to engage civil society in the process and a focus on assistance and compliance facilitation using the enforcement mechanism as an important but ‘hidden’ stick.

In his review of the Kyoto Protocol’s compliance mechanism, Barrett (2003) argues that failure to comply over two compliance periods can essentially be equivalent to indefinitely postponing action: A country that is found in non-compliance in the first period has to make up the difference plus 30% in the next period. If it fails to achieve the latter target as well, it will have to make up the difference in the period thereafter – a process that can continue indefinitely. Perhaps the most important point in his proposal is that if countries feel that they cannot easily meet their commitments, they will negotiate for higher allowances in the period thereafter – or even withdraw from the agreement entirely. He also notes that the Protocol does not have any procedures to deal with countries that decide not to cooperate with the rules.

There is a significant body of research that compares various dispute settlement procedures. A number of these assessments examine environmental agreements (see, for example, Werksman, 2005), while others more specifically focus on possible conflicts between climate agreements and trade agreements (see, for example, Murase, 2002b). With respect to the latter, Murase notes the need for a coordinating authority to be established between a multilateral environmental agreement (MEA) and the WTO. Given that MEAs and the WTO are independent treaties on equal footing, neither can automatically be given the right to make a decision in the case of a conflict. As a result, a number of authors (e.g. Esty, 2001; Murase, 2002b) have called for the establishment of a new institution, such as a World Environment Organization (WEO), that would embody its own dispute settlement mechanism. This institution would function as a counterpart of WTO by attaining an equal footing between the two regimes.

13.3.3.8 Adaptation

The element of adaptation in international climate agreements has been far less explored to date than mitigation.[44] While most authors agree that adaptation is a vital part of a future agreement (although Schipper (2006) suggests that it was not a key focus of the initial UNFCCC negotiators), there is little mention in climate change literature of concrete proposals detailing the actions or obligations that should be undertaken by countries. Most proposals focus on leveraging funding for adaptation activities with an additional set of proposals addressing more specifically the links between adaptation, vulnerability and development agendas (see, for example, Najam *et al*., 2003).

Parry *et al*. (2005) develop an assessment of how adaptation may be incorporated into a future climate change architecture. They begin by noting that much of the adaptive response is likely to be local and, consequently, it is less conducive to a common international approach. Instead, they argue that a key need will be for efforts to incorporate adaptation into development policies and practices, including local, sectoral and national decision-making – a process they refer to as 'climate-proofing'. At the local level, this would incorporate strategies for municipal planning, including developing and maintaining seed banks, emergency preparedness services and community social services. At the sectoral level, it would include efforts to build climate into infrastructure design and maintenance codes and standards. At the national level, it would include integration into national planning and budget processes – for example, by examining whether planned expenditures will increase exposure to the impacts of climate change – and by doing so, minimize the financial risk, promote macro-economic stability and set aside sufficient funds to manage the consequences of climate shocks. Finally, at the international level, they suggest that key opportunities exist for integrating adaptation into the Millennium Development Goals and into lending practices of international institutions and bilateral aid agencies.

Three funds have been created under the UNFCCC and the Kyoto Protocol to manage adaptation issues: the Least Developed Countries Fund, the Special Climate Change Fund (both under the UNFCCC) and the Adaptation Fund (under the Protocol). In addition, the GEF has been requested to consider adopting more flexible approaches to funding adaptation (though this may not happen with core GEF funds, but with new money from these other funds that would be disbursed by the GEF).

Corfee-Morlot *et al*. (2002) suggest that it would be unrealistic to expect the GEF to cover the full cost of adaptation as such expenses would quickly exhaust their resources. Huq and Burton (2003) propose integrating adaptation into the mainstream work of development agencies, thereby allowing for more cost-effective and wider ranging support. However, as noted by Huq and Reid (2004), doing so runs the risk of diluting other existing aid efforts – which often have considerably higher priorities in-country than climate change adaptation.

The potential role for private (and public) insurance has also been suggested as a possible mechanism to pay for adaptation (e.g. Bals *et al*., 2005). Parry *et al*. (2005) list possible insurance schemes and risk transfer instruments, including:

- An international insurance pool (a collective loss-sharing fund to compensate victims of climate change damages);
- Public-private insurance partnerships (where the insurer is the government, but policies are developed and managed by the private sector);
- Regional catastrophic insurance schemes (regional cash reserves are pooled through mandatory contributions from member governments, and reserves are used for weather-related catastrophes);
- Micro-insurance (risk pooling for low-income individuals affected by specific risks);
- Catastrophe bonds (giving private insurers protection against extreme events; capital is provided by large institutional investors);
- Weather derivatives (financial mechanisms to hedge financial risk from catastrophic weather events)
- Weather hedges (providing protection for farmers; currently sold by banks, farm cooperatives and micro-finance institutions).

13.3.3.9 Negotiating process

It is important that several technical issues be taken into consideration when an agreement is negotiated and implemented. Since the international negotiation process under the UNFCCC is based on decisions by consensus, an approach

44 See IPCC(2007b), Chapter 17 and 18 for a broad review of adaptation issues.

Table 13.3: *Assessment of international agreements on climate change.*[45]

Approach	Environmental effectiveness	Cost-effectiveness	Meets distributional considerations	Institutional feasibility
National emission targets and international emission trading (including offsets)	Depends on participation and compliance.	Decreases with limited participation and reduced gas and sector coverage.	Depends on initial allocation.	Depends on capacity to prepare inventories and compliance. Defections weaken regime stability.
Sectoral agreements	Not all sectors amenable to such agreements, thereby limiting overall effectiveness. Effectivenss depends on whether agreement is binding or non-binding.	Lack of trading across sectors increases overall costs, although they may be cost-effective within individual sectors. Competitive concerns reduced within each sector.	Depends on participation. Within-sector competitiveness concerns are alleviated if treated equally at global level.	Requires many separate decisions and technical capacity. Each sector may require cross-country institutions to manage agreements.
Coordinated policies and measures	Individual measures can be effective; emission levels may be uncertain; success will be a function of compliance.	Depends on policy design.	Extent of coordination could limit national flexibility, but may increase equity.	Depends on the number of countries (easier among smaller groups of countries than at the global level).
Cooperation on Technology RD&D[a]	Depends on funding, when technologies are developed and policies for diffusion.	Varies with degree of R&D risk. Cooperation reduces individual national risk.	Intellectual property concerns may negate the benefits of cooperation.	Requires many separate decisions. Depends on research capacity and long-term funding.
Development-oriented actions	Depends on national policies and design to create synergies.	Depends on the extent of synergies with other development objectives.	Depends on distributional effects of development policies.	Depends on priority given to sustainable development in national policies and goals of national institutions.
Financial mechanisms	Depends on funding selection criteria.	Depends on country and project type.	Depends on project and country.	Depends on national institutions.
Capacity building	Varies over time and depends on critical mass.	Depends on programme design.	Depends on selection of recipient group.	Depends on country and institutional frameworks.

[a] Research, Development and Demonstration.

that is simple and requires a small number of separate decisions by international bodies most likely has a higher chance of being agreed upon. This may be true of any agreement that engages multiple countries.

It has been reported in the literature that ownership of an instrument – and hence its commitment and effectiveness – is linked to the manner in which the agreement was negotiated, and that the leadership (directional, instrumental and structural) demonstrated in a regime may stimulate its effectiveness. Kanie (2003) concludes that in the EU, the introduction of policies and measures and institution building changed the dynamics of the climate change negotiation process by enhancing leadership capacity.

The role and influence of non-State actors in the process of negotiation also increase the legitimacy and compliance-pull of a regime, both because such participation promotes the broader acceptability of the agreement and because it may increase knowledge about the regime. Agreements are also more likely to be effective when they are negotiated in accordance with established rules of procedure, when the negotiators of key countries have been able to adequately prepare themselves for the negotiation and when the subject matter of the negotiations is designed to address the problem and has not been artificially limited to make the solutions more attractive to the more powerful countries (Andresen and Wettestad, 1992; Benedick, 1993; Sebenius, 1993; Greene, 1996; Gupta and Grubb, 2000; Gupta and Ringius, 2001). The attention of the regular media to climate negotiations can also mobilize awareness of the issue which then increases pressure on the negotiators to achieve a result (Newell, 2000).

13.3.4 Evaluating international climate change agreements

This section reviews the literature using the same criteria as in Section 13.2: environmental effectiveness, cost-effectiveness, distributional considerations and institutional feasibility. The discussion is summarized in Table 13.3, and then discussed in

45 The table examines each approach based on its capacity to meet its internal goals – not in relation to achieving a global environmental goal. If such targets are to be achieved, a combination of instruments needs to be adopted. Not all approaches have received an equivalent evaluation in the literature; evidence for individual elements of the matrix varies.

greater depth in the text. As is the case with national policies, international agreements are instruments that can be designed well or poorly and be stringent or lax, binding or non-binding, or politically attractive or unattractive.

13.3.4.1 Environmental effectiveness

Environmentally effective international agreements lead to reductions in global GHG emissions and/or concentrations or to decreased climate impacts. The literature suggests that to achieve such success, agreements must provide incentives or deterrents to both State and individual behaviour in order to achieve a specific outcome. However, at the international level, there is some dispute as to whether agreements change trends, or merely codify actions already underway.

An additional critical element in the effectiveness of an international agreement is that of the implementation context: The relevant literature shows that agreements tend to be more successful in countries with both a high level of domestic awareness and resources and a strong institutional and legal framework and where there is clear political will. Where global agreements are designed using only blue-print approaches to instruments, these instruments may ultimately ignore the specific cultural and institutional contexts within which they are designed to function and may actually not work as well (see conclusions of the Millennium Ecosystem Assessment, 2005). Agreements that promote ancillary objectives, such as reductions in ordinary air pollution levels, also have a higher chance of success.

An agreement that includes a limited group of countries (particularly if they are not major emitters) may be less effective – and this weakness may be exaggerated when emissions of non-participating countries increase by the migration of emission-intensive industries. Conversely, additional benefits may accrue due to technology spillover that may enhance environmental effectiveness (see Section 13.3.3.2).

The timing of an agreement's provisions may also affect its effectiveness: Focusing only on longer term emission reductions (as suggested under some forms of technology agreements) may preclude the possibility of reaching low climate stabilization levels, as many lower levels require immediate emission reductions.

13.3.4.2 Cost-effectiveness

A cost-effective international agreement would minimize global and national costs and provide participating sovereign nations with sufficient flexibility to reach their commitments in a fashion tailored to their national needs and priorities. To achieve this, agreements would need to avoid being prescriptive in its actions but, instead, leave room for the implementation of the target, (e.g. while reducing emissions in different sectors or reducing the emissions of different gases, they should not create significant distortions in competitiveness between countries).

Many analysts argue that the most cost-effect system would be one which enables emission trading with the broadest possible participation of countries. Such a system would allow the emission reductions to occur in those countries, sectors and gases where they can be achieved at the lowest cost. An approach based on specific policies and measures would have to be designed carefully to be as efficient as an emission trading system. The flexibility provided to private actors in a trading regime also increases the system's cost-effectiveness.

13.3.4.3 Distributional considerations, including equity

Perhaps the most politically charged issue in international negotiations is that of equity. Whether a system of national emission targets within an international agreement can be conducive to social development and equity depends on participation and the initial allocation of emission rights. For example, Pan (2005) suggests that all countries should participate – but that emissions associated with basic needs should be exempt from limits, while emissions associated with luxury activities should be constrained. Conversely, Gupta and Bhandari (2003) suggest that in the initial stages of an agreement, obligations should only be assigned to a limited set of (wealthier) parties. Exemptions to sectors or countries and modifications to the allocation of obligations can help address equity issues.

13.3.4.4 Institutional feasibility

Two aspects of institutional feasibility are critical in reaching successful international agreements: (1) negotiating and adopting an agreement and (2) the subsequent (usually national) implementation of that agreement.

Since international agreements are usually adopted by consensus, successful agreements are often relatively simple and require only a limited number of separate decisions by international bodies. In addition, global agreements usually require that all data and tools necessary for enforcement be widely available and verifiable (or if not, that they become available in the future). While there has been no comprehensive critique of the proposals in Table 13.3 in terms of their institutional feasibility, the latter clearly varies widely – for example, in terms of the extent to which they try to accommodate national circumstances and different levels of technical sophistication. Hence, the feasibility of reaching agreements will also vary accordingly.

A sectoral or technology approach would require multiple decisions: which sectors, which types of technologies, and how to regulate or support them. Choosing the sectors (and determining sectoral boundaries) or technologies for agreement may be difficult – unless participation were voluntary (e.g. the current suite of IEA implementing agreements, or the bilateral and multilateral efforts on specific technologies). This may require compromises on environmental effectiveness and equity. In addition, the assessment of whether a country had fulfilled its obligations would be complex. Philibert (2005a) notes that determining the effectiveness of technology or sectoral agreements could be difficult. In the case of a technology approach, definitive conclusions would likely be delayed until the technologies began to diffuse – and that could mean concomitant requirements for establishing long-lived institutions. The establishment of international institutions to manage coordinated policies and measures or development-oriented approaches may also be complex. While some private sector international institutions exist (e.g., the Aluminium Institute, which has set targets for GHG reductions in aluminium processing among its member companies), most sectors do not have such institutional arrangements. Similarly, while there are institutions designed to promote development (e.g., the Bretton Woods institutions), few have integrated climate change into their portfolios (see Maurer and Bhandari, 2000). Kanie (2006) argues that while the Kyoto Protocol will remain the core of the institutional system, a network will ultimately be both necessary – and increase effectiveness. The creation of a web of institutions tackling climate change and related issues not only ensures that any shortcoming in one institution does not lead to the collapse of the whole system, but it also enhances collective strength.

13.4 Insights from and interactions with private, local and non-governmental initiatives

This section addresses voluntary actions taken by sub-national governments, corporations, NGO's and others that are independent of national government programs or policies. See Box 13.9. Note that in contrast, section 13.2 addresses voluntary agreements between national governments and private parties.[46]

13.4.1 Sub-national initiatives

Local, state, provincial or regional governments have developed GHG policies and programmes that are either synergistic with national policies or are independent of these policies. Several reasons are given in the literature as to why sub-national entities undertake independent policies on GHGs or other environmental issues. Oates (2001) and Vogel *et al*. (2005) highlight the influence that State governments in the USA have had on national policy by experimenting with innovative initiatives. Rabe (2004) argues that some US states have enacted GHG policies to create incentives for new emission reduction technologies or to facilitate the recognition of emission reductions by companies in the event of future national regulations. Regional or local GHG reductions may also be motivated by the desire to achieve additional environmental co-benefits, such as reductions in air pollution.

On the other hand, sub-national actions to address climate change may be viewed as a 'free rider' problem because non-participating regions may benefit from the actions of the participating areas without paying the costs (Kousky and Schneider, 2003). Regional or local initiatives may also cause 'leakage' if mandatory requirements in one jurisdiction cause a shift in economic activity and emissions to other jurisdictions without mandatory requirements (Kruger, 2006).

Sub-national governments in the USA and Australia, two countries that are not Parties to the Kyoto Protocol, have been among the most active on GHG policy, with a number of US states having adopted or proposed a variety of programmes to address GHGs, including renewable energy portfolio standards, energy efficiency programmes, automobile emissions standards and emissions registries. Perhaps the most notable examples of such an initiative are those of eight states in north-eastern and mid-Atlantic USA announcing their intent to adopt a regional cap-and-trade programme, known as the Regional Greenhouse Gas Initiative (RGGI); three western states – California, Washington and Oregon – may explore a similar initiative (McKinstry, 2004; Peterson, 2004; Pew Center, 2004; Rabe, 2004). Australian states have developed a broad array of programmes to reduce, sequester or measure GHG emissions (see http://www.epa.qld.gov.au/environmental_management/sustainability/greenhouse/greenhouse_policy/other_states_and_territories/). For example, the Australian state of Victoria has adopted a series of programmes to support renewable energy projects and the development of a 'green power' market (Northrop, 2004), while that of New South Wales has developed a credit-based emissions trading scheme for electricity retailers, generators and some electricity users. (Fowler, 2004; Baron and Philibert, 2005; MacGill, *et al*., 2006). Finally, the Australian states have announced their intention to explore the development of a multi-jurisdictional emissions trading system (see http://www.cabinet. nsw.gov. au/ greenhouse/report.pdf).

Northrop (2004) reports that more than 600 cities worldwide have participated in programmes to implement measures aimed at reducing local GHG emissions.[47] These include cities in developing countries. In total, 18 cities in South America,[48] 12 cities in South Africa[49] and 17 cities in India[50] are becoming more active in developing environmental measures at the local level. Kousky and Schneider (2003) find that cities have primarily adopted GHG policies with co-benefits, including more efficient energy use. Fleming and Webber (2004) describe a variety of GHG measurement and energy efficiency measures undertaken at the regional and local level in the UK, and Pizer and

46 See Higley *et al*. (2001), OECD (2003e) and Lyon and Maxwell (2004) for typologies of different types of approaches and initiatives.
47 These cities participate in the International Council for Local Environmental Initiatives (ICLEI), Cities for Climate Protection (CCP) programme. See http://www.iclei.org.
48 http://www.iclei.org/index.php?id=528.
49 http://www.iclei.org/index.php?id=700.
50 http://www.iclei.org/index.php?id=1089.

Tamura (2004) summarize measures undertaken by the Tokyo city government to reduce GHGs and control the 'heat island' effect. These types of initiatives may influence sub-national and national government policies and serve as incubators for new approaches to achieve GHG emission reductions.

13.4.2 Corporate and NGO actions

Corporations and NGOs, including industry associations and environmental advocacy groups, have started a variety of programmes and initiatives to address GHG emissions. The various factors leading corporations to adopt voluntary environmental action have been explored in the literature (Lyon and Maxwell, 2004; Thalmann and Baranzini, 2005). While some companies have attributed these actions to sustainable development goals or environmental stewardship policies (Margolick and Russell, 2001), it is often difficult to separate these goals from economic motives (Kolk and Pinske, 2004). Less controversial is the notion that companies adopt voluntary initiatives to create financial value in one form or another (Lyon and Maxwell, 2004).

There are both political and non-political drivers of corporate voluntary environmental action. Political drivers include a desire to pre-empt or influence future regulation. For example, trade associations in 30 countries have sponsored codes of management practices, the objectives of which are partly intended to forestall the imposition of government mandates (Nash and Ehrenfeld, 1996). Alternatively, corporations may adopt voluntary initiatives to influence future regulation in ways that improve their strategic positions. By adopting environmental technologies or other strategies ahead of regulatory mandates, corporations can signal to regulators that these alternatives are practical or relatively cost-effective (Reinhardt, 1999). Hoffman (2005) finds that some companies have adopted internal emissions trading schemes or GHG measurement programmes to gain expertise that will help them influence future national or international policies. A related motivation for voluntary action is the desire to manage the risks of future regulations by taking action that would increase profitability or protect a company's competitive position in the event of future regulatory mandates (Margolick and Russell, 2001).

Non-political drivers of voluntary corporate environmentalism include the desire to reduce costs through practices that also have environmental benefits (sometimes known as 'eco-efficiency'). Esty and Porter (1998) discuss how the desire to reduce energy or material costs drives corporate voluntary action, although this point of view is subject to some debate (Palmer *et al*., 1995; Porter and van der Linde, 1995). Hoffman (2005) and Margolick and Russell (2001) describe a variety of actions taken by US and Canadian companies to reduce GHG emissions while also reducing energy and operational costs.

Companies may also adopt environmental initiatives to appeal to green consumers, environmentally conscious stakeholders or even their own employees. Reinhardt (1998) discusses how this approach can take the form of companies differentiating their products by their environmental performance. Other companies have identified market opportunities for new products from potential GHG gas regimes (Reinhardt and Packard, 2001; Kolk and Pinske, 2005). In terms of the composition of the stakeholders, Maxwell *et al*. (2000) find that firms located in US states with a higher per capita membership in environmental organizations had more rapid reductions of toxic emissions. Margolick and Russell (2001) and Reinhardt (2000) report that corporate managers cited employee retention and recruitment as reasons for taking voluntary action.

Voluntary corporate-wide emissions targets for GHGs have become particularly popular. For example, Hoffman (2005) finds that as many as 60 US corporations have adopted corporate GHG emissions reduction targets and that some of these companies have participated in one of several partnership programmes run by NGOs (see Box 13.9). Under many of these programmes, companies develop a corporate GHG inventory and adopt an emission target. These targets take different forms, including absolute targets and intensity targets based on emissions or energy use per unit of production or sales (Margolick and Russell, 2001; King *et al*., 2004). Corporate targets have also been implemented with internal trading systems, such as those operated by British Petroleum (Margolick and Russell, 2001; Akhurst *et al*., 2003) and Petroleos Mexicana (PEMEX) (Bygrave, 2004).

Levy and Newell (2005) describe how the business sector, sometimes in partnership with NGOs, has initiated environmental certification or standardization regimes to fulfill a quasi-governmental role or to augment the role of governments. One of the most widely-used examples of this type of standard setting is the Greenhouse Gas Protocol, an initiative organized by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI) to develop an internationally accepted accounting and reporting standard for GHGs (WRI/WBCSD, 2004). The WRI/WBCSD reporting standard has been used by corporations, NGOs and government voluntary programmes. The International Standards Organization (ISO), based on the WRI/WBCSD, has adopted standards for the reporting of GHGs at the company and project level.[51]

Other standardization or certification efforts have been formed to support markets for project-based mechanisms or emissions trading. For example, the International Financial Reporting Interpretations Committee (IFRIC), which is the interpretive arm of the International Accounting Standards Board (IASB), has issued guidelines on financial accounting for emission allowances.[52] The International Emissions Trading

51 The relevant ISO standards are ISO 14064 Part 1. This may be found at: http://www.iso.org/iso/en/CatalogueDetailPage.CatalogueDetail?CSNUMBER=38381&scopelist=PROGRAMME
52 See http://www.iasb.org/news/index.asp?showPageContent=no&xml=10_262_25_02122004_31122009.htm

Box 13.9 Examples of private partnerships and programmes

Business Leader Initiative on Climate Change (BLICC): Under this initiative, five European companies monitor and report their GHG emissions and set a reduction target. See http://www.respecteurope.com/rt2/BLICC/

Carbon Disclosure Project: Under this project, 940 companies report their GHG emissions. The project is supported by institutional investors controlling about 25% of the global stock markets. See http://www.cdproject.net

Carbon Trust: The Carbon Trust is a not-for-profit company set up by the UK government to reduce carbon emissions. The Trust provides technical assistance, investment funds and other services to companies on emission reduction strategies and for the development of new technologies. See http://www.thecarbontrust.co.uk/default.ct

Cement Sustainability Initiative: Ten companies have developed 'The Cement Sustainability Initiative' for 2002–2007 under the umbrella of the World Business Council for Sustainable Development. This initiative out-lines individual or joint actions to set emissions targets and monitor and report emissions.

Chicago Climate Exchange: The Chicago Climate Exchange is a GHG emission reduction and trading pilot programme for emission sources and offset projects in the USA, Canada and Mexico. It is a self-regulatory, rules-based exchange designed and governed by the members who have made a voluntary commitment to reduce their GHG emissions by 4% below the average of their 1998–2001 baseline by 2006. See http://www.chicagoclimatex.com

Offset Programmes: Braun and Stute (2004) identified 35 organizations that offer services to offset the emissions of companies, communities and private individuals. These organizations first calculate the emissions of their participants and then undertake emission reduction or carbon sequestration projects or acquire and retire emission reduction units or emission allowances.

Pew Center on Climate Change Business Environmental Leadership Council: Under this initiative, 41 companies establish emissions reduction objectives, invest in new, more efficient products, practices, and technologies and support actions to achieve cost-effective emissions reductions. See: http://www.pewclimate.org/companies_leading_the_way_belc/

Top ten consumer information system: This NGO-sponsored programme provides consumers with information on the most efficient consumer products and services available in local markets. The service is available in ten EU countries, with plans to expand to China and Latin America. See http://www.topten.info

WWF Climate Savers: The NGO World Wide Fund of Nature (WWF) has build partnerships with individual leading corporations that pledge to reduce their global warming emissions worldwide by 7% below 1990 levels by the year 2010. Six companies have entered this programme. See http://www.panda.org/about_wwf/what_we_do/climate_change/our_solutions/business_industry/climate_savers/ index.cfm

Association, together with the World Bank Carbon Finance Group/Prototype Carbon Fund have developed a validation and verification manual to be used by stakeholders involved in developing, financing, validating and verifying CDM and JI projects.

13.4.3 Litigation related to climate change

The authors of many technical articles point out that litigation is likely to be used increasingly as countries and citizens become dissatisfied with the pace of international and national decision-making on climate change (Penalver, 1998; Marburg, 2001; Weisslitz, 2002; Allen, 2003; Grossman, 2003; Verheyen, 2003; Gillespie, 2004; Thackeray, 2004; Dlugolecki, 2005; Hancock, 2005; Jacobs, 2005; Lipanovich, 2005; Mank, 2005). These authors argue that the possible causes of action in litigation include (1) customary law principle of state responsibility, (2) nuisance and the no-harm principle, (3) violation of international agreements including the WTO and the United National Convention on the Law of the Sea (UNCLOS) and the violation of human rights and (4) the abdication of authority by states to legislate on environmental issues based on the existing environmental legislation in the country concerned. However, they also emphasize that although there are often strong legal grounds for taking action, there may also be reasons for a strong defence.

Gillespie (2004) argues that if the international process is arguably not taking place in good faith, there is sound reason for requesting the International Court of Justice for an Advisory Opinion in this area, especially when the significant (potential) harm faced by small island states are taken into account. Jacobs (2005) and Verheyen (2003) analysed the potential case for a small island state actually suing the USA before the International

Court of Justice. Burns (2004) and Doelle (2004) point out that non-ratification of the Kyoto Protocol could imply illegal subsidies to national industries under the WTO and pollution of the seas under UNCLOS. Hancock (2005) sees the potential for liability suits increasing and advises companies to disclose their emissions to the Securities and Exchange Commission as a step to limit liability. Issues of causality are being dealt with in the literature (Allen, 2003) and through precedent (Lipanovich, 2005).

There are currently a number of court cases in Kyoto Party countries, both developed (Germany) and developing (Nigeria), and non-Parties (Australia and the USA). For example, in Germany, NGOs have sued the export credit support agencies for not disclosing information on the GHG emissions of the projects they support in developing countries. (See www.climatelaw.org/media/german.suit). A similar case was filed in the US District Court for the Northern District of California, on August 26, 2002 by Friends of the Earth, Greenpeace and the city of Boulder, Colorado, which have sued the Export-Import Bank and the Overseas Private Investment Corporation under the National Environmental Policy Act, alleging that these two US government agencies had provided 32 billion US$ for supporting the finance and insurance of oil fields, pipelines and coal-fired plants in developing countries over the previous 10 years without assessing the impacts on the environment including global warming. A Federal Judge in California has ruled in favour of the plaintiffs.[53]

In a case filed in Argentina, the plaintiffs allege a violation of Article 6 of the Climate Convention. In Nigeria, NGOs have sued the major oil companies and the state for continuing gas flaring, an industrial process which contributes about 70 million tonnes of CO_2 annually to global GHG emissions (Climate Justice Programme, 2005) and which is viewed as a violation of the Convention and the human rights of the local people.[54] In Australia, NGOs have filed a suit against a minister for permitting a mine expansion project without examining the GHG emissions. See www.austlii.edu.au/au/cases/vic/VCAT/2004/2029.html.

There are two law cases in the USA where a coalition of states[55] and environmental NGOs argue that the US EPA has the authority to regulate CO_2 and other GHGs as air pollutants under the Clean Air Act.[56] In addition, eight US States, New York City and two land conservation trusts initiated a lawsuit in July 2004 against the five US power companies with the largest CO_2 emissions, on the grounds that these companies contribute to a public nuisance (global warming). That case, though dismissed by the trial court, is on appeal.[57] Non-government organizations in Australia have also given notice to the major GHG emitters in the USA about their obligations under national and international law to reduce their emissions (http://www.cana.net.au/documents/legal/aus_fin_rev.doc). In July 2005, a wildlife organization sued the Australian Government for failing to protect the Great Barrier Reef (http://www.climatelaw.org/media/Australia.emissions.suit). A court case was filed in December 2005 by the Inuit people before the Inter-American Commission of Human Rights against the US government for human rights violations of the Inuit people's way of life.[58] There have also been cases that have challenged the allocation of emission allowances. With the entry into force of the EU Emissions Trading Directive,[59] there has been some litigation in Germany that has challenged the manner in which the German Government has interpreted and transposed the directive into its National Allocation Plan in 2004[60]. The courts have thus far decided that the Emission Allocation Law is in conformity with German law and with European rules on property rights.[61]

While many of the these legal cases have not yet led to interim judgments in favour of the plaintiff, they do reveal there is a decided interest in pursuing the legal route as the means to pushing for action on climate change. These cases are based on a number of different legal grounds for doing so, but it may take some years before courts decide which, if any, of these grounds are valid.

13.4.4 Interactions between private, local and non-governmental initiatives and national/international efforts

The preceding sections have touched on a number of the interactions that take place between private, sub-national and non-governmental initiatives and national and international climate change efforts. As discussed, some of these efforts have been designed, at least in part, to influence the development of

53 Order Denying Defendants' Motion for Summary Judgment, in the case of Friends of the earth, Greenpeace, Inc. and City of Boulder Colorado versus Peter Watson (Overseas Private Investment Corporation) and Phillip Lerrill (Export-Import Bank of the United States), No. C 02-4106 JSW.
54 Suit No. FHC/CS/B/126/2005; filed in the Federal High Court of Nigeria, in the Benin Judicial Division, Holden at Benin City.
55 California, Connecticut, Illinois, Maine, Massachusetts, New Jersey, New Mexico, New York, Oregon, Rhode Island, Vermont and Washington together with New York City, Baltimore, and Washington, DC.
56 Massachusetts vs. Environmental Protection Agency, 415 F.3d 50 (D.C. Cir. 2005). A petition for Supreme Court review is pending. This case concerns motor vehicle emissions. Another case has been filed in the US Court of Appeals for the District of Columbia Circuit by a coalition of states and NGOs led by New York over an EPA decision not to regulate CO_2 from power plants.
57 Connecticut, *et al*. vs. American Electric Power Company Inc., *et al*.; 406 F.Supp.2d 265 (S.D.N.Y. 2005), appeal pending in the Court of Appeals for the Second Circuit.
58 Petition to the Inter-American Commission on Human Rights Seeking Relief From Violations Resulting From Global Warming Caused by Acts and Omissions of the United States, December 7, 2005.
59 Directive 2003/87/EC of the European Parliament and the Council of 13 October 2003 (OJ L 275, 25-10-2003), establishing a scheme for GHG allowance trading within the community and amending Council Directive 96/61/EC (OJ L257, 10-10-1996); available at < http://europa.eu.int/eur-lex/pri/en/oj/dat/2003/l_275/l_27520031025en00320046.pdf>
60 Gesetz über den nationalen Zuteilungsplan für Treibhausgasemissionsberechtigungen in der Zuteilungsperiode 2005-2007 (Zuteilungsgesetz 2007 - ZuG2007), Bundesgesetzblatt Jahrgang 2004, Teil I, Nr. 45, 30. August 2004.
61 Beschluss vom 1.9.2004, NVwZ2004, S.1389 ff; Beschluss vom 18.10.2004, NVwZ2005, S.112 ff; BverwG, Urteil vom 309.6.2005, NVwZ2005, S. 1178ff.

national programmes or the international climate regime. Other programmes have been designed to fill roles in these regimes that may be appropriate for private or non-governmental entities. Finally, other legal or programmatic initiatives have been launched because of the perceived inadequacy of national or international efforts.

One of the most important drivers of these interactions is the development of a global GHG emission trading market. Many of the standardization and certification efforts described above have been designed to build institutions for the emerging GHG market which in turn may also facilitate interactions between sub-national initiatives and national or international climate regimes. For example, the eight north-eastern and mid-Atlantic states in the US Regional Greenhouse Gas Initiative (RGGI) cap and trade programme will allow the use of CDM credits and EU ETS allowances under certain circumstances (RGGI, 2005). Similarly, there has been an exploration of a possible linkage between the NSW Greenhouse Gas abatement scheme and the EU ETS and Kyoto mechanisms (Fowler, 2004; Betz and MacGill, 2005).

In addition to international carbon markets, there are other frameworks that facilitate interactions between private, sub-national, and non-governmental initiatives and national and international climate change efforts. For example, NGOs, private companies and governments have formed partnerships to help implement the World Summit on Sustainable Development (WSSD). These partnerships, known as 'type II agreements' are self-organized and are formed as voluntary cooperative initiatives and have the common goal of integrating the economic, social and environmental dimensions of sustainable development. To date, more than 300 partnerships are registered. A significant number of these partnerships are climate change-related (see http://www.un.org/esa/sustdev/partnerships/partnerships.htm).

13.5 Implications for global climate change policy

This chapter has provided information on the national and international policy options available to governments and the global community to address global climate change. We note that there are many tools available and that each has its own unique advantages and disadvantages. While further studies are likely to yield additional insights, particularly with respect to the implementation of policy choices, it is unlikely that the suite of policies available to governments will grow substantially in the future.

With this in mind, it is useful to consider several questions in the light of the following background information. Since the IPCC was formed nearly 20 years ago atmospheric GHG concentrations have gone up from 354 to 385 ppm (or approximately 25% of the total increase since the pre-industrial level of 270 ppm) as the emissions of GHG have risen (see http://cdiac.ornl.gov/ftp/trends/CO_2/maunaloa. CO_2). We have measurement data that indicates that the world is warming, and we can calculate, given the data on past and current emissions, that there is at the present time approximately 0.6 degrees of additional warming 'in the bank' (See IPCC, 2007a). Therefore:

- Why has the application of policies been so modest?
- Why is the global community not on a faster implementation track?
- Why have – at the very least – hedging strategies not emerged in many more countries?
- Is the scale of the problem too large for current institutions?
- Is there a lack of information on potential impacts or on low-cost options?
- Has policy-making been influenced by the special interests of a few?

Assuming that policies have been carefully designed, there appears to be no need to delay their implementation – indeed, there is an abundance of information in climate change literature that continues to suggest the non-climate benefits of many of these policies and the potential climate benefits of many non-climate policies. Moreover, as outlined in other chapters of this report, with a few exceptions, these policies would have only a very small impact on national economic growth – albeit the impact would be large in absolute terms.

One answer to these questions may lie in the complex nature of the policy-making processes – both for climate change policy and, even more importantly, in other areas at the national and sub-national level. For example, some of the most significant emissions reductions in both developed and developing countries have occurred at this intersection of policies (e.g. the switch to gas in the UK, the Chinese energy efficiency programmes for energy security, the Brazilian development of a bio-fuel-driven transport fleet, or the trend in the 1970s and 1980s toward nuclear power). Conversely, some of the most significant increases in emissions have been the result of non-climate policy priorities which have overwhelmed climate mitigation efforts (e.g. decisions in Canada to exploit the tar sands reserves, those in Brazil to clear forests for agriculture and those in the USA to promote coal-powered electricity generation to enhance energy security). Assessing how these mega-decisions are made and how they can be linked with climate change policies is the topic of chapter 12 and may be crucial to the future.

A second answer may be linked to the over-riding drive by all governments (reflecting both corporate and individual desires) for cheap and secure energy and for economic growth, to the competitive nature of the global economy and to the perception that any step, however modest, will disadvantage some special interest. Finding a way to mitigate the impacts on the losers – as well as create new winners – may be a key to accelerating the pace of policy implementation. Most importantly perhaps, finding ways to eliminate the climate of ‘fear’ that prevents actions (or more aggressive actions) and to promote a climate of ‘opportunity’ may be crucial to moving beyond modest steps. As outlined in other chapters of this report, the impact of mitigation efforts on national economic growth is relatively small, although the economic impacts differ among countries and may be larger than the impacts of other environmental problems. Mitigation is also more complicated as it involves more political actors and greater levels of cooperation and/or coordination. In this respect, better estimates of the risks, costs and benefits of climate policies in terms of market and no-market terms as well as ethical terms may enable governments to make informed decisions.

From the literature reviewed in this chapter, it is clear that governments, companies and civil society have been actively grappling with these questions. The very diversity of the policy mix, the activism of NGOs and the wealth of modelling, research and analysis (even if, to date, these have yielded only modest changes in emissions) collectively provide a framework for taking additional steps.

New research might provide further insight into why some policies have succeeded – and why others have not. In particular, additional work is needed to bolster the currently sparse body of research addressing the concerns of developing countries. Understanding how to accelerate policy adoption may be the most important research topic for the immediate future. As this chapter and others have noted, technology and policy tools do exist for taking that significant first step in addressing climate change. Potential future agreements can take advantage of this learning to encourage economically prudent and politically feasible actions.

REFERENCES

Ackermann, T., G. Andersson, and L. Söder, 2001: Overview of government and market driven programs for the promotion of renewable power generation. *Renewable Energy*, **22**(1-3), January-March 2001, pp. 197-204.

Ahman, M., D. Burtraw, J. Kruger, and L. Zetterberg, 2006: A ten year rule to guide the allocation of EU emission allowances. *Energy Policy*.

Akhurst, M., J. Morgheim, and R. Lewis, 2003: Greenhouse gas emissions trading in BP. *Energy Policy*, **31**(7), June 2003, pp. 657-663.

Aldy, J.E., S. Barrett, and R.N. Stavins, 2003: Thirteen plus one: a comparison of global climate policy architectures. *Climate Policy*, **3**(4), December 2003, pp. 373-397.

Alic, J.A., D.C. Mowery, E.S. Rubin, 2003: U.S. Technology and Innovation Policies: Lessons for Climate Change. Pew Center on Global Climate Change, Washington, D.C.

Allen, M., 2003: Liability for Climate Change: Will it ever be possible to sue anyone for damaging the climate? Commentary in *Nature*, **421**, 27 February 2003, pp. 891-89.

Anderson, D., C.D. Bird, 1992: Carbon accumulations and technical progress - A simulation study of costs. *Bulletin of Economics and Statistics*, **54**(1), pp. 1-27, Oxford.

Andresen, S. and J. Wettestad, 1992: International resource cooperation and the greenhouse problem. *Global Environmental Change, Human and Policy Dimensions*, **2**(4), December 1992, Butterworth-Heinemann, Oxford, pp. 277-291.

Andronova, N.G. and M.E. Schlesinger, 2004: Importance of sulfate aerosol in evaluating the relative contributions of regional emissions to the historical global temperature change. *Adaptation and Mitigation Strategies for Global Change*, **9**, pp. 383-390.

Arora, S. and T. Cason, 1996: Why do firms volunteer to exceed environmental regulations? Understanding Participation in EPA’s 33/50 Program. *Land Economics*, **72**, pp. 413-32.

Asheim, G.B., W. Buchholz, and B. Tungodden, 2001: Justifying sustainability. In *Journal of Environmental Economics and Management*, **41**, pp. 252-268.

Aslam, M.A., 2002: Equal per capita entitlements: a key to global participation on climate change? K.A. Baumert, O. Blanchard, S. Llosa, and J.F. Perkaus (eds), Options for protecting the climate (pp. 175-201). Washington, WRI.

Assunção, L., and Z.X. Zhang, 2002: Domestic climate policies and the WTO. United Nations Conference on Trade and Development, Discussion Paper No. 164.

Azar, C. and H. Dowlatabadi, 1999: A review of technical change in assessment of climate policy. *Annual Review Energy Economics*, **24**, pp.513-544.

Babiker, M.H., R.S. Eckhaus 2002: Rethinking the Kyoto targets. *Climatic Change*, **54**, pp. 99-114.

Babiker, M., L., P. Criqui, A.D. Ellerman, J. Reilly and L. Viguier, 2003: Assessing the impact of carbon tax differentiation in the European Union. *Environmental Modeling and Assessment*, **8**(3), pp. 187-197.

Baer, P., J. Harte, B. Haya, A.V. Herzog, J. Holdren, N.E. Hultman, D.M. Kammen, R.B. Norgaard, and L. Raymond, 2000: Equity and greenhouse gas responsibility. *Science*, **289** (2287.12 Discussion paper 2003-2).

Bailey, P., T. Jackson, S. Parkinson, and K. Begg, 2001: Searching for baselines constructing joint implementation project emission reductions. *Global Environmental Change*, **11**, pp.185-192.

Bakker, S.J.A., H.C. de Coninck, and J.C. Jansen, 2004: Air pollution, health and climate change. M.T.J. Kok and H.C. de Coninck (ed.), *Beyond Climate: Options for Broadening Climate Policy*, RIVM Report 500036 001, Bilthoven, pp. 139-171.

Bals, C., I. Burton, S. Butzengeiger, A. Dlugolecki, E.Gurenko, E. Hoekstra, P. Höppe, R. Kumar, J. Linnerooth-Bayer, R. Mechler, and K. Warner, 2005: Insurance-related options for adaptation to climate change, the Munich Climate Insurance Initiative (MCII). <http://www.germanwatch.org/rio/c11insur.pdf>, accessed 03/07/07.

Baron, R. and C. Philibert, 2005: Act Locally, Trade Globally: Emissions Trading for Climate. International Energy Agency, 2005, Paris.

Baron, R. and J. Ellis, 2006: Sectoral crediting mechanisms for greenhouse gas mitigation: institutional and operational issues. OECD/IEA Annex I Group, Paris.

Baron, R. and S. Bygrave (2002). ”Towards International Emissions Trading: Design Implication for Linkages”. Paper presented at the 3rd CATEP Workshop on Global Trading, Kiel Institute for World Economics, 30 September - 1 October 2002.

Barrett, S., 2001: Towards a better climate treaty. Policy matters. *World Economics*, **3**(2), pp. 35-45.

Barrett, S., 2003: Environment and Statecraft. Oxford University Press, Oxford.

Baumert, K., A.R. Bhandari, N. Kete, 1999: What might a developing country climate commitment look like? World Resources Institute, Washington D.C.

Baumert, K., T. Herzog, and J. Pershing, 2005a: Navigating the numbers: Greenhouse gases and international climate change agreements. World Resources Institute, Washington D.C., USA, ISBN: 1-56973-599-9.

Baumert, K., R. Bradley, N.K. Dubach, J.R. Moreira, S. Mwakasonda, W.-S. Ng, L.A. Horta Nogueira, V. Parente, J. Pershing, L. Schipper, and H. Winkler, 2005b: Growing in the greenhouse: Policies and measures for sustainable development while protecting the climate. Washington, USA, World Resources Institute.

Begg, K. and D. van der Horst, 2004: Preserving environmental integrity in standardised baselines: The role of additionality and uncertainty. *Mitigation and Adaptation Strategies for Global Change*, **9**, pp. 180-200.

Beierle, T.C., 2004: The benefits and costs of environmental information disclosure: What do we know about right-to-know? RFF Discussion Paper 03-05, March.

Bell, R. and C. Russell, 2002: Environmental policy for developing countries. *Issues in Science and Technology*. Spring, pp. 63-70.

Bell, R.G., 2003: Choosing environmental policy instruments in the real world. OECD: Paris.

Benedick, R.E., 1993: Perspectives of a negotiation practioner. Sjostedt, G. (ed.) *International Environment Negotiation*, IIASA, pp. 219-243.

Benedick, R., 2001: Striking a new deal on climate change. *Science and Technology Online*, Fall 2001.

Berk, M.M. and M.G.J. den Elzen, 2001: Options for differentiation of future commitments in climate policy: how to realise timely participation to meet stringent climate goals. *Climate Policy*, **1**, pp. 465-480.

Berkhout, F. and A. Smith, 2003: Carbon flows between the EU and Eastern Europe: Baselines, scenarios and policy options. *International Environmental Agreements: Politics, Law and Economics*, **3**, pp. 199-219.

Betz, R., W. Eichhammer, and J. Schleich, 2004: Designing national allocation plans for EU emissions trading - A first analysis of the outcomes. *Energy & Environment*, **15**, pp. 375-425.

Betz, R. and I. MacGill, 2005: Emissions trading for Australia: Design, transition and linking options. CEEM Discussion Paper, DP_050815.

Biermann, F. and R. Brohm, 2005: Border adjustments on energy taxes: A possible tool for european policymakers in implementing the Kyoto Protocol? In *Vierteljahrshefte zur Wirtschaftsforschung*. **74**, pp. 249-258.

Blackman, A. and W. Harrington, 2000: The use of economic incentives in developing countries: Lessons from international experience with industrial air pollution. *Journal of Environment and Development*, **9**(1), pp. 5-44.

Blanchard, O., 2002: Scenarios for differentiating commitments. K.A. Baumert, O. Blanchard, S. Llosa and J.F. Perkaus (eds), *Options for protecting the climate*. WRI, Washington D.C.

Blanchard, O, C. Criqui, A. Kitous, and L. Vinguier, 2003: Efficiency with equity: A pragmatic Approach. I. Kaul, P. Conceição, K. Le Goulven, R.U. Mendoza (eds), *Providing public goods: managing globalization*. Oxford, Oxford University Press, Office of Development Studies, United Nations Development Program, Grenoble, France.

Blok, K., G.J.M. Phylipsen, and J.W. Bode, 1997: The Triptych Approach, burden sharing differentiation of CO_2 emissions reduction among EU Member States. Discussion paper for the informal workshop for the European Union Ad Hoc Group on Climate, Zeist, the Netherlands, January 16-17, 1997, Dept. of Science, Technology and Society, Utrecht University, Utrecht, 1997 (9740).

Bluffstone, R. and B.A. Larson (eds) 1997: Controlling Pollution in Transition economies: Theories and Methods. London, UK: Edward Elgar.

Blyth, W. and R. Baron, 2003: Green investment schemes: Options and issues. COM/ENV/EPOC/IEA/SLT(2003)9, OECD/IEA, Paris.

Blyth, W. and M. Yang, 2006: Impact of climate change policy uncertainty on power investment. Document no. IEA/SLT(2006)11. IEA, Paris.

Bodansky, D., 2004: International climate efforts beyond 2012: A survey of approaches. Pew Climate Center, Washington D.C., <www.pewclimate.org>, accessed 03/07/07.

Bode, S., 2004: Equal emissions per capita over time - a proposal to combine responsibility and equity of rights for post-2012 GHG emission entitlement allocation. *European Environment*, **14**, pp. 300-316.

Böhringer, C. and H. Welsch, 2004: Contraction and convergence of carbon emissions: an intertemporal multi-region CGE analysis. *Journal of Policy Modeling*, **26**, pp. 21-39.

Böhringer, C. and A. Löschel, 2005: Climate policy beyond Kyoto: Quo vadis? A computable general equlibrium analysis based on expert judgements. KYKLOS 58(**4**), pp. 467-493.

Böhringer, C. and H. Welsch, 2006: Burden Sharing in a greenhouse: egalitarianism and sovereignty reconciled. *Applied Economics*, **38**, pp. 981-996.

Bollen, J.C., A.J.G. Manders, and P.J.J. Veenendaal, 2004: How much does a 30% emission reduction cost? Macroeconomic effects of post-Kyoto climate policy in 2020. CPB Document no 64, Netherlands Bureau for Economic Policy Analysis, The Hague.

Bosi, M. and J. Ellis, 2005: Exploring options for sectoral crediting mechanisms. OECD/IEA Annex 1 Expert Group, Paris.

Bouille, D., O. Girardin, 2002: Learning from the Argentine Voluntary Commitment. K.A. Baumert (ed), *Options for Protecting the Climate*. World Resource Institute, Washington D.C.

Bovenburg, A. and L. Goulder, 2001: Neutralizing the adverse industry impacts of CO_2 abatement policies: What does it cost? Behavioral and distributional effects of environmental policy (eds, C. Carraro and G. Metcalf), University of Chicago Press.

Braathen, N.A., 2005: Environmental agreements in combination with other policy instruments. E. Croci, *the Handbook of Environmental Voluntary Agreements*, Springer, 2005.

Bradford, D.F., 2004: Improving on Kyoto: Greenhouse gas control as the purchase of a global public good. Bradnee Chambers *et al*. (2005). Typology of Response Options, Millennium Ecosystem Assessment.

Bradley, R., K. Baumert, N.K. Dubash, J.R. Moreira, S. Mwakasonda, W.-S. Ng, L.A. Horta Nogueira, V. Parente, J. Pershing, L. Schipper, and H. Winkler, 2005: Growing in the greenhouse: Policies and measures for sustainable development while protecting the climate. Washington, USA, World Resources Institute.

Braun, M. and Stute, E. 2004: Anbieter von Dienstleistungen fur den Ausgleich von Treibhaus-gasemissionen. Germanwatch-Hintergrundpapier, Bonn/Berlin, <www.germanwatch.org/rio/thg-ad03.htm> accessed 03/07/07.

Broekhoff, M., 2004: Institutional and cost implications of multi-project baselines. *Mitigation and Adaptation Strategies for Global Change*, **9**, pp. 201-216, Centre for Economic Policy Research, London.

Brouhle, K., C. Griffiths, and A. Wolverton, 2005: The use of voluntary approaches for environmental policymaking in the US. E. Croci, *the Handbook of Environmental Voluntary Agreements*, Springer, 2005.

Bruvoll, A. and B.M. Larsen, 2004: Greenhouse gas emissions in Norway: Do carbon taxes work? Energy Policy, 32. A previous version is available as Discussion Papers 337 by Statistics Norway, <www.ssb.no/cgi-bin/publsoek?job=forside&id=dp-337&kode=dp&lang=en>, accessed 03/07/07.

Bulkeley, H., 2001: No regrets? Economy and environment in Australia's domestic climate change policy process. *Global Environmental Change*, **11**, pp. 155-169.

Burns, W.C.G., 2004: Climate justice: The prospect for climate change litigation. The exigencies that drive potential causes of action for climate change damages at the international level. American Society of International Law Proceedings, **98**, 223 pp.

Burtraw, D., A. Krupnick, K. Palmer, A. Paul, M. Toman, and C. Bloyd, 2001a: Ancillary benefits of reduced air pollution in the United States from moderate greenhouse gas mitigation policies in the electricity sector. RFF Discussion Paper 01-61.

Burtraw, D., K. Palmer, A. Paul, R. Bharvirkar, 2001b: The effect of allowance allocation on the cost of carbon emissions trading. RFF Discussion Paper 01-30.

Burtraw, D., K. Palmer, R. Bharvirkar, and A. Paul, 2002: The effect on asset values of the allocation of carbon dioxide emission allowances. *The Electricity Journal*, June 2002, **15**(5), pp. 51-62.

Bygrave, S., 2004: Experience with emissions trading and project-based mechanisms in OECD and non-OECD countries. *Greenhouse Gas Emissions Trading and Project-Based Mechanisms*, Proceedings of OECD Global Forum on Sustainable Development: Emissions Trading, OECD, Paris.

Bygrave, S. and M. Bosi, 2004a: Linking non-EU domestic emisisons trading schemes with the EU emissions trading scheme. OECD/IEA Annex I Expert Group, Paris.

Bygrave, S. and M. Bosi, 2004b: Linking project-based mechanisms with domestic greenhouse gas emissions trading schemes. OECD/IEA Annex I Expert Group, Paris.

Cambridge Econometrics, 2005: Modelling the initial effects of the climate change levy. Report submitted to HM Customs and Excise by Cambridge Econometrics, Department of Applied Economics, University of Cambridge and the Policy Studies Institute, <http://customs.hmrc.gov.uk/channelsPortalWebApp/channelsPortalWebApp.portal?_nfpb=true&_pageLabel=pageLibrary_MiscellaneousReports&propertyType=document&columns=1&id=HMCE_PROD1_023971>, accessed 03/07/07.

Carraro, C. and D. Siniscalco, 1993: Strategies for the international protection of the environment. *Journal of Public Economics*, **52**, pp. 309-328.

Chander, P. and H. Tulkens, 1995: A core-theoretic solution for the design of cooperative agreements on transfrontier pollution. *International Tax and Public Finance*, **2**, pp. 279-293.

Chan-Woo, K., 2002: Negotiations on Climate Change: Debates on commitment of developing countries and possible responses. *East Asian Review*, **14**, pp. 42-60.

Charnovitz, S., 2003: Trade and climate: Potential conflicts and synergies. In *Beyond Kyoto: Advancing the International Effort Against Climate Change*, Aldy *et al*., Report prepared for the Pew Center on Global Climate Change, 2003.

Chen, W., 2003: Carbon quota price and CDM potential after Marrakesh. *Energy Policy*, **31**, pp. 709-719.

Chidiak, M., 2002: Lessons from the French experience with voluntary agreements for greenhouse-gas reduction. *Journal of Cleaner Production*, **10**, pp 121-128.

Christiansen, A.C. and J. Wettestad, 2003: The EU as a frontrunner on emissions trading: how did it happen and will the EU succeed? *Climate Policy*, **3**, pp. 3-13.

Christiansen, A.C., A. Arvanitakis, K. Tangen, H. Hasselkippe, 2005: Price determinants in the EU emissions trading scheme. *Climate Policy,* **5**, pp. 1-17.

Climate Justice Programme, 2005: Gas flaring in Nigeria: A human rights, environmental change. *Natural Resources Journal*, **38**, pp. 563-569.

Cooper, R., 1998: Towards a real treaty on global warming. *Foreign Affairs*, **77**, pp. 66-79.

Cooper, R., 2001: The Kyoto Protocol: A flawed concept. *Environmental Law Reporter*, **31**(11), pp. 484-411, 492 pp.

Corfee-Morlot, J., M. Berg, and G. Caspary, 2002: Exploring linkages between natural resource management and climate adaptation strategies. OECD, Paris, COM/ENV/EPOC/DCD/DAC(2002)3/Final.

Corfee-Morlot, J., N. Höhne, 2003: Climate change: long-term targets and short-term commitments. *Global Environmental Change*, **13**, 2003, pp. 277-293.

Cramton, P. and S. Kerr, 2002: Tradable carbon permit auctions: How and why to auction not grandfather. *Energy Policy*, **30**, pp. 333-345.

Criqui, P., A. Kitous, M. Berk, M. Den Elzen, B. Eickhout, P. Lucas, D. van Vuuren, N. Kouvaritakis, and D. Vanregemorter, 2003: Greenhouse gas reduction pathways in the UNFCCC process up to 2025 - Technical Report. Study Contract: B4-3040/2001/325703/MAR/E.1 for the European Commission, DG Environment, Brussels.

Croci, E. (ed.), 2005: The handbook of environmental voluntary agreements: Design, implementation and evaluation issues. Springer, The Netherlands.

Dang, H., A. Michaelowa, and D. Tuan, 2003: Synergy of adaptation and mitigation strategies in the context of sustainable development: the case of Vietnam. *Climate Policy*, **3**, Supplement 1, pp. S81-S96.

Darnall, N. and J. Carmin, 2003: The design and rigor of U.S. voluntary environmental programs: results from the survey. Raleigh, North Carolina State University.

Dasgupta, C. and U. Kelkar, 2003: Indian perspectives on beyond-2012. Presentation at the open symposium 'International Climate Regime beyond 2012: Issues and Challenges', Tokyo.

Davies, J.C. and J. Mazurek, 1998: Pollution control in the United States: Evaluating the system.

DEHSt, 2005: Implementation of the emissions trading in the EU: National allocation plans of all EU states. German Emissions Trading Authority (DEHSt) at the Federal Environmental Agency (UBA), Berlin, November 2005.

Demailly, D. and P. Quirion, 2006: CO_2 abatement, competitiveness and leakage in the European cement industry under the EU ETS: Grandfathering vs. output-based allocation. *Climate Policy*.

Den Elzen, M.G.J. and M. Schaeffer, 2002: Responsibility for past and future global warming: uncertainties in attributing anthropogenic climate change. *Climatic change*, **54**, pp. 29-73.

Den Elzen, M.G.J. and M.M. Berk, 2004: Bottom-up approaches for defining future climate mitigation commitments. MNP Report 728001029/2005, Netherlands Environmental Assessment Agency (MNP), Bilthoven, the Netherlands.

Den Elzen, M.G.J. and M. Meinshausen, 2005: Meeting the EU 2°C climate target: global and regional emission implications. MNP Report 728001031/2005, Netherlands Environmental Assessment Agency (MNP), Bilthoven, the Netherlands.

Den Elzen, M.G.J. and M. Meinshausen, 2006: Multi-gas emission pathways for meeting the EU 2°C climate target. *Avoiding Dangerous Climate Change*, H.J. Schellnhuber, W. Cramer, N. Nakicenovic, T. Wigley, and G. Yohe (eds), Cambridge University Press, Cambridge, UK.

Den Elzen, M.G.J. and P. Lucas, 2005: The FAIR model: a tool to analyse environmental and costs implications of climate regimes. *Environmental Modeling & Assessment*, **10**(2) pp. 115-134.

Den Elzen, M.G.J., F. Fuglestvedt, N. Höhne, C. Trudinger, J. Lowe, B. Matthews, B. Romstad, C. Pires de Campos, and N. Andronova, 2005a: Analysing countries' contribution to climate change: Scientific and policy-related choices. *Environmental Science & Policy*, **8**, pp. 614-636.

Den Elzen, M.G.J., M. Schaeffer, and P. Lucas, 2005b: Differentiation of future commitments based on Parties' contribution to climate change. Climate Change: uncertainties in the 'Brazilian Proposal' in the context of a policy implementation. *Climatic Change*, **71**(3), pp. 277-301.

Den Elzen, M.G.J., P. Lucas, and D.P. van Vuuren, 2005c: Abatement costs of post-Kyoto climate regimes. *Energy Policy*, **33**(16), pp. 2138-2151.

Den Elzen, M.G.J., M.M. Berk, P. Lucas, C. Criqui, and A. Kitous, 2006a: Multi-Stage: a rule-based evolution of future commitments under the Climate Change Convention. *International Environmental Agreements: Politics, Law and Economics*, **6**(2006), pp. 1-28.

Den Elzen, M.G.J., P. Lucas, and D.P. van Vuuren, 2006b: Exploring regional abatement costs and options under allocation schemes for emission allowances. MNP report, Bilthoven, the Netherlands.

Depledge, J., 2000: Tracing the origins of the Kyoto Protocol: An article-by-article textual history. UNFCCC document FCCC/TP/2000/2, <www.unfccc.int>, accessed 16/04/2007.

Dinan, T. and D.L. Rogers, 2002: Distributional effects of carbon allowances trading: How government decisions determine winners and losers. *National Tax Journal*, **55**(2).

Dlugolecki, A. and S. Lafeld, 2005: Climate change - agenda for action: the financial sector's perspective. Allianz Group and WWF, Munich.

Doelle, M., 2004: Climate Change and the WTO: Opportunities to motivate state action on climate change through the world trade organization. *Review of European Community and International Environmental Law*. **13**(1), pp. 85-103.

Dudek, D. and A. Golub, 2003: 'Intensity' targets: Pathway or roadblock to preventing climate change while enhancing economic growth? Climate Policy, 3(S2), pp. S21-28.

Dutschke, M., 2002: Fractions of permanence - Squaring the cycle of sink carbon accounting. *Mitigation and Adaptation Strategies for Global Change*, **7**(4), pp.381-402.

Edenhofer, O., K. Lessmann, C. Kemfert, M. Grubb, and J. Köhler, 2006: Induced technological change: Exploring its implication for the ecnomics of atmospheric stabilization. *The Energy Journal Special Issue*, **57**, pp. 107.

Edmonds, J. and M. Wise, 1998: Building backstop technologies and policies to implement the framework convention on climate change. Washington, D.C., Pacific Northwest National Laboratory.

Edmonds, J. and M.A. Wise, 1999: Exploring a technology strategy for stabilising atmospheric CO_2. *International Environmental Agreements on Climate Change*, C. Carraro, Dordrecht, Netherlands, Kluwer Academic Publishers, 19.

Ekboir, J.M., 2003: Research and technology policies in innovation systems: zero tillage in Brazil, *Research Policy*, **32**, pp. 573-586.

Ellerman, A.D., P. Joskow, R. Schmalensee, J.P. Montero, and E. Bailey, 2000: Markets for clean air. The U.S. Acid Rain Program, Cambridge University Press.

Ellerman, A.D., 2002: Designing a tradeable permit system to control SO_2 emissions in China: Principles and practice. *The Energy Journal*, **23**(2), pp. 1-26.

Ellerman, A.D. and I. Sue Wing, 2003: Absolute v. intensity-based emission caps. *Climate Policy* **3**(Supplement 2), pp. S7-S20.

Ellerman, A.D., 2005: U.S. experience with emissions trading: Lessons for CO_2. Climate Policy and Emissions Trading After Kyoto, edited by Bernd Hansjurgen. Cambridge, England, Cambridge University Press.

Ellerman, A.D., 2006: Are cap-and-trade programs more environmentally effective than conventional regulation? In *Moving to Markets: Lessons from Thirty Years of Experience*, J. Freeman and C. Kolstad (eds), Oxford University Press, New York.

Ellis, J. and R. Baron, 2005: Sectoral Crediting Mechanisms: An initial assessment of electricity and aluminium. OECD/IEA Annex I Group, Paris.

Ellis, J. and K. Karousakis, 2006: The developing CDM market: May 2006 Update. OECD/IEA Annex I Expert Group, Paris.

Ellis, J., 2006: Issues related to a programme of activities under the CDM. OECD/IEA Annex I Group, Paris.

Ellis, J., H. Winkler, J. Corfee-Morlot, and F. Gagnon-Lebrun, 2007: CDM: Taking stock, Looking forward. *Energy Policy*, **35**, pp.15-28.

Esty, D.C. and M.E. Porter, 1998: Industrial ecology and competitiveness, Strategic implications for the firm. *Journal of Industrial Ecology*, **2**(1), pp. 35-43.

Esty, D.C., 2001: Bridging the trade-environment divide. *Journal of Economic Perspectives*, **15**(3), Summer 2001, pp. 113-130.

Esty, D. and M. Ivanova (eds), 2002: Global environmental governance: Options and opportunities. Yale School of Forestry and Environmental Studies, New Haven.

Eyckmans, J. and M. Finus, 2003: Coalition formation in global warming game: How the design of protocols affects the success of environmental treaty-making. Pre-publication draft.

Fernandez, M. and A. Michaelowa, 2003: Joint implementation and EU accession countries. *Global Environmental Change*, **13**, pp. 269-275.

Fichtner, W., M. Goebelt, and O. Rentz, 2001: The efficiency of international cooperation in mitigating climate change: analysis of joint implementation, the clean development mechanism and emission trading for the Federal Republic of Germany, the Russian Federation and Indonesia. *Energy Policy*, **29**, pp. 817-830.

Figures, C., 2004: Institutional capacity to integrate institutional development and climate change consideration: An assessment of DNAs in LAC. Interamerican Development Bank, October 2004, Washington, D.C.

Finus, M., 2002: New developments in coalition theory: An application to the case of global pollution. *The International Dimension of Environmental Policy*. Kluwer, Dordrecht, Holland.

Fischer, C., 2001: Rebating environmental policy revenues: Output-based allocations and tradable performance standards. RFF Discussion Paper, 01-22.

Fischer, C., S. Hoffman, and Y. Yoshino, 2002: Multilateral trade agreements and market-based environmental policies. RFF Discussion Paper, May.

Fischer, C., 2006: Project-based mechanisms for emissions reductions: balancing trade-offs with baselines. *Energy Policy*.

Fisher, C., I.W.H. Parry, and W.A. Pizer, 2003: Instrument choice for environmental protection when technological innovation is endogenous. *Journal of Environmental Economics and Management*, **45**, pp.523-545.

Fisher, C. and R. Newell, 2004: Environmental and technology policies for climate change and renewable energy, resources for the future. Discussion paper 04-05, April 2004.

Fleming, P.D. and P.H. Webber, 2004: Local and regional greenhouse gas management. *Energy Policy*, **32**(2004), pp. 761-771.

Fowler, R., 2004: Lessons from the implementation of a mandatory project-based greenhouse gas abatement scheme in the state of New South Wales, Australia. *Greenhouse Gas Market 2004: Ready for Takeoff*, International Emissions Trading Association, 2004.

Foxon, T. and R. Kemp, 2004: Innovation impacts of environmental policies. International Handbook on Environment and Technology Management (ETM).

Frankel, J.A., 1999: Greenhouse Gas Emissions. Policy Brief, Brookings Institution, Washington D.C., **52**.

Frankel, J.A. and A.K. Rose, 2003: Is trade good or bad for the environment? Sorting out the causality. National Bureau of Economic Research (NBER).

Freeman, J. and C. Kolstad (eds), 2006: Moving to markets: Lessons from thirty years of experience. (Oxford University Press, New York.

Fritsche, M. and R. Lukas, 2001: Who cooperates on R&D? *Research Policy*, **30**, pp. 297-312.

Gallagher, K.P., 2004: *Free Trade and the Environment. Mexico, NAFTA and Beyond*. Palo Alto, CA: Stanford University Press.

Gangopadhyay, S., B. Ramaswami, and W. Wadhwa, 2005: Reducing subsidies on household fuels in India: How will it affect the poor? *Energy Policy*, **33**(2005), pp. 2326-2336.

GCI, 2005: GCI Briefing: Contraction & Convergence. <http://www.gci.org.uk/briefings/ICE.pdf>, accessed April 2006.

Geres, R. and A. Michaelowa, 2002: A qualitative method to consider leakage effects from CDM and JI projects. *Energy Policy*, **30**(2002), pp. 461-463.

Germain, M., P.L. Toint, and H. Tulkens, 1998: Financial transfers to sustain cooperative international optimality in stock pollutant abatement. *Sustainability and Firms: Technological Change and the Changing Regulatory Environment*. Edward Elgar, Cheltenham, UK, pp. 205-219.

Germain, M., P.L. Toint, H. Tulkens, and A.d. Zeeuw, 2003: Transfers to sustain core theoretic cooperation in international stock pollutant control. *Journal of Economic Dynamics & Control*, **28**, pp. 79-99.

Gillespie, A., 2004: Small Island States in the face of Climate Change: The end of the line in international environmental responsibility. *UCLA Journal of Environmental Law and Policy*, **22**, 107 pp.

Goldberg, D. and K. Baumert, 2004: Action targets: A new form of GHG commitment. *Joint Implementation Quarterly*, **10**(3), pp. 8-9.

Golub, A. and E. Strukova, 2004: Russia and the GHG market. *Climatic Change*, **63**, pp.223-243.

Goulder, L., I. Parry, R. Williams, and D. Burtraw, 1999: The cost effectiveness of alternative instruments for environmental effectiveness in a second best setting. *Journal of Public Economics*, **72**(3), pp. 329-360.

Goulder, L.H. and S.H. Schneider, 1999: Induced technological change and the attractiveness of CO_2 emissions abatement policies. *Resource and Energy Economics*, **21**, pp. 211-253.

Grafton, Q., F. Jotzo, and M. Wasson, 2004: Financing sustainable development: country undertakings and rights for environmental sustainability (CURES). Ecological Economics, 51, pp. 65-78.

Greene, O., 1996: Lessons from other international environmental agreements. In *Sharing the effort - Options for differentiating commitments on climate change*, M. Paterson and M. Grubb (eds) The Royal Institute of International Affairs, London, pp. 23-44.

Greiner, S. and A. Michaelowa, 2003: Defining investment additionality for CDM projects - practical approaches. *Energy Policy*, **31**(2003), pp. 1007-1015.

Groenenberg, H., K. Blok, and J. van der Sluijs, 2004: Global Triptych: a bottom-up approach for the differentiation of commitments under the Climate Convention. *Climate Policy*, **4**(4), pp. 153-175.

Grossman, D.A., 2003: Warming up to a not-so-radical idea: Tort based climate change litigation. *Colombia Journal of Environmental Law*, **28**, pp. 1-61.

Grubb, M., C. Hope, and R. Fouquet, 2002: Climatic implications of the Kyoto Protocol: The contribution of international spillover. *Climatic Change*, **54**, pp. 11-28.

Grubb, M., 2004: Technology innovation and climate change policy: an overview of issues and options. Keio Economic Studies, **41**(2), pp.103-132.

Grubb, M., C. Azar, and U.M. Persson, 2005: Allowance allocation in the European emissions trading scheme: a commentary. *Climate Policy*, **5**, pp. 127-136.

Gupta, J., 1998: Encouraging developing country participation in the climate change regime. Institute for Environmental Studies (IVM), Vrije Universiteit, Amsterdam, The Netherlands.

Gupta, J. and M. Grubb (eds), 2000: Climate Change and European leadership: A sustainable role for Europe. Environment and Policy Series, Kluwer Academic Publishers, Dordrecht, 344 pp.

Gupta, J. and L. Ringius, 2001: The EU's climate leadership: Between ambition and reality. International Environmental Agreements. *Politics, law and economics*, **1**(2), pp. 281-299, London, 178 pp.

Gupta, J., 2003a: Engaging developing countries in climate change: (KISS and Make-up!). *Climate Policy for the 21st Century, Meeting the Long-Term Challenge of Global Warming*, D. Michel (ed.), Washington D.C., Center for Transatlantic Relations, <http://transatlantic.sais-jhu.edu>, accessed 03/07/07.

Gupta, S., 2003b: Incentive-based approaches for mitigating greenhouse gas emissions: Issues and prospects for India. *India and Global Climate Change Perspectives on Economics and Policy from a Developing Country*, M.A. Toman, U. Chakravorty, and S. Gupta (eds), Washington, Resources for the Future Press.

Gupta, S. and P.M. Bhandari, 1999: An effective allocation criterion for CO_2 emissions. *Energy Policy*, **27**(12), November.

Gupta, S. and P.M. Bhandari, 2003: Allocation of GHG emissions - An example of short term and long term criteria. *India and Global Climate Change, Perspectives on Economics and Policy from a Developing Country, Resources for the Future*, M.A. Toman, U. Chakravorty, S. Gupta (eds).

Hahn, R., 1998: The economic and politics of Climate Change. Washington D.C., American Enterprise Institute Press.

Hahn, R.W., 2001: A primer on environmental policy design. London, Routledge.

Haites, E., 2003a: Harmonization between national and International Tradeable Permit Schemes. CATEP Synthesis Paper, OECD, Paris.

Haites, E., 2003b: Output-based allocation as a form of protection for internationally competitive industries. *Climate Policy*, **3**(Supplement 2), December 2003, pp. S29-S41.

Hall, B.H., 2002: The financing of research and development NBER Working Papers 8773. International Bureau of Economic Research.

Hamilton, K., 2005: The finance-policy gap: Policy conditions for attracting long-term investment. *The Finance of Climate Change*, K. Tang (ed.), Risk Books, London.

Hancock, E.E., 2005: Red dawn, blue thunder, purple rain: Corporate risk of liability for global climate change and the sec disclosure dilemma. *Georgetown International Environmental Law Review*, **17**, 223 pp.

Hanks, J., 2002: Voluntary agreements, climate change and industrial energy efficiency. *Journal of Cleaner Production*, **10**, pp. 103-107.

Hargrave, T., N. Helme, and C. Vanderlan, 1998: Growth baselines. Washington, D.C., USA, Center for Clean Air Policy.

Harrington, W., R.D. Morgenstern, and P. Nelson, 2000: On the accuracy of regulatory cost estimates. *Journal of Policy Analysis and Management*, **19**(2), pp.297-322.

Harrington, W., R.D. Morgenstern, and T. Sterner, 2004: Overview: Comparing instrument choices. *Choosing Environmental Policy*, W. Harrington, R.D. Morgenstern, and T. Sterner (eds), Washington, D.C., Resources for the Future Press.

Harrison, K., 1999: Talking with the donkey: Cooperative approaches to environmental protection. *Journal of Industrial Ecology*, **2**(3), pp. 51-72.

Harrison, D. and D. Radov, 2002: Evaluation of alternative initial allocation mechanisms in a European Union greenhouse gas emissions allowance trading scheme. National Economic Research Associates, prepared for DG Environment, European Commission.

Heemst, J. van, and V. Bayangos, 2004: Poverty and Climate Change. *Beyond Climate: Options for Broadening Climate Policy*, M.T.J. Kok and H.C. de Coninck (ed.), RIVM Report 500036 001, Bilthoven, pp. 21-51.

Helby, P., 2002: EKO-Energi - a public voluntary programme: targeted at Swedish firms with ambitious environmental goals. *Journal of Cleaner Production*, **10**, pp 143-151.

Helm, C. and U.E. Simonis, 2001: Distributive justice in international environmental policy: Axiomatic foundation and exemplary formulation. Environmental Values, 10, pp. 5-18.

Hepburn, C., M. Grubb, K. Heuhoff, F. Matthes, and M. Tse, 2006: Auctioning of EU ETS Phase II allowances: how and why? *Climate Policy*.

Hershkowitz, A., 1998: In defense of recycling. *Social research*, **65**(1), Spring.

Herzog, H., K. Caldeira, and J. Reilly, 2003: An issue of permanence: Assessing the effectiveness of temporary carbon storage. *Climatic Change*, **59**, pp. 293-310.

Higley, C.J., F. Convery, and F. Leveque, 2001: Voluntary approaches: An introduction. *Environmental Voluntary Approaches: Research Insights for Policy Makers*, C.J. Higley and F. Leveque (eds), CERNA, 2001.

Hoel, M. and K. Schneider, 1997: Incentives to participate in an international environmental agreement. *Environmental and Resource Economics*, **9**, pp. 153-170.

Hoffman, A., 2005: Climate change strategy: The business logic behind voluntary greenhouse gas reductions. California Management Review, **47**(3).

Höhne, N., J. Harnisch, G.J.M. Phylipsen, K. Blok, and C. Galleguillos, 2003: Evolution of commitments under the UNFCCC: Involving newly industrialized economies and developing countries. Research Report 201 41 255. UBA-FB 000412, <http://www.umweltbundesamt.de/uba-info-medien-e/index.htm >, accessed 03/07/07.

Höhne, N. and K. Blok, 2005: Calculating historical contributions to climate change - discussing the 'Brazilian Proposal'. *Climatic Change*, **71**, pp. 141-173.

Höhne, N., D. Phylipsen, S. Ullrich, and K. Blok, 2005: Options for the second commitment period of the Kyoto Protocol. For the German Federal Environmental Agency, 02/05, ISSN 1611-8855, <http://www.fiacc.net/data/Climate_Change_02.05.pdf>, accessed 03/07/07.

Höhne, N. and K. Blok, 2006: The impact of the Kyoto Protocol on climate stabilization. What is next after the Kyoto Protocol? Assessment of options for international climate policy post 2012. Amsterdam, The Netherlands, Techne Press.

Höhne, N., 2006: *What is next after the Kyoto Protocol. Assessment of options for international climate policy post 2012*. Techne Press, Amsterdam, the Netherlands, ISBN 908594005-2.

Höhne, N., M.G.J. den Elzen, and M. Weiss, 2006: Common but differentiated convergence (CDC), a new conceptual approach to long-term climate policy. *Climate Policy* (accepted).

Hovi, J. and I. Areklett, 2004: Enforcing the climate regime: Game theory and the Marrakesh Accords. In *International Environmental Agreements: Politics, Law and Economics*, **4**, pp. 1-26.

Humphreys, J., M. van Bueren, and A. Stoeckel, 2003: Greening farm subsidies, rural industries research and development corporation, Barton ACT ISBN 064258608.

Huq, S. and I. Burton, 2003: Funding adaptation to climate change: What, who and how to fund? Sustainable Development opinion paper, IIED, London.

Huq, S. and H. Reid, 2004: Mainstreaming adaptation in development. *IDS Bulletin*. **35**, pp. 15-21.

IAI, 2002: Aluminium: Industry as a partner for sustainable development. International Aluminium Institute, Paris: ICCA and UNEP, <http://www.uneptie.org/outreach/wssd/docs/sectors/final/aluminium.pdf>, accessed 03/07/07.

IEA, 2001: Energy subsidy reform and sustainable development challenges for policymakers. International Energy Agency, Paris.

IEA, 2003: World Energy Investment Outlook. International Energy Agency, Paris.

IEA, 2004: Renewable Energy: Market and Policy Trends in IEA countries. International Energy Agency, Paris.

IEA, 2005: Renewables Information. International Energy Agency, Paris.

IEA, 2006: Energy Statistics of Non-OECD Countries. International Energy Agency, Paris.

Illum, K. and N. Meyer, 2004: Joint implementation: methodology and policy considerations. *Energy Policy*, **32**, pp. 1013-1023.

IPA Energy Consulting (IPA), 2005: Implications of the EU Emissions Trading Scheme for the U.K. power Generation Sector. Report to the Department of Trade and Industry, November 11, 2005.

IPCC, 1996: Climate Change 1995 - Economic and social dimensions of climate change. Contribution of Working Group III to the Second Assessment Report of the Intergovernmental Panel on Climate Change. J.P. Bruce, H. Lee, E.F. Haites [eds]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 448 pp.

IPCC, 2001: Climate Change 2001: Mitigation. Contribution of Working Group III to the third assessment report of the Intergovernmental Panel on Climate Change. B. Metz, O. Davidson, R. Swart, J. Pan [eds.]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 752 pp.

IPCC, 2007a: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B.M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp.

IPCC, 2007b: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Parry, M.L., O.F. Canziani, J.P. Palutikof, P.J. van der Linden, C.E. Hanson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Ivanova, A. and M. Angeles, 2005: Trade and environmental issues in APEC. *Globalization: Opportunities and Challenges for East Asia*, K. Fatemi, (ed), The Haworth Press, Binhampton, N.Y.

Jaccard, M., N. Rivers, C. Bataille, R. Murphy, J. Nyboer, and B. Sadownik, 2006: Burning our money. C.D. Howe Institute, ISSN 0824-8001, **204**, May 2006.

Jacobs, R.W., 2005: Treading deep waters: Substantive law issues in Tuvalu's threat to sue the United States in the international court of justice. *Pacific Rim Law and Policy Journal*, **14**, 103 pp.

Jacoby, H.D., R. Prinn, and R. Schmalensee, 1998: Kyoto's Unfinished Business. Foreign Affairs.

Jacoby, H.D. and A.D. Ellerman, 2004: The safety valve and climate policy. *Energy Policy*, **32**(4), pp. 481-491.

Jaeger, C.C., 2003: Climate Change: Combining mitigation and adaptation. Climate Policy for the 21st Century: Meeting the Long-Term Challenge of Global Warming. D. Michel,Washington, D.C., Center for Transatlantic Relations.

Jaffe, A.B., R.G. Newell, and R.N. Stavins, 2003: Technological change and the environment. In *Handbook of Environmental Economics*. K.-G. Mäler and J. Vincent (eds), Amsterdam, The Netherlands, Elsevier Science, 2003.

Johannsen, K.S., 2002: Combining voluntary agreements and taxes: an evaluation of the Danish agreement scheme on energy efficiency in industry. *Journal of Cleaner Production*, **10**, pp 129-141.

Johnstone, N., 2002: The use of tradable permits in combination with other policy instruments: A scoping paper. ENV/EPOC/WPNEP(2002)28, Working Party on National Environmental Policy, OECD, Paris.

Jordaan, J., 2004: Competition, geographical concentration and FDI-induced externalities: New evidence for Mexican manufacturing industries. Working Paper 32, Technological Institute of Monterrey, Mexico.

Jotzo, F. and A. Michaelowa, 2002: Estimating the CDM market under the Marrakech Accords. C*limate Policy*, **2**, pp. 179-196.

Jotzo, F. and J.C.V. Pezzey, 2005: Optimal intensity targets for emissions trading under uncertainty. Draft. Canberra, AU: Centre for Resource and Environmental Studies - Australian National University.

Justice, D. and C. Philibert, 2005: International energy technology collaboration and climate change mitigation. Synthesis Report, OECD/IEA Annex I Expert Group on the UNFCCC, Paris.

Kågeström, J., K. Astrand, and P. Helby, 2000: Voluntary Agreements-Implementation and Efficiency: Swedish Country Report,

Kameyama, Y., 2003: Dual track approach: an optional climate architecture for beyond 2012? COM/ENV/EPOC/IEA/SLT(2005)6 30. Tsukuba, JP, National Institute for Environmental Studies.

Kameyama, Y., 2004: The future climate regime: a regional comparison of proposals. *International Environmental Agreements: Politics, Law and Economics*, **4**, pp. 307-326.

Kanie, N., 2003: Leadership and domestic policy in multilateral diplomacy: The case of the Netherlands. *International Negotiation*, **8**(2), pp. 339-365.

Kartha, S., M. Lazarus, and M. Bosi, 2002: Practical baseline recommendations for greenhouse gas projects in the electric power sector. OECD, Paris.

Kartha, S., M. Lazarus, and M. Bosi, 2004: Baseline recommendations for greenhouse gas mitigation projects in the electric power sector. *Energy Policy*, **32**, pp.545-566.

Kemfert, C., W. Liseb, and R.S.J. Tol, 2004: Games of Climate Change with international trade. Kluwer Academic Publishers. Printed in the Netherlands, *Environmental and Resource Economics*, **28**, pp. 209-232

Kennedy, P.W., B. Laplante, and J. Maxwell, 1994: Pollution policy: The role for publicly provided information. *Journal of Environmental Economics and Management*, **26**, pp. 31-43.

Keohane, N., R.L. Revesz, and R.N. Stavins, 1998: The choice of regulatory instruments in environmental policy. *Harvard Environmental Law Review*, **22**, pp.313-367.

Khanna, M. and L.A. Damon, 1999: EPA's voluntary 33/50 Program: Impact on toxic releases and economic performance of firms. *Journal of Environmental Economics and Management*, **37**(1), pp. 1-25.

Kim, Y. and K. Baumert, 2002: Reducing uncertainty through dual intensity targets. K. Baumert (ed.), *Building on the Kyoto Protocol, Options for protecting the climate*, World resources Institute, Washington, USA, <http://pubs.wri.org/pubs_pdf.cfm?PubID=3762>, accessed 03/07/07.

King, A. and M. Lenox, 2000: Industry self-regulation without sanctions: The chemical industry's responsible care program. *Academy of Management Journal*, **43**(4),pp. 698-716.
King, M.D., P. Sarria, D.J. Moss, and N.J. Numark, 2004: U.S. business actions to address climate change: case studies of five industry sectors. Sustainable Energy Institute, November, 2004.
Klepper, G. and S. Peterson, 2004: The EU emissions trading scheme - allowance prices, trade flows and competitiveness effects. *European Environment*, **14**, pp.201-218.
Koch, T. and A. Michaelowa, 1999: 'Hot air' reduction through non-quantifiable measures and early JI. *Joint Implementation Quarterly*, **5**(2), pp. 9-10.
Kolk, A. and J. Pinske, 2004: Market strategies for Climate Change. *European Management Journal*, **22**(3), pp.304-314.
Kolk, A. and J. Pinske, 2005: Business responses to Climate Change: Identifying emergent strategies. *California Management Review,* Spring, 2005.
Kolstad, C., 2000: *Environmental Economics*. Oxford University Press, New York.
Kolstad, C.D. 2006: The simple analytics of greenhouse gas emission intensity reduction targets. *Energy Policy*, **33**(17), pp. 2231-2236.
Konar, S. and M.A. Cohen, 1997: Information as regulation: The effect of community right-to-know laws on toxic emissions. *Journal of Environmental Economics and Management*, **32**, pp.109-124.
Korppoo, A., 2005: Russian energy efficiency projects: lessons learnt from activities implemented jointly. Pilot phase. *Energy Policy*, **33**, pp. 113-126.
Kousky, C. and S. Schneider, 2003: Global climate policy: will cities lead the way? **3**(4), December 2003, pp. 359-372.
Krarup, S. and S. Ramesohl, 2002: Voluntary agreements: key to higher energy efficiency in industry? *Voluntary Environmental Agreements: Process, Practice and Future Use*, P. ten Brink (ed.), Sheffield, UK.
Kruger, J., B. McLean, and R. Chen, 2000: A tale of two revolutions: Administration of the SO_2 trading program. *Emissions Trading: Environment al Policy's New Approach*, R. Kosobud (ed.), New York, John Wiley & Sons.
Kruger, J., K. Grover, and J. Schreifels, 2003: Building institutions to address air pollution in developing countries: The Cap-and-trade approach. *Greenhouse Gas Emissions Trading and Project-Based Mechanisms*, Proceedings of OECD Global Forum on Sustainable Development: Emissions Trading, OECD, Paris.
Kruger, J., 2006: From SO_2 to greenhouse gases: Trends and events shaping future emissions trading programs in the United States. In *Acid in the Environment: Lessons Learned and Future Prospects*, G.R. Visgilio and D.M. Whitelaw (ed.), Springer Science+Business Media, Inc. 2006.
Kuik, O., 2003: Climate change policies, energy security and carbon dependency. Trade-offs for the European Union in the Longer Term. *International Environmental Agreements: Politics, Law and Economics*, **3**, pp.221-242.
Kuik, O., and M. Mulder, 2004: Emissions trading and competitiveness: pros and cons of relative and absolute schemes. *Energy Policy*, **32**, pp. 737-745.
La Rovere, E.L., S.K. Ribeiro, and K.A. Baumert, 2002: The Brazilian proposal on relative responsibility for global warming. Options for protecting the climate. K.A. Baumert, O. Blanchard, S. Llosa, and J. F. Perkaus. Washington, World Resource Institute (WRI).
Lecoq, F. and R. Crassous, 2003: International climate regime beyond 2012 - Are quota allocation rules robust to uncertainty? Policy Research Working Paper. Washington D.C.
Lecoq, F. and K. Capoor, 2005: State and trends of the carbon market 2005. World Bank, Washington D.C.
Levy, D.L. and P.J. Newell, 2005. The business of global environmental governance (Global Environmental Accord: Strategies for sustainability and institutional innovation). Cambridge, MIT Press.
Lipanovich, A., 2005: Smoke before oil: Modeling a suit against the auto and oil industry on the tobacco tort litigation is feasible. *Golden Gate University Law Review*, **35**, 429 pp.
Lisowski, M., 2002: The emperor's new clothes: redressing the Kyoto Protocol. *Climate Policy* **2**(2-3).
Lutter, R., 2000: Developing countries' greenhouse emissions: Uncertainty and implications for participation in the kyoto protocol. The Energy Journal, 21(4).
Lyon, T. P. and J.W. Maxwell, 2000: Voluntary approaches to environmental regulation: A survey. Economic Institutions and Environmental Policy, M. Franzini and A. Nicita (eds), Chapter 7, pp. 142-174.
Lyon, T.P. and J.W. Maxwell, 2004: Corporate environmentalism and public policy. Cambridge University Press, Cambridge, UK, 2004.
MacGill, I., H. Outhred, and K. Nolles, 2006: Some design lessons from market-based greenhouse gas regulation in the restructured Australian electricity industry. *Energy Policy*, **34**, pp.11-25.
Maeda, A., 2003: The emergence of market power in emission rights markets: The role of initial permit distribution. *Journal of Regulatory Economics*, **24**(3), pp. 293-314.
Mank, B.C., 2005: Standing and global warming: Is injury to all, injury to none? *Environmental Law*, **35**, pp.1-83.
Manne, A.S. and R.G. Richels, 1999: The Kyoto Protocol: A cost-effective strategy for meeting environmental objectives? *Energy Journal, Kyoto Special Issue*, pp. 1-25.
Marburg, K.L., 2001: Combating the impacts of global warming: A novel legal strategy. *Colorado Journal of International Environmental Law and Policy*, 171 pp.
Margolick, M. and D. Russell, 2001: Corporate greenhouse gas reduction targets. Pew Center on Global Climate Change, Washington, D.C.
Margolis, R.M. and D.M. Kammen, 1999: Evidence of under-investment in energy R&D in the United States and the impact of federal policy. *Energy Policy*, **27**, pp. 575-584.
Markussen, P. and G.T. Svendsen, 2005: Industry lobbying and the political economy of GHG trade in the European Union. *Energy Policy*, **33**, pp. 245-255.
Matthes, F. *et al*., 2005: The environmental effectiveness and economic efficiency of the European Union Emissions Trading Scheme (Öko Institut).
Maurer, C. and R. Bhandari, 2000: The climate of export credit agencies. World Resources Institute, Washington D.C.
Maxwell, J.W., T.P. Lyon, and S.C. Hackett, 2000: Self-regulation and social welfare: The political economy of corporate environmentalism. *Journal of Law and Economics*, **XLIII**, October, pp. 583-618.
McKibbin, W. and P. Wilcoxen, 1997: Salvaging the Kyoto climate negotiations. *Policy Brief, Brookings Institution*, **27**.
McKibbin, W.J. and P.J. Wilcoxen, 2002: Climate change policy after Kyoto: A blueprint for a realistic approach. Washington D.C., Brookings Institution.
McKinstry, R., 2004: Laboratories for local solutions for global problems: State, local, and private leadership in developing strategies to mitigate the causes and effects of climate change. *Penn State Environmental Law Review*, **12**(1), pp. 15-82.
Meira Filho, L.G. and J.D. Gonzales Miguez, 2000: Note on the time-dependant relationship between emissions of greenhouse gases and climate change. Technical note, Ministry of Science and Technology Federal Republic of Brazil, <http://www.mct.gov.br/clima>, accessed 03/07/07.
Menanteau, P., D. Finon, and M-L. Lamy, 2003: Prices versus quantities: choosing policies for promoting the development of renewable energy. *Energy Policy*, **31**(8), pp.799-812.
Meyer, N.I., 2004: Development of Danish wind power market. *Energy &Environment*, **15**(4), pp.657-672.
Michaelowa, A., 2002: The AIJ pilot phase as laboratory for CDM and JI. *International Journal of Global Environmental Issues*, **2**(3-4), pp. 267-280.
Michaelowa, A., 2003a: CDM host country institution building. *Mitigation and Adaptation Strategies for Global Change*, **8**, pp.201-220.
Michaelowa, A., 2003b: Germany - a pioneer on earthen feet? *Climate Policy*, **3**(1), pp. 31-44.
Michaelowa, A., 2004: *International review for Environmental Strategies*, **5**, 217-231.

Michaelowa, A. and F. Jotzo, 2005: Transaction costs, institutional rigidities and the size of the clean development mechanism. *Energy Policy*, **33**, pp. 511-523.

Michaelowa, A., K. Tangen, and H. Hasselknippe, 2005a: Issues and options for the post-2012 climate architecture -- An overview. *International Environmental Agreements*, **5**, pp. 5-24.

Michaelowa, A., S. Butzengeiger, and M. Jung, 2005b: Graduation and deepening: An ambitious post-2012 climate policy scenario. *International Environmental Agreements: Politics, Law and Economics*. **5**, pp. 25-46.

Millennium Ecosystem Assessment, 2005: Ecosystems and human well-being: Synthesis. Island Press, Washington, D.C.

Mitchell, R.B., 2005: Flexibility, compliance and norm development in the climate regime. *Implementing Climate Regime: International Compliance*, O.S. Stokke, J. Hovi, and G. Ulfstein, Earthscan, London, pp. 65-83.

Moe, A., K. Tangen, V. Berdin, and O. Pluzhnikov, 2003: emissions trading and green investments in Russia. *Energy & Environment*, **14**(6), pp. 841-858.

Montero, J-P., J.M. Sanchez, and R. Katz, 2002: A market-based environmental policy experiment in Chile. *Journal of Law and Economics*, **XLV**, pp. 267-287 (April 2002).

Montero, J-P., 2005: Pollution markets with imperfectly observed emissions. *RAND Journal of Economics*, Autumn 2005, **36**(3), pp. 645-660.

Montero. J-P., 2007: Tradeable Permits with incomplete monitoring: Evidence from Santiago's Particulate Permits Program. Ch 6 in *Moving to Markets in Environmental Regulation*, J. Freeman and C.D. Kolstad (eds), New York, Oxford University Press.

Morthorst, P.E., 2001: Interactions of a tradable green certificate market with a tradable permits market. *Energy Policy*, **29**(5), pp. 345-353.

Müller, B., 1999: Justice in global warming negotiations - How to achieve a procedurally fair compromise. Oxford, Osford Institute for Energy Studies.

Müller, B., M. Michealowa, and C. Vrolijk, 2001: Rejecting Kyoto: A study of proposed alternatives to the Kyoto Protocol. Oxford, Climate Strategies International Network for Climate Policy Analysis, Oxford Institute for Energy Analysis.

Müller, B., 2002: Equity in global climate change: the great divide. Oxford, UK, Oxford University Press.

Müller, B. and G. Müller-Fürstenberger, 2003: Price-related sensitivities of greenhouse gas intensity targets. *Mimeo*, Oxford Energy Institute.

Murase, S., 2002a: Implementation of international environmental law: Its international and domestic aspects: Case of the Kyoto Protocol. *Jurisuto*,**1232**, pp.71-78 (in Japanese).

Murase, S., 2002b: Conflict of international regimes: Trade and the environment, Institute of International Public Law and International Relations of Thessaloniki. *Thesaurus Acroasium*, **XXXI**, pp. 297-340.

Murase, S., 2003: Problem on compliance of the Kyoto Protocol and building a new international regime: Possibility of an alternative regime that includes the United States and major developing countries. Keio University, *Mita Gakkai Zasshi*, **96**(2), pp. 5-18 (in Japanese).

Murase, S., 2004: Japan's measures on global warming and the TBT agreement. *Survey and Research on Coordination of Trade and Environment*. GISPRI, 2004 (in Japanese), pp. 81-92.

Murase, S., 2005: Trade and the environment: With particular reference to climate change issues. *Manchester Journal of International Economic Law*, 2(2), pp. 18-38.

Najam, A., S. Huq, and Y. Sokona, 2003: Climate negotiations beyond Kyoto: developing countries concerns and interests. *Climate Policy*, **3**, pp. 221-231.

Nakicenovic, N. and K. Riahi, 2003. Model runs with MESSAGE in the context of the further development of the kyoto-protocol. Technical report, Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen, Berlin.

Nash, J. and J. Ehrenfeld, 1996: Code Green: Business adopts voluntary environmental standards. *Environment*, **38**(1), pp. 16-20, 36-45.

National Commission on Energy Policy (NCEP), 2004: Ending the energy stalemate: A bipartisan strategy to address America's energy challenges. Washington, D.C.

National Research Council (NRC), 2003: Planning climate and global change research: A review of the draft U.S. Climate Change Science Program Strategic Plan. Washington, D.C.

Nelson, K. and B. de Jong, 2003: Making global initiatives local realities: carbon mitigation projects in Chiapas, Mexico. *Global Environmental Change*, **13**, pp.19-30.

Nemet, G.F., 2005: Beyond the learning curve: factors influencing cost reductions in photovoltaics. *Energy Policy*, August 2005.

Nemet, G.F. and D.M. Kammen, 2006: U.S. energy research and development: Declining investment, increasing need, and feasibility of expansion. *Energy Policy*, February 2006.

Nentjes, A., and G. Klaassen, 2004: On the quality of compliance mechanisms in the Kyoto Protocol. *Energy Policy*, **32**, pp. 531-544.

NERA, 2005: Interactions of the EU ETS with Green and White Certificate Schemes: Summary Report for Policy Makers. <http://europa.eu.int/comm/environment/climat/pdf/ec_green_summary_report051117.pdf>, accessed 03/07/07.

Neuhoff, K., K. Keats, and M. Sata, 2006: Allocation and incentives: Impacts of CO_2 emission allowance allocations to the electricity sector. *Climate Policy* (forthcoming).

Newell, P., 2000: Climate for change. Non-state actors and the global politics of the greenhouse. Cambridge University Press, Cambridge, 2000, pp. 222,

Newell, R. and W.A. Pizer, 2003: Regulating stock externalities under uncertainty. *Journal of Environmental Economics and Management*, **45**, pp. 416-432.

Newell, R. and W. Pizer, 2004: Uncertain discount rates in climate policy analysis. *Energy Policy*, **32**, pp. 519-529.

Newell, R. and N. Wilson, 2005: Technology prizes for Climate Change Mitigation, Resources for the future. Discussion paper 05-33, June, 2005, Washington, D.C.

Ninomiya, Y., 2003: Prospects for energy efficiency improvement through an international agreement. *Climate Regime Beyond 2012: Incentives for Global Participation*, National Institute for Environmental Studies and the Institute for Global Environmental Strategies.

Nordhaus, W., 1998: Is the Kyoto Protocol a dead duck? Are there any live ducks around? Comparison of Alternative Global Tradable Emissions Regimes.

Nordhaus, W., 2001: After Kyoto: Alternative mechanisms to control global warming. Paper prepared for a joint session of the American Economic Association and Association of Environmental and Resource Economists.

Nordic Council of Ministers, 2002: The use of economic instruments in Nordic Environmental Policy 1999-2001. TemaNord 2002:581, Nordic Council of Ministers, Copenhagen.

Northrop, M., 2004: Leading by example: Profitable corporate strategies and successful public policies for reducing greenhouse gas emissions. *Widener Law Journal*, **14**(1), pp. 21-80.

Oates, W.E., 2001: A Reconsideration of Environmental Federalism, Resources for the Future. Discussion Paper 01-54, November, 2001.

OECD, 1999: Conference on foreign direct investment & environment, The Hague, 28-29 January 1999, BIAC Discussion Paper.

OECD, 2001: Environmental indicators for Agriculture: methods and Results. Volume **3**, Paris.

OECD, 2002: Agricultural practices that reduce greenhouse gas emissions: Overview and results of survey instruments. Paris.

OECD, 2003(b): Choosing environmental policy instruments in the real world. Global forum on Sustainable Development: Emission Trading, 17-18 March, 2003, Paris.

OECD, 2003(c): Policies to reduce greenhouse gas emissions in industry - successful approaches and lessons learned. Workshop Report, Paris.

OECD, 2003(d): Technology innovation, development and diffusion. OECD and IEA Information Paper, COM/ENV/EPOC/IEA/SLT(2003)4, Paris.

OECD, 2003(e): Voluntary approaches for environmental policy: Effectiveness, efficiency and usage in policy mixes. Paris.

OECD, 2005(a): Main science and technology indicators. 2005/2, Paris.

OECD, 2005(b): An empirical study of environmental R&D: What encourages facilities to be environmentally innovative. Paris.

OECD, 2005(c): The United Kingdom Climate Change Levy - A study in political economy. Paris.

OECD, 2005(d): Mobilising private investment for development: Policy lessons on the role of ODA. *The DAC Journal*, **6**(2) - ISSN: 15633152, Paris.

Osgood, D.E., 2002: Environmental improvement with economic development through public information provision. Cambridge University Press, *Environment and Development Economics*, **7**, pp. 751-768

Ott, H.E., H. Winkler, B. Brouns, S. Kartha, M. Mace, S. Huq, Y. Kameyama, A.P. Sari, J. Pan, Y. Sokona, P.M. Bhandari, A. Kassenberg, E.L. La Rovere, and A. Rahman, 2004: South-North dialogue on equity in the greenhouse. A proposal for an adequate and equitable global climate agreement. GTZ, Eschborn, Germany.

Pacala, S. and R. Socolow, 2004: Stabilization wedges: Solving the climate problem for the next 50 years with current technologies. *Science*, **305**(5686), pp. 968-972.

Palmer, K., W.E. Oates, and P.R. Portney, 1995: Tightening environmental wtandards: The benefit-cost or the no-cost paradigm? *Journal of Economic Perspectives*, **9**(4), pp. 119-132.

Pan, J., 2005: Meeting human development goals with low emissions: An alternative to emissions caps for post-Kyoto from a developing country perspective. *International Environmental Agreements: Politics, Law and Economics*, **5**, pp. 89-104.

Parry, I., 2004: Are emissions permits regressive? *Journal of Environmental Economics and Management*, **47**, pp. 364-387.

Parry, J., A. Hammill, and J. Drexhage, 2005: Climate change and adaptation: A summary. International Institute for Sustainable Development (IISD), Winnipeg, <http://www.iisd.org/pdf/2005/climate_adaptation_sum.pdf>, accessed 03/07/07.

Peck, S.C. and T.J. Teisberg, 2003: An innovative policy approach to solve the global climate issue.

Penalver, E.M., 1998: Acts of God or toxic torts? Applying tort principles to the problem of climate change. *Natural Resources Journal*, **38**, pp. 563-569.

Pershing, J. and F. Tudela, 2003: A long-term target: Framing the climate effort. *Beyond Kyoto: advancing the international effort against climate change*. Pew Climate Center, Washington D.C.

Persson, M. and C. Azar, 2004: Brazil beyond Kyoto - Prospects and problems in handling tropical deforestation in a second commitment period.

Persson, T.A., C. Azar, and K. Lindgren, 2006: Allocation of CO_2 emission permits - economic incentives for emission reductions in developing countries. *Energy Policy*.

Peterson, T.D., 2004: The evolution of state climate change policy in the United States: Lessons learned and new directions. *Widener Law Journal*, **14**(1), pp. 81-120.

Petrtakis, E., E.S. Sartzetakis, and A. Xepapadeas, 2005: Environmental information provision as a public policy instrument. Contributions to *Economic Analysis & Policy*, **4**(1), Article 14. <http://www.bepress.com/bejeap/contributions/vol4/iss1/art14>, accessed 03/07/07.

Pew Center Report, 2004: Learning from State Action on Climate Change. In *Brief*, **8**.

Pew Center Report, 2005: International climate efforts beyond 2012: Report of the climate dialogue at Pocantico. Arlington, VA, USA, Pew Center on Global Climate Change.

Pezzey, J.C.V. and M.A. Toman, 2002: The economics of sustainability: A review of journal articles. Discussion Paper 02-03, Resources for the Future, Washington, D.C.

Pezzey, J.C.V., 2003: Emission taxes and tradable permits: A comparison of views on long run efficiency. *Environmental and Resource Economics*, **26**(2), pp. 329-342.

Philibert, C., 2000: How could emissions trading benefit developing countries. *Energy Policy*, **28**(13), pp. 947-956.

Philibert, C. and J. Pershing, 2001: Considering the options: climate targets for all countries. *Climate Policy*, **1**(2), pp. 211-227.

Philibert, C., 2004: International energy technology collaboration and climate change mitigation. COM/ENV/EPOC/IEA/SLT(2004)1, OECD/IEA, Paris.

Philibert, C., 2005a: Climate mitigation: Integrating approaches for future international co-operation. OECD/IEA Annex I Expert Group, Paris.

Philibert, C., 2005b: New commitment options: Compatibility with emissions trading. No. COM/ENV/EPOC/IEA/SLT(2005)9. Paris, France: Organisation for Economic Co-operation and Development/International Energy Agency, <http://www.oecd.org/dataoecd/62/40/35798709.pdf>, accessed 03/07/07.

Phillips, G., 2004: GHG assessors - A new career option? Greenhouse Gas Market 2004: Ready for Takeoff, International Emissions Trading Association, 2004.

Pinguelli, R., S. Luiz, and S. Kahn Ribeiro, 2001: The present, past, and future contributions to global warming of CO_2 emissions from fuels. *Climatic Change*, **48**, pp. 289-308.

Pinguelli, R., S. Luiz, K. Ribeiro, M.S. Muylaert, and C. Pires de Campos, 2004: Comments on the Brazilian Proposal and contributions to global temperature increase with different climate responses - CO_2 emissions due to fossil fuels, CO_2 emissions due to land use change. *Energy Policy*, **32**(13), pp. 1499-1510.

Pizer, W., 1999: Choosing price or quantity controls for greenhouse gases. Climate Issues Brief, *Resources for the Future*, **17**.

Pizer, W.A., 2002: Combining price and quantity controls to mitigate global climate change. Journal of Public Economics, 85(3), pp. 409-434.

Pizer, W.A. and K. Tamura, 2004: Climate Policy in the U.S. and Japan: A Workshop Summary, Resources for the Future Discussion Paper. 04-22, March, 2004.

Pizer, W.A., 2005a: Climate policy design under uncertainty. Discussion Paper 05-44, Resources for the Future.

Pizer, W.A., 2005b: The case for intensity targets. *Climate Policy*, **5**(4), pp. 455-462.

Pizer, W., D. Burtraw, W. Harrington, R. Newell, and J. Sanchirico, 2006: Modeling Economy-wide vs. Sectoral Climate Policies. *The Energy Journal*, **27**(3).

Popp, D., 2002: They don't invent them like they used to: an examination of energy patent citation over time. National Bureau of Economic Research, Working Paper No. 11415, Cambridge, Massachusetts.

Popp, D., 2004: R&D subsidies and climate policy: Is there a free lunch? National Bureau of Economic Research, Working Paper No. 10880, Cambridge, Massachusetts.

Porter, M.E. and C. van der Linde, 1995: Toward a new conception of the environment-competitiveness relationship. *The Journal of Economic Perspectives*, **9**(4), pp. 97-118.

Price, L., 2005: Voluntary agreements for energy efficiency or GHG emission reduction in industry: An assessment of programs around the world. Lawrence Berkeley National Laboratory, LBNL-58138, April 2005.

Quirion, P., 2005: Does uncertainty justify intensity emission caps? *Resource & Energy Economics*, **27**(4), November 2005, pp. 343-353.

Rabe, B.G., 2004: Statehouse and greenhouse, the emerging politics of American climate change policy. Washington, Brookings Institution Press, 2004.

Reedman, L., P. Graham, and P. Coombes, 2006: Using a real-options approach to model technology adoption under carbon price uncertainty: An application to the Australian electricity sector. *The Economic Record*, **82**, Special Issue, pp. 864-873.

Regional Greenhouse Gas Initiative (RGGI), 2005: Regional greenhouse gas initiative, Memorandum of Understanding. December, 2005, accessed at <http://www.rggi.org/agreement.htm>, accessed 03/07/07.

Reinhardt, F., 1998: Environmental product differentiation: Implications for corporate strategy. *California Management Review*, **40**(1), pp. 43-73.

Reinhardt, F., 1999: Market failure and the environmental policies of firms, economic rationales for 'beyond compliance' behavior. *Journal of Industrial Ecology*, **3**(1), pp. 9-21.

Reinhardt, F., 2000: What every executive needs to know about global warming. *Harvard Business Review*, July/August, 2000.

Reinhardt, F. and K.O. Packard, 2001: A business manager's approach to climate change. *Climate Change: Science, Strategies, and Solutions*, E. Claussen (ed.), Leiden, Boston, Koln, Brill, 2001.

Reinstein, R., 2004: A possible way forward on climate change. *Mitigation and Adaptation Strategies for Global Change*, **9**, 2004, pp. 295-309.

Revesz, R.L. and R.N. Stavins, 2006: Environmental Law and Policy. Handbook of Law and Economics, A.M. Polinsky and S. Shavell (eds). Amsterdam: Elsevier Science.

Richards, M., 2003: Poverty reduction, equity and climate change: Global governance synergies or contradictions? Overseas Development Institute, Globalisation and Poverty Programme.

Rietbergen, M. and K. Blok, 2000: Voluntary agreements- implementation and efficiency. <http://www.akf.dk/VAIE/>, accessed 03/07/07.

Rietbergen, M.G., J.C.M. Farla, and K. Blok, 2002: Do agreements enhance energy efficiency improvement? Analysing the actual outcome of long-term agreements on industrial energy efficiency improvement. *The Netherlands Journal of Cleaner Production*, **10**, pp. 153-163.

Ringius, L., A. Torvanger, and B. Holtsmark, 1998: Can multi-criteria rules fairly distribute climate burdens? - OECD results from three burden sharing rules. *Energy Policy*, **26**(10), pp. 777-793.

Ringius, L., A. Torvanger, and A. Underdal, 2002: Burden sharing and fairness principles in international climate policy. I*nternational Environmental Agreements: Politics, Law and Economics*, **2**, pp. 1-22.

Rive, N., A. Torvanger and J.S. Fuglestvedt, 2006: Climate agreements based on responsibility for global warming: periodic updating, policy choices, and regional costs. *Global Environmental Change*.

Rivera, J., 2002: Assessing a voluntary environmental initiative in the developing world: The Costa Rican certification for sustainable tourism. *Policy Sciences*, **35**, pp. 333-360.

Rivera, J. and P. deLeon, 2004: Is greener whiter? The Sustainable Slopes Program and the voluntary environmental performance of western ski areas. *Policy Studies Journal*, **32**(3), pp. 417-437.

Rose, A., B. Stevens, J. Edmonds, and M. Wise, 1998: International equity and differentiation in global warming policy. *Environmental & Resource Economics*, **12**(1), pp. 25-51.

Rosen, J., W. Fichtner, and O. Rentz, 2004: Baseline standardization with optimising energy system models. *Mitigation and Adaptation Strategies for Global Change*, **9**, pp.121-146.

Russell, C. and W. Vaughan, 2003: The choice of pollution control policy instruments in developing countries: Arguments, evidence and suggestions. H. Folmer and T. Tietenberg (eds), The International Yearbook of Environmental and Resource Economics 2003/2004, Cheltenham, UK, Edward Elgar.

Sagar, A., 2000: Capacity building for the environment: A view for the South, A view for the North. *Annual Review of Energy and the Environment,* **25**, pp. 377-439.

Sagar, A.D. and B.C.C. van der Zwaan, 2006: Technological innovation in the energy sector: R&D deployment, and learning-by-doing. *Energy Policy*, November 2006.

Saito, K., 2001: Observation on voluntary initiatives as environmental policy. Keizai Kenkyuu Nenpo (Yearbook of Economic Studies), Tokyo University, **26**, pp. 91-108.

Sakakibara, M., 2001: Cooperative research and development: who participates and in which industries do projects take place? *Research Policy*, **30**, pp. 993-1018.

Samaniego, J. and C. Figueres, 2002: Evolving to a sector-based Clean Development Mechanism. Options for protecting the climate. K.A. Baumert, O. Blanchard, S. Llosa, and J.F. Perkaus. Washington, WRI.

San Martin, R., 2003: Marketable emissions permits with imperfect monitoring. *Energy Policy*, **31**, pp. 1369-1378.

Sathaye, J., S. Murtishaw, L. Price, M. Lefranc, J. Roy, H. Winkler, and R. Spalding-Fecher, 2004: Multiproject baselines for evaluation of electric power projects. *Energy Policy*, **32**, pp. 1303-1317.

Sathaye, J., E. Holt, and S. De La Rue du Can, 2005: Overview of IPR practices for publicly-funded technologies. Lawrence Berkeley Laboratory Report # 59072, Berkeley.

Sauer, A., P. Mettler, F. Wellington, and G.G. Hartmann, 2005: Transparency issues with ACEA agreement: Are investors driving blindly? World Resources Institute, Washington, D.C.

Schelling, T.C., 1997: The cost of combating global warming, facing the tradeoffs. Foreign Affairs, November/December.

Schelling, T.C., 2002: What makes greenhouse sense? Foreign Affairs, May/June COM/ENV/EPOC/IEA/SLT(2005)6 32.

Schipper, L., 2006: Conceptual history of adaptation in the UNFCCC Process. Review of European Community & International Environmental Law, **15**(1), pp. 82 - April 2006.

Schleich, J. and R. Betz, 2005: Incentives for energy efficiency and innovation in the European Emission Trading System. Proceedings of the 2005 ECEEE Summer Study - What works and who delivers? Mandelieu, France, pp.1495.

Schmidt, J., N. Helme, J. Lee, M. Houdashelt, and N. Höhne, 2006: Sector-based approach to the post-2012 climate change policy architecture. *Climate Policy*.

Sebenius, J.K., 1993: The Law of the Sea Conference: Lessons for negotiations to control global warming. G. Sjostedt (ed.), International Environment Negotiations, IIASA, pp. 189-216.

Shrestha, R. and G. Timilsina, 2002: The additionality criterion for identifying clean development mechanism projects under the Kyoto Protocol. *Energy Policy*, **30**, pp.73-79.

Sijm, J., J.C. Jansen, and A. Torvanger, 2001: Differentiation of mitigation commitments: the multi-sector convergence approach. *Climate Policy*, **1**(4), pp. 481-497.

Sijm, J., 2004: Induced technological change and spillovers in climate policy modeling. Energy Research Centre, The Netherlands, ECN-C-04-073.

Sijm, J., 2005: The interaction between the EU emissions trading scheme and national energy policies. *Climate Policy*, **5**(1), pp. 79-96.

Sijm, J., K. Neuhoff, and Y. Chen, 2006: CO_2 cost pass through and windfall profits in the power sector. *Climate Policy*, **6**(1), pp. 49-72.

Smith, J. and S.J. Scherr, 2002: Forest carbon and local livelihoods: assessment of opportunities and policy recommendations. CIFOR Occasional Paper No. 37. CIFOR (Center for International Forestry Research), Bogor, Indonesia.

Sohn, J., S. Nakhouda, and K. Baumert, 2005: Mainstreaming climate change at the multilateral development banks. World Resources Institute, Washington, D.C.

Sorrell, S. and J. Sijm, 2003: Carbon trading in the policy mix. *Oxford Review of Economic Policy*, **19**(3), pp. 420-437.

Spalding-Fecher, R., S. Thorne, and N. Wamukonya, 2002: Residential solar water heating as a potential Clean Development Mechanism project: A South African case study. *Mitigation and Adaptation Strategies for Global Change*, **7**, pp. 135-153.

Springer, U. and M. Varilek, 2004: Estimating the price of tradable permits for greenhouse gas emissions in 2008-12. *Energy Policy*, **32**, pp. 611-621.

Stavins, R.N., 2001: Economic analysis of global climate change policy: A primer. *Climate Change: Science, Strategies, and Solutions*. E. Claussen, V.A. Cochran, and D.P. Davis. Boston. Brill 18 Discussion paper 2003-2: draft ver. 1 August 2003 Publishing.

Stavins, 2003: Experience with market-based environmental policy instruments. *Handbook of Environmental Economics*, I, K.-G. Mäler and J. Vincent (eds), Chapter 9, pp. 355-435. Amsterdam: Elsevier Science.

Sterk, W. and B. Wittneben, 2005: Addressing opportunities and challenges of a sectoral approach to the clean development mechanism. JIKO Policy Paper 1/2005, August 2005, Wuppertal Institute, Wuppertal. Available at <http://www.wupperinst.org/jiko>, accessed 03/07/07.

Sterner, T., 2003: Policy instruments for environmental and natural resource management. Washington, D.C., Resources for the Future Press.

Stewart, R.B. and J.B. Wiener, 2001: Reconstructing climate policy: The paths ahead. *Policy Matters*, AEI-Brookings Joint Center for Regulatory Studies, Washington, DC August: 01-23.

Stewart, R. and J. Wiener, 2003: Practical climate change policy. *Issues on Line in Science and Technology*. National Academy of Science, Washington, D.C.

Storey, M., 2002: Kyoto and beyond, issues and options in the global response to climate change. Stockholm, Sweden: Swedish Environmental Protection Agency. <http://www.internat.naturvardsverket.se/documents/issues/climate/report/Kyoto.pdf>, accessed 03/07/07.

Stranland, J., C. Chavez, and B. Field, 2002: Enforcing emissions trading programs: Theory, practice, and performance. *Policy Studies Journal*, **303**(3), pp. 343-361.

Sugiyama, T., J. Sinton, O. Kimura, and T. Ueno, 2003: Orchestra of Treaties. CRIEPI, Tokyo, Japan.

Sugiyama, T. and J. Sinton, 2005: Orchestra of treaties: A future climate regime scenario with multiple treaties among like-minded countries. *International Environmental Agreements: Politics, Law and Economics*, **5**, pp. 65-88.

Sussman, F. and N. Helme, 2004: Harnessing financial flows from export credit agencies for climate protection. Washington D.C., USA, Center for Clean Air Policy.

Sussman, F., N. Helme, and C. Kelly, 2004: *Establishing Greenhouse Gas Emission Caps for Multinational Corporations*. Washington D.C., USA, Center for Clean Air Policy.

Swift, B., 2001: How environmental laws work: An analysis of the utility sector's response to regulation of nitrogen oxides and sulfur dioxide under the clean air act. *Tulane Environmental Law Journal*, **14**, 309 pp.

Tangen, K. and H. Hasselknippe, 2005: Converging markets. *International Environmental Agreements: Politics, Law and Economics*. **5**, pp. 47-64.

Tanikawa, H., 2004: Incentive structure of the voluntary environmental responses of the japanese industrial enterprises. RIETI Discussion Paper 04-J-30, pp. 1-55, 2004, Summary, *RIETI Journal*, pp.1-4.

Thackeray, R.W., 2004: Struggling for air: The Kyoto Protocol, citizen's suits under the Clean Air Act, and the United States Options for Addressing Global Climate Change. Indiana International and Comparative Law Review, 14, 855 pp.

Thalmann, P. and A. Baranzini 2005: An overview of the economics of voluntary approaches in climate policies. Edward Elgar, United Kingdom.

Tietenberg, T., 2000: Environmental and natural resource economics, 4th ed. New York: Harper-Collins.

Tietenberg, T., 2003: The tradable permits approach to protecting the commons: Lessons for Climate Change. Oxford Review of Economic Policy, 19(3), pp. 400-419.

Tietenberg, T., 2006: Emissions trading: Principles and practice, Second Edition. Washington: RFF Press.

Tol, R.S.J., W. Lise, and B.C.C. Van der Zwaan, 2000: Technology diffusion and the stability of climate coalitions. February 2000.

Torvanger, A. and T. Skodvi, 2002: Environmental agreements in climate politics. *Voluntary Environmental Agreements- Process, Practice and Future Use*, P. Brink, Greenleaf Publishing, Sheffield, UK.

Torvanger, A. and G. Odd, 2004: An evaluation of pre-kyoto differentiation proposals for national greenhouse gas abatement targets. *International Environmental Agreements: Politics, Law and Economics*, **4**, pp. 65-91.

Torvanger, A., G. Bang, H.H. Kolshus, and J. Vevatne, 2005: Broadening the climate regime: Design and feasibility of multi-stage climate agreements. Oslo, Norway, Center for International Climate and Environmental Research.

Trudinger, C.M. and I.G. Enting, 2005: Comparison of formalisms for attributing responsibility for climate change: Non-linearities in the Brazilian Proposal. *Climatic Change*, **68**(1-2), pp. 67-99.

U.S. Environmental Protection Agency (US EPA), 2004: International experiences with economic incentives for protecting the environment. National Center for Environmental Economics, EPA-236-R-04-001.

U.S. Government Accountability Office, 2006: Climate Change: EPA and DOE should do more to encourage progress under two voluntary programs. GAO 06 97, April 2006, Washington, D.C. <http://www.gao.gov/new.items/d0697.pdf>, accessed 03/07/07.

U.S. National Science Foundation, 2003: National patterns of research development resources: 2003. <http://www.nsf.gov/statistics/nsf05308/sectd.htm>, accessed 03/07/07.

UNFCCC, 1997: Implementation of the Berlin Mandate, Additional proposal by Parties. Document FCCC/AGBM/1997/MISC.1/Add.3, <http://www.unfccc.int>, accessed 03/07/07.

UNFCCC, 1997b: Paper no.1: Brazil, proposed elements of a protocol to the United Nations Framework Convention on Climate Change, Bonn.

UNFCCC, 2001: Report of the Conference of the Parties on its seventh session, Addendum, Part 2: Action taken by the Conference of the Parties. Vol II, FCCC/CP/2001/13/Add.2, Bonn.

UNFCCC, 2003a: Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories. Appendix B1 of the simplified modalities and procedures for small-scale CDM project activities, Annex 6, Report of the 7th meeting of the Executive Board, Bonn.

UNFCCC, 2003b: Clarifications on issues relating to baselines and monitoring methodologies. Annex 1, Report of the 8th meeting of the Executive Board, Bonn.

UNFCCC, 2003c: Procedures for submission and consideration of a proposed new methodology. Annex 2, Report of the 8th meeting of the Executive Board, Bonn.

UNFCCC, 2006a: Synthesis report on regional workshops on Article 6 of the Convention. FCCC/2006/SBI/17, Bonn.

Van der Gaast, W., 2002: The scope for joint implementation in the EU candidate countries. *International Environmental Agreements: Politics, Law and Economics*. **2**, pp. 277-292.

Van Vliet, O., A. Faaj, and C. Dieperink, 2003: Forestry projects under the Clean Development Mechanism? *Climatic Change*, **61**, pp. 123-156.

Van Vuuren, D.P., M.G.J. den Elzen, M.M. Berk, P. Lucas, B. Eickhout, H. Eerens, and R. Oostenrijk, 2003: Regional costs and benefits of alternative post-Kyoto climate regimes. Netherlands Environmental Assessment Agency (MNP), Bilthoven, the Netherlands. RIVM-report 728001025, <www.mnp.nl/en>, accessed 02/07/07.

Verhagen, A., G.J. Nabuurs, and J. Veraart, 2004: The role of land use in sustainable development: Options and constraints under climate change. M.T.J. Kok and H.C. de Coninck (ed.) *Beyond Climate: Options for Broadening Climate Policy*, RIVM Report 500036 001, Bilthoven, pp. 53-75.

Verheyen, R., 2003: Climate Change Damage in International Law, Universität Hamburg, Fachbereich Rechtswissenschaften, Dissertation.

Victor, D.G., 1998: The operation and effectiveness of the Montreal Protocol's non-compliance procedure. *The Implementation and effectiveness of International Environmental Commitments: Theory and Practice*. D.G. Victor, K. Raustiala, and E.B. Skolnikoff (eds), Cambridge, MA, MIT Press, Ch.4, pp. 137-176.

Victor, D.G., 2001a: The collapse of the Kyoto Protocol and the struggle to slow global warming. Princeton, University Press.

Victor, D., 2001b: International agreements and the struggle to tame carbon. *Global Climate Change*, pp. 204-229.

Viguier, L., 2004: A proposal to increase developing country participation in international climate policy. *Environmental Science & Policy*, **7**, pp. 195-204.

Vogel, D., Toffel, M., and D. Post, 2005: Environmental federalism in the European Union and the United States. A handbook of globalization and environmental policy: National Government Interventions in a Global Arena. F. Wiken, K. Zoeteman, and J. Pieters (eds), E. Elgar, United Kingdom.

Vöhringer, F. 2004: Forest conservation and the Clean Development Mechanism: Lessons from the Costa Rican protected areas project. *Mitigation and Adaptation Strategies for Global Change*, **9**, pp. 217-240.

Wang, J., J. Yang, C. Ge, D. Cao, and J. Schreifels, 2004: Controlling sulfur dioxide in China: Will emission trading work? *Environment*, June. Washington, D.C., RFF Press.

Watanabe, C., 1999: Systems options for sustainable development-effect and limit of the Ministry of International Trade and Industry's efforts to substitute technology for energy. *Research Policy*, **28**, pp. 719-749.

Wätzold, F., 2004: SO_2 emissions in Germany, Regulations to fight Waldsterben. *Choosing Environmental Policy*, W. Harrington, R.D. Morgenstern, and T. Sterner, eds, Washington, D.C. Resources for the Future Press.

WBGU, 2003: Climate Protection Strategies for the 21st Century. Kyoto and Beyond. German Advisory Council on Global Change, Berlin.

Weisslitz, M., 2002: Rethinking the equitable principle of common but differentiates responsibility: differential versus absolute norms of compliance and contribution in the global climate change context. *Colorado Journal of International Environmental Law and Policy*, **13**, pp. 473.

Welch, E.W., A. Mazur, and S. Bretschneider, 2000: Voluntary behavior by electric utilities: Levels of adoption and contribution of the climate challenge program to the reduction of carbon dioxide. *Journal of Public Policy Analysis and Management*, **19**(3), pp. 407-426.

Werksman, J., 2001: Greenhouse gas emissions trading and the WTO: 153. In *Inter-linkages. The Kyoto Protocol and the International Trade and Investment Regime*. W. Bradnee, Chambers (ed.), United Nations University Press.

Werksman, J., 2005: The negotiations of the Kyoto Compliance System: Towards hard enforcement. In *Implementing Climate Regime: International Compliance*, O.S. Stokke, J. Hovi, and G. Ulfstein, *Earthscan*, London, pp. 17-37.

Wettestad, J., 1996: Acid Lessons? Assessing and explaining LRTAP implementation and effectiveness IIASA. Working Paper, March 1996.

Wettestad, J., 2005: Enhancing climate compliance - What are the lessons to learn from environmental regimes and the EU? In *Implementing Climate Regime: International Compliance*, O.S. Stokke, J. Hovi and G. Ulfstein, *Earthscan*, London, pp. 209-231.

Wicke, L., 2005: Beyond Kyoto - A new global climate certificate system. Heidelberg, Germany, Springer Verlag.

Wiener, J.B., 1999: Global environmental regulation: Instrument choice in legal context. In *The Yale Law Journal*, **108**(4), pp. 677-800.

Willems, S. and K. Baumert, 2003: Institutional capacity and climate change, OECD document COM/ENV/EPOC/IEA/SLT(2003)5, Paris.

Winkler, H., R. Spalding-Fecher, and L. Tyani, 2002a: Comparing developing countries under potential carbon allocation schemes. *Climate Policy*, **2**, pp. 303-318.

Winkler, H., R. Spalding-Fecher, S. Mwakasonda, and O. Davidson, 2002b: Sustainable development policies and measures: Starting from development to tackle climate change. Options for protecting the climate. K.A. Baumert, O. Blanchard, S. Llosa, and J.F. Perkaus. Washington DC, WRI: 61-87.

Working Group on Baseline for CDM/JI Project, 2001: *Technical Procedures for CDM/JI Projects at the Planning Stage, Interim Report to Ministry of the Environment, Government of Japan*, Tokyo, Ministry of the Environment, pp. 70.

World Bank, 2003: Survey of contingent financing and risk mitigation instruments for clean infrastructure projects. Nov 3003, Washington, D.C. <http://carbonfinance.org/Router.cfm?Page=DocLib&ht=23&dl=1>, accessed 02/07/07.

World Bank, 2004a: Striking a better balance - the Final Report of the Extractive Industries Review. The World Bank Group on Extractive Industries Group, Washington D.C.

World Bank, 2006: An investment framework for clean energy and development: A progress report. World Bank Group Development Committee, September 5, 2006 (DC2006-0012).

World Bank and International Emission Trading Association, 2006: State and trends of the Carbon Market 2006. Washington, D.C.

World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD), 2004: The Greenhouse Gas Protocol, a corporate accounting and reporting standard. Revised Edition, ISBN 1-56973-568-9.

Yamaguchi, M., 2003: Environmental effectiveness of voluntary agreement to cope with climate change: An evaluation methodology, *Mita Journal of Economics*, **96**(2), pp. 19-47.

Yamaguchi, M., 2004: Implementing the Kyoto Protocol commitment and their impacts on trade: Focusing on Japanese automobile fuel efficiency standards. *Keio Economic Studies*, **41**(1).

Yamaguchi, M. and T. Sekine, 2006: A proposal for the Post-Kyoto framework. *Keio Economic Studies*, **43**, pp. 85-112.

Yamin, F. and J. Depledge, 2004: The International Climate Change Regime: A guide to rules, institutions and procedures. Cambridge University Press.

Yohe, G., N. Andronova and M. Schlesinger, 2004: To hedge or not against an uncertain climate future? *Science*, **306**, pp. 416-417.

Zarsky, L. and K. Gallagher, 2003: Searching for the Holy Grail? Making FDI Work for Sustainable Development. Analytical Paper, World Wildlife Fund (WWF), Switzerland.

Zetterberg, L., K. Nilsson, M. Ahman, A.S. Kumlin, and L. Birgirsdotter, 2004: Analysis of national allocation plans of the EU ETS. Research Report, IVL, B-1591.

Zhang, C., T. Heller, M. May, 2001: Impact on global warming of development and structural changes in the electricity sector of Guangdong Province, China. In *Energy Policy*, **29**, pp. 179-203.

Stabilizing climate requires near-zero emissions

H. Damon Matthews[1] and Ken Caldeira[2]

Received 17 October 2007; revised 11 December 2007; accepted 11 January 2008; published 27 February 2008.

[1] Current international climate mitigation efforts aim to stabilize levels of greenhouse gases in the atmosphere. However, human-induced climate warming will continue for many centuries, even after atmospheric CO_2 levels are stabilized. In this paper, we assess the CO_2 emissions requirements for global temperature stabilization within the next several centuries, using an Earth system model of intermediate complexity. We show first that a single pulse of carbon released into the atmosphere increases globally averaged surface temperature by an amount that remains approximately constant for several centuries, even in the absence of additional emissions. We then show that to hold climate constant at a given global temperature requires near-zero future carbon emissions. Our results suggest that future anthropogenic emissions would need to be eliminated in order to stabilize global-mean temperatures. As a consequence, any future anthropogenic emissions will commit the climate system to warming that is essentially irreversible on centennial timescales. **Citation:** Matthews, H. D., and K. Caldeira (2008), Stabilizing climate requires near-zero emissions, *Geophys. Res. Lett.*, *35*, L04705, doi:10.1029/2007GL032388.

1. Introduction

[2] Avoiding dangerous anthropogenic interference in the climate system has been a key international policy goal since the publication of the United Nations Framework Convention on Climate Change in 1992 [*United Nations*, 1992]. Since that time, scientific and policy literature concerning climate change mitigation has been centered around stabilizing concentrations of greenhouse gases in the atmosphere [*Wigley*, 2005; *Stern*, 2006; *Meehl et al.*, 2005]. However, stable greenhouse gas concentrations do not equate to a stable global climate. Model simulations have demonstrated that global temperatures continue to increase for many centuries beyond the point of CO_2 stabilization [e.g., *Matthews*, 2006]. As such, we are committed to future warming, even with stable greenhouse gas concentrations [*Hansen et al.*, 1985; *Wigley*, 2005; *Meehl et al.*, 2005]. This implies that stabilizing global climate within the next several centuries would require decreasing, rather than stabilized, greenhouse gas levels. In this paper, we demonstrate that to achieve atmospheric carbon dioxide levels that lead to climate stabilization, the net addition of CO_2 to the atmosphere from human activities must be decreased to nearly zero.

[3] Recent research has highlighted the very long lifetime of anthropogenic carbon in the atmosphere; while approximately half of the carbon emitted is removed by the natural carbon cycle within a century, a substantial fraction of anthropogenic CO_2 will persist in the atmosphere for several millennia [*Archer*, 2005]. A recent analysis by *Montenegro et al.* [2007] found that 25% of emitted CO_2 will have an atmospheric lifetime of more than 5000 years. Studies of the climate response to declining CO_2 concentrations have generally assumed that global temperatures will decrease in response to decreases in atmospheric CO_2 [*Friedlingstein and Solomon*, 2005]. However, as we demonstrate here, because of the high heat capacity of the ocean, global temperatures may not parallel decreases in atmospheric concentrations of greenhouse gases, but rather will increase and remain elevated for at least several centuries. Thus, fossil fuel CO_2 emissions may produce climate change that is effectively irreversible on human timescales.

[4] In this paper, we present a series of idealized climate simulations to assess the centennial-scale climate response to anthropogenic CO_2 emissions, and conversely, to quantify the emissions requirements for climate stabilization. We have used the University of Victoria Earth System Climate Model (UVic ESCM), an intermediate complexity global climate model which includes an interactive global carbon cycle. We present first a series of 500-year simulations forced by CO_2 emissions, in which a specified amount of carbon was added to the atmosphere either instantaneously, or following a business-as-usual emissions scenario. The model was then run for up to 500 years without additional carbon emissions to determine the persistence of climate warming resulting from past emissions. Second, we specified hypothetical future temperature trajectories for the UVic ESCM, and controlled emissions such that the specified future temperature changes were achieved. We used this method to estimate the CO_2 emissions requirements for climate stabilization at levels between 1 and 4 degrees above pre-industrial temperatures.

2. Methods

[5] We used version 2.8 of the UVic ESCM, an intermediate complexity coupled climate-carbon model with spatial resolution of 1.8 degrees latitude by 3.6 degrees longitude. The ocean is a 19-layer general circulation model, driven by specified wind stress at the surface and coupled to a dynamic-thermodynamic sea-ice model. The atmosphere is a vertically-integrated single layer model; both temperature and moisture are transported horizontally by a combination of diffusion and advection by specified wind fields [*Weaver et al.*, 2001]. Terrestrial vegetation distributions are calculated dynamically as a function of simulated regional climatic conditions, with the result that vegetation is able to both respond to and affect simulated climate changes

[1]Department of Geography, Planning and Environment, Concordia University, Montreal, Quebec, Canada.
[2]Department of Global Ecology, Carnegie Institution of Washington, Stanford, California, USA.

0094-8276/08/2007GL032388$05.00

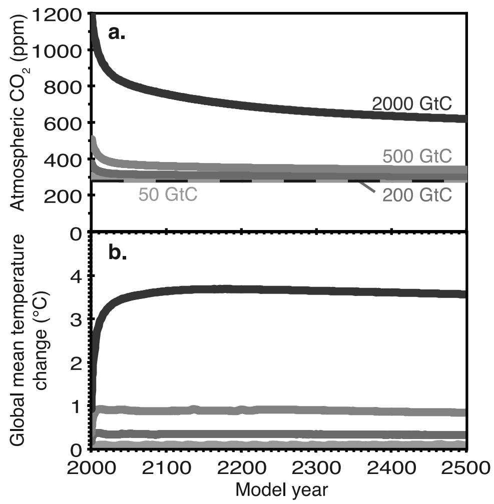


Figure 1. Climate response to an instantaneous carbon emission pulse at year zero. (a) Simulated atmospheric CO_2. (b) Simulated change in global mean surface air temperature, relative to pre-industrial.

[*Meissner et al.*, 2003]. Additionally, the UVic ESCM includes an interactive global carbon cycle [*Schmittner et al.*, 2008] which allows for the direct simulation of coupled carbon cycle and climate responses to anthropogenic carbon emissions. The version of the UVic ESCM used here does not include a sedimentary carbon model; as such we have restricted our simulations to a 500-year timescale over which time the effect of carbonate compensation on ocean carbon uptake is negligible.

[6] In forward mode, specified carbon emissions elicit climate and carbon cycle model responses. We ran the model in this mode for a series of idealized pulse-response simulations, in which emissions of 50, 200, 500 and 2000 billion tonnes (giga-tonnes of carbon: GtC) were added instantaneously to the atmosphere under pre-industrial conditions; we then ran the model with prognostic CO_2 and carbon sinks for 500 years with no additional carbon emission. In a second series of zero-emissions commitment scenarios, the model was spun-up transiently using historical CO_2 concentrations from 1800 to 2000. We then specified future business-as-usual emissions and calculated cumulative emissions relative to the year 2005. We set emissions to zero at cumulative emission levels of 0, 50, 200, 500 and 2000 GtC after 2005, and ran the model until the year 2500 with no further CO_2 emissions. In addition, we performed four simulations in which emissions were reduced linearly to zero from 2005 levels, such that total carbon emissions after 2005 were equal to 50, 200, 500 and 2000 GtC, respectively.

[7] In inverse mode, we are able to specify a desired global temperature trajectory and calculate anthropogenic carbon emissions which are consistent with this specified temperature profile. Emissions (E) were calculated at each model timestep as $E = K\,(T' - T_m)$, where T' is the desired target temperature and T_m is a running one-year global average of modelled surface air temperature. K is a constant which represents the approximate temperature response per unit of CO_2 emission, divided by the timescale of temperature response to CO_2 forcing. Emissions diagnosed in this way represent the total anthropogenic addition of carbon to the atmosphere, including both fossil fuel and net land-use change emissions.

[8] Historical temperatures were specified as an exponential curvefit to observed temperature data from 1880 to 2005. From 2005 to 2500, we constructed nine temperature profiles whereby global temperatures increased at constant rates of 0.1, 0.2 and 0.4°C/decade to stabilization levels of 1, 2 and 4 degrees above pre-industrial temperature. The transition from a fixed rate of temperature increase to temperature stabilization was smoothed using a 30-year running average.

3. Results and Discussion

[9] Figure 1 shows the climate response to an instantaneous pulse emission of carbon dioxide of between 50 and 2000 GtC. After 500 years, between 20 and 35% of the initial emission pulse remained in the atmosphere (with higher airborne fractions associated with larger emission pulses); the remaining carbon was split approximately 60/40 between ocean and land carbon sinks. The emissions pulse was followed immediately by climate warming, which then persisted for the remainder of the simulation. Averaged over the last 450 years of the simulation, temperatures increased by 0.09, 0.34, 0.88 and 3.6°C for emissions pulses of 50, 200, 500 and 2000 GtC, respectively. Historical emissions from fossil fuels and land-use change total approximately 450 GtC, which would represent about 0.8 degrees warming in the context of these pulse-response simulations. These numbers correspond roughly to a 0.175°C temperature increase for every 100 GtC emitted. This version of the UVic ESCM has an equilibrium climate sensitivity of 3.5°C for a doubling of atmospheric CO_2; as such, every 100 GtC emitted resulted in a step-wise warming of about 5% of the model's climate sensitivity.

[10] The amount of climate warming per unit of carbon emitted did not depend strongly on the timing nor duration of emissions. Figure 2 (thick lines) shows the result of a series of transient zero-emissions commitment simulations in which CO_2 emissions were set to zero when cumulative carbon emissions after 2005 reached 0, 50, 200, 500 and 2000 GtC (Figure 2a). After emissions were set to zero, simulated atmospheric CO_2 decreased as a function of time as natural carbon sinks continued to take up carbon (Figure 2b). Ocean temperatures increased throughout the simulation showing continued heat uptake, though the rate of heat uptake slowed as a function of time (Figure 2c). This slowing of ocean heat uptake balanced the decreasing radiative forcing from atmospheric CO_2; as a result, surface temperatures remained approximately constant (Figure 2d).

[11] Figure 2 also shows four additional simulations (thin lines) in which emissions were reduced to zero gradually such that total cumulative emissions after 2005 were equivalent to the thick-line zero-emissions commitment simulations. In these thin-line simulations, atmospheric CO_2 and global temperatures increased more gradually in response to gradually declining emissions; however, the final stabilization temperature was unchanged. Furthermore, the amount of additional warming that resulted per unit of carbon emitted in both sets of simulations was equivalent to the pulse-response cases shown above (approximately 5% of climate sensitivity per 100 GtC emitted), despite both higher

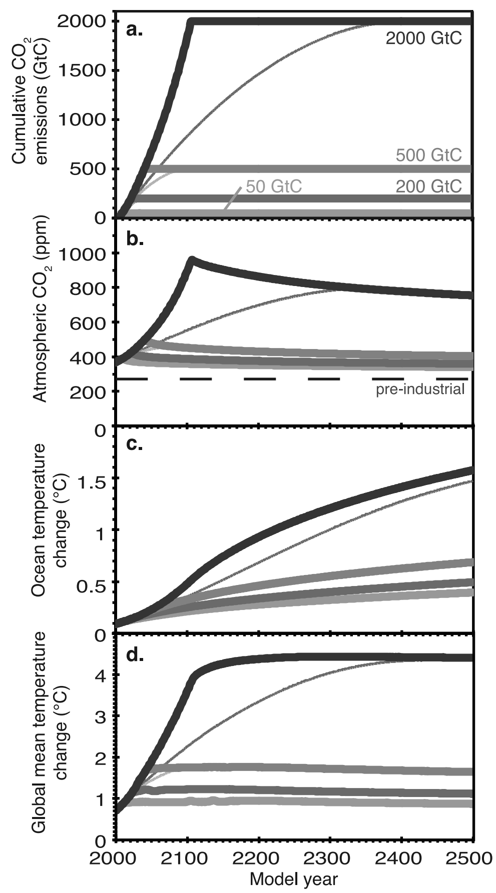


Figure 2. Climate response to transient followed by zero CO_2 emissions. (a) Specified cumulative CO_2 emissions relative to the year 2005. (b) Simulated atmospheric CO_2. (c) Simulated change in global mean ocean temperature relative to pre-industrial. (d) Simulated change in global mean surface air temperature relative to pre-industrial. Thick lines show business-as-usual followed by an abrupt elimination of emissions. Thin lines show the same post-2005 cumulative emissions but with a gradual reduction from 2005 emission levels to zero.

initial CO_2 levels in the atmosphere and the distribution of emissions over the next 10 to 100 years. This result is consistent with previous research which has shown that the declining radiative forcing per unit CO_2 increase at higher CO_2 levels is approximately counter-balanced by increased airborne fraction of emissions due to weakened carbon sinks [*Caldeira and Kasting*, 1993].

[12] The results shown here differ importantly from previous zero-emissions commitment analyses [e.g., *Friedlingstein and Solomon*, 2005], which have neglected the heat capacity of the deep ocean, and have therefore concluded that after emissions are stopped, global temperatures would decrease in response to declining atmospheric CO_2 concentrations. Our results also differ from previous studies of warming commitment which have analyzed the future warming commitment resulting from constant radiative forcing associated with stable atmospheric greenhouse gas levels [*Wigley*, 2005; *Meehl et al.*, 2005]. In contrast with these studies, our results suggest that if emissions were eliminated entirely, radiative forcing from atmospheric CO_2 would decrease at a rate closely matched by declining ocean heat uptake, with the result that while future warming commitment may be negligible, atmospheric temperatures may not decrease appreciably for at least 500 years.

[13] In the simulations described above, eliminating CO_2 emissions resulted in stable global temperatures for the following five centuries of model simulation. This result implies that stabilizing climate at a given temperature would require that anthropogenic CO_2 emissions be decreased to near-zero. We demonstrate this in a series of transient model simulations in which global temperatures in the UVic ESCM were constrained to follow a desired future climate trajectory. Results from these simulations are shown in Figure 3 for temperature stabilization levels of 1, 2 and 4°C above pre-industrial temperatures, with temperatures approaching stabilization at rates of 0.1, 0.2 and 0.4°C per decade after the year 2005. Also shown is a simulation in which climate was stabilized at year-2005 temperatures.

[14] Simulated global mean surface air temperatures for the ten temperature stabilization simulations followed closely the prescribed temperature trajectories (Figure 3a). Atmospheric CO_2 concentrations consistent with simulated temperature changes are shown in Figure 3b; in all cases, CO_2 concentrations reached a maximum value at the time of temperature stabilization, followed by a gradual decrease consistent with that shown in Figures 1 and 2. Also consistent with Figure 2, ocean temperatures increased throughout the simulation, though the rate of ocean heat uptake slowed with time after atmospheric temperatures were stabilized (Figure 3c). Cumulative CO_2 emissions from each simulation are shown in Figure 3d. At the year 2500, cumulative emissions depended only on the level of temperature stabilization, and not on the path taken to stabilization. Stabilizing climate change at 1°C above pre-industrial (approximately 0.2°C above present) required cumulative carbon emissions (from any source) after 2005 to be confined to less than 150 GtC. Stabilizing at 2 or 4°C above pre-industrial required cumulative emissions after 2005 of less than 725 and 1825 GtC, respectively. In all cases, annual emissions consistent with temperature-stabilization were reduced to nearly zero. Notably, stabilizing global temperature at present-day (year-2005) levels required emissions to be reduced to near-zero within a decade.

[15] The result shown here that each unit of CO_2 emissions results in a quantifiable step-wise increase of global temperatures, and its corollary that temperature stabilization requires near-zero CO_2 emissions, is not model specific; this same qualitative result can be demonstrated using a simple analytic model of the global climate-carbon system (see auxiliary material).[1] However, the specific amount by which global temperatures increased per unit of CO_2 emission—and correspondingly, the cumulative CO_2 emissions required to meet a given temperature target—does depend on several important model characteristics and assumptions. For example, future changes in non-CO_2 climate forcings (both natural and anthropogenic) could have an important effect on the magnitude of temperature changes associated with future carbon emissions. Furthermore, different models vary considerably with respect to both the strength of

[1] Auxiliary materials are available in the HTML. doi:10.1029/2007GL032388.

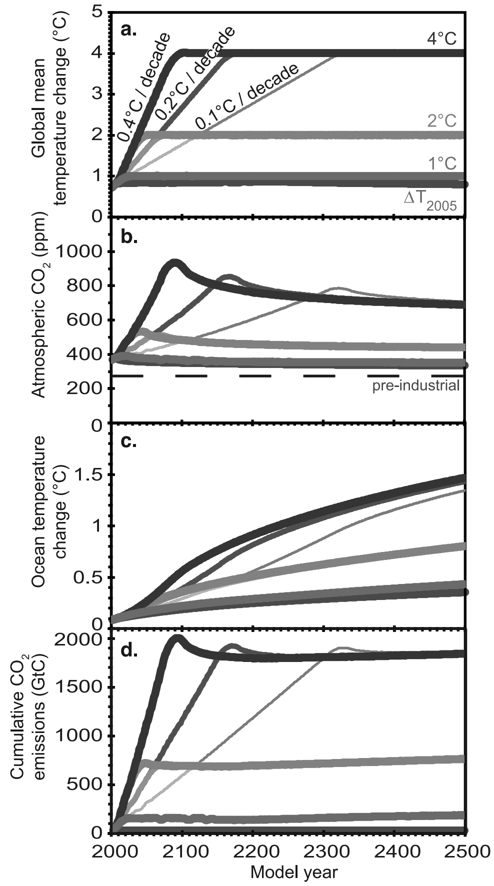


Figure 3. CO_2 emissions required for climate stabilization. (a) Simulated global mean surface air temperature relative to pre-industrial. (b) Simulated atmospheric CO_2. (c) Simulated change in global mean ocean temperature relative to pre-industrial. (d) Cumulative carbon emissions relative to the year 2005 (where near-constant cumulative emissions reflect near-zero yearly emissions). Colors indicate climate stabilization at 1 (red lines), 2 (green lines), and 4 (blue lines) °C above pre-industrial temperatures. Line styles indicate rates of warming (between 2005 and the time of temperature-stabilization) of 0.1 (thick lines), 0.2 (medium lines), and 0.4 (thin lines) °C per decade. The solid grey line shows climate stabilization at year-2005 temperatures.

carbon sinks (the carbon cycle sensitivity to CO_2 and climate changes) as well as the climate system's sensitivity to CO_2 increases (climate sensitivity).

[16] To examine the dependence of our results on the model's climate sensitivity, we repeated the temperature-stabilization simulations shown in Figure 3 with two additional versions of the model in which climate sensitivity after 2005 was approximately doubled and halved respectively by means of an adjustable temperature-longwave radiation feedback [*Matthews and Caldeira*, 2007]. Cumulative emissions from 2005 to 2500 for each of these simulations are given in Table 1. It is clear that the range of climate sensitivities explored here had a very large effect on the cumulative carbon emissions for a given temperature target. However, across all combinations of climate sensitivity and stabilization level, the rate of warming approaching a stabilization temperature had very little influence on the allowable cumulative emissions. This is consistent with the pulse-response and zero-emissions commitment experiments in which each unit of CO_2 emission produced a persistent increment of warming that was largely independent of the warming produced by other CO_2 emissions.

[17] In this study, we have made no attempt to construct economically optimal emissions scenarios for climate stabilization, but rather to quantify the climatic requirements for allowable emissions consistent with global temperature targets. It is evident that some of the temperature trajectories (and their associated emissions scenarios) illustrated here may not be economically feasible, as they require either abrupt transitions from very high to near-zero emissions, or even prolonged periods of negative emissions for combinations of high climate sensitivity and low temperature targets. It is also clear from these simulations that delays in emissions reductions now will lead to a requirement for much more rapid emissions reductions in the future in order to meet the same global temperature target. In addition, an important conclusion of our study is that if total future emissions can be constrained to within a given amount, the same long-term temperature target can be achieved by a wide range of specific emissions scenarios.

4. Conclusions

[18] International climate policies aimed at climate stabilization must reflect an understanding of the lasting effect of greenhouse gas emissions; as illustrated by a recent study, year-2050 emissions targets currently being proposed are likely insufficient to avoid substantial future climate warming [*Weaver et al.*, 2007]. We have shown here that the climate warming resulting from CO_2 emissions is not a transient phenomenon, but rather persists well beyond the timescale of human experience. In the absence of human intervention to actively remove CO_2 from the atmosphere [e.g., *Keith et al.*, 2006], each unit of CO_2 emissions must be viewed as leading to quantifiable and essentially permanent climate change on centennial timescales. We emphasize that a stable global climate is not synonymous with stable radiative forcing, but rather requires decreasing greenhouse gas levels in the atmosphere. We have shown here that stable global temperatures within the next several centuries can be achieved if CO_2 emissions are reduced to

Table 1. Effect of Climate Sensitivity on Cumulative Emissions Targets for Climate Stabilization[a]

Global temperature target (°C)	1			2			4		
Target rate of change (°C/yr)	0.01	0.02	0.04	0.01	0.02	0.04	0.01	0.02	0.04
$\Delta T_{2X} \sim 1.8$ °C	787	789	788	1970	1977	1979	4806	4801	4794
$\Delta T_{2X} \sim 3.5$ °C	149	148	150	720	723	723	1823	1808	1804
$\Delta T_{2X} \sim 7$ °C	−166	−167	−167	115	115	116	633	607	599

[a]Effect of climate sensitivity measured by ΔT_{2X}. Cumulative emissions represent total GtC emitted from 2005 to 2500.

nearly zero. This means that avoiding future human-induced climate warming may require policies that seek not only to decrease CO_2 emissions, but to eliminate them entirely.

[19] **Acknowledgments.** We would like to acknowledge and thank M. Eby at the University of Victoria for his contribution to this research in the form of development of model code which enables simulation of specified global temperature input profiles. We would also like to thank A. Weaver, C. Jones and one anonymous reviewer for their helpful comments and suggestions.

References

Archer, D. (2005), Fate of fossil fuel CO_2 in geologic time, *J. Geophys. Res.*, *110*, C09S05, doi:10.1029/2004JC002625.

Caldeira, K., and J. F. Kasting (1993), Insensitivity of global warming potentials to carbon dioxide emissions scenarios, *Nature*, *366*, 251–253.

Friedlingstein, P., and S. Solomon (2005), Contributions of past and present human generations to committed warming caused by carbon dioxide, *Proc. Natl. Acad. Sci. U. S. A.*, *102*, 10,832–10,836.

Hansen, J. E., G. Russell, A. Lacis, I. Fung, and D. Rind (1985), Climate response times: Dependence on climate sensitivity and ocean mixing, *Science*, *229*, 857–859.

Keith, D. W., M. Ha-Duong, and J. K. Stolaroff (2006), Climate strategy with CO_2 capture from the air, *Clim. Change*, *74*, 17–45.

Matthews, H. D. (2006), Emissions targets for CO_2 stabilization as modified by carbon cycle feedbacks, *Tellus, Ser. B*, *55*, 591–602.

Matthews, H. D., and K. Caldeira (2007), Transient climate-carbon simulations of planetary geoengineering, *Proc. Natl. Acad. Sci. U. S. A.*, *104*, 9949–9954.

Meehl, G. A., W. M. Washington, W. D. Collins, J. M. Arblaster, A. Hu, L. E. Buja, W. G. Strand, and H. Teng (2005), How much more global warming and sea level rise?, *Science*, *307*, 1769–1772.

Meissner, K. J., A. J. Weaver, H. D. Matthews, and P. M. Cox (2003), The role of land-surface dynamics in glacial inception: A study with the UVic Earth System Climate Model, *Clim. Dyn.*, *21*, 515–537.

Montenegro, A., V. Brovkin, M. Eby, D. Archer, and A. J. Weaver (2007), Long term fate of anthropogenic carbon, *Geophys. Res. Lett.*, *34*, L19707, doi:10.1029/2007GL030905.

Schmittner, A., A. Oschlies, H. D. Matthews, and E. D. Galbraith (2008), Future changes in climate, ocean circulation, ecosystems and biogeochemical cycling simulated for a business-as-usual CO_2 emissions scenario until year 4000 AD, *Global Biogeochem. Cycles*, *22*, GB1013, doi:10.1029/2007GB002953.

Stern, N. (2006), *The Economics of Climate Change*, Cambridge Univ. Press, Cambridge, U. K.

United Nations (1992), *Earth Summit Convention on Climate Change*, U. N. Conf. on Environ. and Dev., Rio de Janeiro, Brazil.

Weaver, A. J., et al. (2001), The UVic Earth System Climate Model: Model description, climatology and applications to past, present and future climates, *Atmos. Ocean*, *39*, 361–428.

Weaver, A. J., K. Zickfeld, A. Montenegro, and M. Eby (2007), Long term climate implications of 2050 emission reduction targets, *Geophys. Res. Lett.*, *34*, L19703, doi:10.1029/2007GL031018.

Wigley, T. M. L. (2005), The climate change commitment, *Science*, *307*, 1766–1769.

K. Caldeira, Department of Global Ecology, Carnegie Institution of Washington, 260 Panama Street, Stanford, CA 94305, USA.

H. D. Matthews, Department of Geography, Planning and Environment, Concordia University, 1455 de Maisonneuve Boulevard W., Montreal, QC, Canada H3G 1M8. (dmatthew@alcor.concordia.ca)

ATTACHMENT E

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Draft Guidance Document – Interim CEQA Greenhouse Gas (GHG) Significance Threshold

October 2008

Deputy Executive Officer
Planning, Rule Development and Area Sources
Elaine Chang, DrPH

Assistant Deputy Executive Officer
Planning, Rule Development and Area Sources
Laki Tisopulos, Ph.D., P.E.

Planning and Rules Manager
Planning, Rule Development and Area Sources
Susan Nakamura

Author:	Steve Smith, Ph.D.	Program Supervisor
	Michael Krause	Air Quality Specialist
Contributors:	Jeffery Inabinet	Air Quality Specialist
	James Koizumi	Air Quality Specialist
	Barbara Radlein	Air Quality Specialist
Reviewed:	Barbara Baird	Principal District Counsel

TABLE OF CONTENTS

TABLES

FIGURES

P R E F A C E

This Draft *Guidance Document – Interim CEQA Greenhouse Gas (GHG) Significance Threshold* document contains the proposed interim GHG significance threshold, rationale for developing the threshold, and details of the working group meetings and represents a work-in-progress of staff's efforts to date. This document will be updated as more information becomes available. For the staff recommendation to the Governing Board at the December 5, 2008 public hearing, please refer to Attachment A of Agenda Item Number 31.

Finally, to facilitate identifying changes to this Guidance Document since its release in October 2008, added text is <u>underlined</u> and deleted text is denoted with ~~strikethrough~~ text.

LIST OF ACRONYMS AND ABBREVIATIONS

List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
AB 32	Assembly Bill 32 Global Warming Solutions Act of 2006
AER	Annual Emission Reporting
AG	Attorney General
ARB	Air Resources Board
BACT	Best Available Control Technology
BARCT	Best Available Retrofit Control Technology
BAU	Business as Usual
CAPCOA	California Air Pollution Control Officers Association
CARB	California Air Resource Board
CAT	Climate Action Team
CCAR	California Climate Action Registry
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CPUC	California Public Utilities Commission
EIR	Environmental Impact Report
EPA	U.S. Environmental Protection Agency
FY	Fiscal Year
GHG	Greenhouse Gas
GGRP	Greenhouse Gas Reduction Plan
GP	General Plan
GWP	Global Warming Potential
IGR	Intergovernmental Review
IPCC	International Panel on Climate Change
ITE	Institute of Transportation Engineers
km	Kilometer
LNG	Liquefied Natural Gas
MMBTU	Million British Thermal Units
MND	Mitigated Negative Declaration
MMT CO_2e	Million Metric Tons Carbon Dioxide Equivalent
MW	Megawatts
N_2O	Nitrous Oxide
ND	Negative Declaration
NO_x	Oxides of Nitrogen
OPR	State Office of Planning and Research
PFC	Perfluorocarbon

List of Acronyms and Abbreviations (Concluded)

Acronym/ Abbreviation	Definition
PM	Particulate Mater
ROG	Reactive Organic Gas
RPS	Renewable Portfolio Standards
S-3-05	Executive Order S-3-05
SB	Senate Bill
SCAQMD	South Coast Air Quality Management District
SIP	State Implementation Plan
SO_X	Sulfur Oxides
TAC	Toxic Air Contaminants
URBEMIS	Urban Emissions Model
VMT	Vehicle Miles Traveled

CHAPTER 1

INTRODUCTION AND EXECUTIVE SUMMARY

Introduction

Purpose of This Guidance Document

California Environmental Quality Act and GHGs

Legal Authority

Contents of This Guidance Document

INTRODUCTION

The California Environmental Quality Act (CEQA) requires public agencies in California to analyze potential adverse impacts for proposed projects undertaken by a public agency, funded by a public agency, and requiring discretionary approval by a public agency. The fundamental purposes of CEQA are to inform governmental decision-makers and the public about the significant environmental effects of proposed activities, identify ways to avoid or significantly reduce environmental damage, use feasible alternatives or mitigation measures to avoid significant damage, and disclose to the public why a governmental agency approved a project if significant effects are involved (CEQA Guidelines §15002[a]). To disclose potential adverse impacts from a proposed project, pursuant to CEQA lead agencies typically prepare multidisciplinary environmental impact analysis and make decisions based on the analysis regarding the environmental effects of the proposed project (CEQA Guidelines §15002[a]).

In the past, air quality analyses tended to focus on potential adverse impacts from criteria pollutants and toxic air contaminants. Subsequent to the adoption of Assembly Bill (AB) 32 – The California Global Warming Solutions Act of 2006, lead agencies have increasingly faced legal challenges to their CEQA documents for failure to analyze greenhouse gases (GHGs) or making a determination of significance regarding GHG emission impacts.

Greenhouse gases are those gases that have the ability to trap heat in the atmosphere, a process that is analogous to the way a greenhouse traps heat. GHGs may be emitted as a result of human activities as well as through natural processes. As a result of human activities, such as electricity production, vehicle use, etc., GHGs have been accumulating in the earth's atmosphere at a faster rate than has occurred historically, i.e., prior to the Industrial Age starting approximately 150 years ago. Increasing GHG concentrations in the atmosphere are leading to global climate change.

The Intergovernmental Panel on Climate Change (IPCC) provided the first unequivocal evidence that global climate temperatures are increasing (2007a). Further, the primary driver of global climate change is increased emissions of GHGs due to human activities. According to the IPCC, there is very high confidence, based on more evidence from a wider range of species, that recent warming is strongly affecting terrestrial, marine, freshwater biological systems.

Carbon dioxide (CO2) is the most important anthropogenic GHG because it comprises the majority of total GHG emissions emitted per year and it is very long-lived in the atmosphere. Annual emissions of CO2 have increased approximately 80 percent between 1970 and 2004. In addition to CO2, other GHG pollutants emitted directly as a result of human activities include methane (CH4), nitrous oxide (N2O) and halocarbons (a group of gases containing fluorine, chlorine or bromine). Without changes in current climate change mitigation policies and related sustainable development practices, GHG emissions and global climate temperatures will continue to increase.

To prevent or minimize further increases in global temperatures resulting from increases in GHG emissions due to human activities, it is necessary to stabilize the concentration of GHGs in the atmosphere. Stabilizing GHGs in the atmosphere can only occur through reducing GHG emissions. Without further reductions in GHGs, increased global temperatures will surpass humans' and ecosystems' ability to adapt to these changing conditions (IPCC, 2007b).

In response to the increasing body of evidence that GHGs will continue to affect global climate, Governor Schwarzenegger issued executive order (EO S-3-05), which established the following greenhouse gas emission reduction targets for California: by 2010, reduce GHG emissions to 2000 levels; by 2020, reduce GHG emissions to 1990 levels; by 2050, reduce GHG emissions to 80 percent below 1990 levels.

Subsequent to the Governor's issuance of EO S-3-05, the California State Legislature adopted Assembly Bill (AB) 32 – The California Global Warming Solutions Act of 2006. With the adoption of AB 32, the California State Legislature recognized the growing concern regarding changes to global climate resulting from increasing emissions of greenhouse gases (GHGs). AB 32 establishes a cap on statewide greenhouse gas emissions and sets forth the regulatory framework to achieve the corresponding reduction in statewide emissions levels. Specifically, (AB 32) recognizes the serious threat to the "economic wellbeing, public health, natural resources, and the environment of California" that results from global warming. Consequently, AB 32 mandates a significant reduction in GHGs in order to contribute to efforts to stabilize atmospheric concentrations of GHGs. Under AB 32, greenhouse gases are defined as: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

In general, there is currently an absence of regulatory guidance with regard to analyzing GHG emission impacts in CEQA documents. Similarly, no public agency in California has formally adopted GHG significance thresholds. Recognizing the absence of guidance regarding analyzing and determining the significance of GHGs, the California Air Pollution Control Officers Association (CAPCOA) prepared a White Paper reviewing policy choices, analytical tools, and mitigation strategies for GHGs. In particular, the White Paper identifies a number of options for establishing GHG significance thresholds, but makes no formal recommendation of one approach over another.

Air districts typically act in an advisory capacity to local governments in establishing the framework for environmental review of air pollution impacts under CEQA. This may include recommendations regarding significance thresholds, analytical tools to estimate emissions and assess impacts, and mitigations for potentially significant impacts. Although districts will also address some of these issues on a project-specific basis as responsible agencies, they may provide general guidance to local governments on these issues.

Because of its expertise in establishing air quality analysis methodologies and comprehensive efforts to establish regional and localized significance thresholds for criteria pollutants, local public agencies have asked South Coast Air Quality Management District (SCAQMD) for guidance in quantifying GHG impacts and recommending GHG significance thresholds to assist them with determining whether or not GHG impacts in their CEQA documents are significant. As a result, SCAQMD staff has received requests from a number of public agencies and other stakeholders to provide guidance on analyzing GHG impacts and establishing a GHG significance threshold. In response to these requests from the various stakeholders, SCAQMD established a stakeholder working group to receive input on establishing a GHG significance threshold. In the meantime, SCAQMD staff has joined many other stakeholders urging CARB to establish a statewide threshold for GHGs. In the absence of a statewide threshold, SCAQMD staff will recommend its interim approach to the Governing Board for consideration and it will also become the SCAQMD's input to the statewide process.

PURPOSE OF THIS GUIDANCE DOCUMENT

The purpose of this Guidance Document, therefore, is to provide information on GHG legislation relative to CEQA, a brief summary of the Working Group process, development of the resulting staff-recommended interim GHG significance threshold proposal, and how to use it. This Guidance Document also provides information on the SCAQMD's authority to establish a GHG significance threshold pursuant to CEQA and some background information on GHGs and global climate change. This Guidance Document also discusses future efforts to further refine the interim GHG significance threshold as necessary, includes recommendations for analyzing GHG impacts using current modeling tools, and describes measures to mitigate GHG emission impacts.

CALIFORNIA ENVIRONMENTAL QUALITY ACT AND GHGS

- California Attorney General's Office

Subsequent to adopting AB 32, the California Attorney General's Office determined that GHG emissions contributing to global climate change also contribute to potential adverse environmental impacts that should be evaluated pursuant to the California Environmental Quality Act (CEQA). The Attorney General's Office has submitted numerous comment letters to lead agencies on their CEQA documents for failure to analyze GHG emissions, failure to make a significance determination, and failure to implement feasible mitigation measures to reduce GHG emissions to the maximum extent feasible.

For example, the California Attorney General, on behalf of the people of California, filed a legal challenge against the County of San Bernardino for failure to analyze "reasonably foreseeable" GHG emissions in the CEQA document prepared for its

General Plan update. The County reached a settlement with the Attorney General by committing to developing a GHG inventory and a plan for reducing GHGs.

Similarly, the California Attorney General submitted comments on the CEQA document for a refinery in northern California. Although GHG emissions were quantified, the Attorney General cited the failure of the lead agency to make a determination of significance relative to GHG emissions stating, "[E]ven if there is no established threshold in law or regulation, lead agencies are obligated by CEQA to determine significance. Neither CEQA, nor the regulations, authorize reliance on the lack of an agency-adopted standard as the basis for determining that a project's potential cumulative impact is not significant." In other words, the absence of a threshold does not in any way relieve lead agencies of their obligations to address GHG emissions from projects under CEQA. By not concluding whether or not a project is significant, the lead agency may be avoiding its responsibility to implement GHG mitigation measures.

- Senate Bill (SB) 97 – CEQA: Greenhouse Gas Emissions

In August 2007, Governor Schwarzenegger signed into law Senate Bill (SB) 97 – CEQA: Greenhouse Gas Emissions stating, "This bill advances a coordinated policy for reducing greenhouse gas emissions by directing the Office of Planning and Research (OPR) and the Resources Agency to develop CEQA guidelines on how state and local agencies should analyze, and when necessary, mitigate greenhouse gas emissions." Specifically, SB 97 requires OPR, by July 1, 2009, to prepare, develop, and transmit to the Resources Agency guidelines for the feasible mitigation of greenhouse gas emissions or the effects of greenhouse gas emissions, as required by CEQA, including, but not limited to, effects associated with transportation or energy consumption. The Resources Agency would be required to certify and adopt those guidelines by January 1, 2010. OPR would be required to periodically update the guidelines to incorporate new information or criteria established by the State Air Resources Board pursuant to the California Global Warming Solutions Act of 2006. SB 97 also identifies a limited number of types of projects that would be exempt under CEQA from analyzing GHG emissions. Finally, the legislation will be repealed on January 1, 2010.

- Office of Planning and Research Technical Advisory

Consistent with SB 97, on June 19, 2008, OPR released its *Technical Advisory on CEQA and Climate Change*, which was developed in cooperation with the Resources Agency, the California Environmental Protection Agency (Cal/EPA), and the California Air Resources Board (CARB). According to OPR, the *Technical Advisory* offers the informal interim guidance regarding the steps lead agencies should take to address climate change in their CEQA documents, until CEQA guidelines are developed pursuant to SB 97 on how state and local agencies should analyze, and when necessary, mitigate greenhouse gas emissions.

According to OPR, lead agencies should determine whether greenhouse gases may be generated by a proposed project, and if so, quantify or estimate the GHG emissions by type and source. Second, the lead agency must assess whether those emissions are individually or cumulatively significant. When assessing whether a project's effects on climate change are "cumulatively considerable" even though its GHG contribution may be individually limited, the lead agency must consider the impact of the project when viewed in connection with the effects of past, current, and probable future projects. Finally, if the lead agency determines that the GHG emissions from the project as proposed are potentially significant, it must investigate and implement ways to avoid, reduce, or otherwise mitigate the impacts of those emissions.

- SB 375 (Steinberg) Transportation, Land Use, and the California Environmental Quality Act (CEQA)

On September 30, 2008, Governor Schwarzenegger signed into law SB 375 (Steinberg). SB 375 focuses on housing and transportation planning decisions to reduce fossil fuel consumption and conserve farmlands and habitat. This legislation is important to achieving AB 32 goals because greenhouse gas emissions associated with land use, which includes transportation, are the single largest sector of emissions in California. Further, SB 375 provides a path for better planning by providing incentives to locate housing developments closer to where people work and go to school, allowing them to reduce vehicle miles traveled (VMT) every year. The following bullet points summarize some of the main provisions of the bill.

- Require the regional governing bodies in each of the state's major metropolitan areas to adopt, as part of their regional transportation plan, a "sustainable community strategy" that will meet the region's target for reducing GHG emissions. These strategies would get people out of their cars by promoting smart growth principles such as: development near public transit; projects that include a mix of residential and commercial use; and projects that include affordable housing to help reduce new housing developments in outlying areas with cheaper land and reduce vehicle miles traveled (VMT).

- Create incentives for implementing the sustainable community strategies by allocating federal transportation funds only to projects that are consistent with the emissions reductions.

- Provide various forms of CEQA relief by allowing projects that are shown to conform to the preferred sustainable community strategy through the local general plans (and therefore contribute to GHG reduction) to have a more streamlined environmental review process. Specifically, SB 375 will change CEQA in two ways:

    - If a development is consistent with the sustainable community's strategy and incorporates any mitigation measures required by a prior EIR, then the environmental review does not have to consider: a) growth-inducing impacts, or b) project-specific or cumulative impacts from cars on global warming or the regional transportation network.

- A narrowly-defined group of "transit priority projects" will be exempt from CEQA review.

LEGAL AUTHORITY

CEQA Guidelines §15022(a) states that a public agency shall adopt objectives, criteria, and specific procedures consistent with CEQA and these [State] Guidelines for administering its responsibilities under CEQA. CEQA Guidelines §15022(d) states further, "In adopting procedures to implement CEQA, a public agency may adopt the State CEQA Guidelines through incorporation by reference. The agency may then adopt only those specific procedures or provisions described in subsection [15022] (a) which are necessary to tailor the general provisions of the guidelines to the specific operations of the agency." At the December 11, 1998 Public Hearing the SCAQMD's Governing Board formally incorporated by reference the State CEQA Guidelines as the implementing guidelines for the SCAQMD's CEQA program. Adopting GHG significance thresholds would be consistent with CEQA Guidelines §15022 provision to tailor a public agency's implementing guidelines by adopting criteria relative to the specific operations of the SCAQMD.

Specifically with regard to thresholds of significance, CEQA Guidelines §15064.7(a) states, "Each public agency is encouraged to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects." Subsection (b) of the same section states further, "Thresholds of significance to be adopted for general use as part of the lead agency's environmental review process must be adopted by ordinance, resolution, rule or regulation, and developed through a public review process and be supported by substantial evidence." Staff's recommended GHG significance threshold has undergone a public review process as part of stakeholder working group meetings that are open to the public. This Guidance Document provides the substantial evidence relative to the methodology for developing the interim GHG significance threshold. After completion of the public process, the proposed interim GHG significance threshold will be brought to the SCAQMD's Governing Board at a public meeting, where it will be considered for adoption by resolution, consistent with CEQA Guidelines §15064.7(b). Staff's proposed interim GHG significance threshold is a recommendation only for lead agencies and not a mandatory requirement. The GHG significance threshold may be used at the discretion of the local lead agency. However, if adopted the SCAQMD will use the interim GHG significance threshold for projects where it is the lead agency.

- Considerations When Establishing Significance Thresholds

No significance thresholds for GHG emissions have been developed, adopted, or endorsed statewide or at the local level[1]. Air districts have primary authority under

[1] In response to comments submitted by the Attorney General's Office on a dairy project, the San Joaquin Valley Air Pollution Control District (SJVAPCD) identified a significance threshold of 38,477 metric tons of

state law for "control of air pollution from all sources, other than emissions from motor vehicles" (H&SC §40000). The term air contaminant or "air pollutant" is defined extremely broadly, to mean "any discharge, release, or other propagation into the atmosphere" and includes, but is not limited to, soot, carbon, fumes, gases, particulate matter, etc. Greenhouse gases and other global warming pollutants such as black carbon would certainly be included in this definition. The U.S. Supreme Court held in Massachusetts v. EPA 549 U.S. 497 (2009) that greenhouse gases were clearly within the Federal Clean Air Act's broad definition of air pollutants. Therefore, air districts have the authority to regulate global warming pollutants primarily from non-vehicular sources, while pursuant to AB 32 CARB has authority over a wide range of sources, including vehicular sources.

Appendix G of the CEQA Guidelines provides a checklist of suggested environmental topics that should be addressed in a CEQA document. Questions under each environmental topic area are designed to elicit information on whether a project has the potential to generate significant adverse environmental impacts to that environmental topic area. However, neither the CEQA statutes nor the implementing Guidelines discuss or identify thresholds of significance or particular methodologies for performing an impact analysis. These tasks are left to a lead agency's judgment and discretion, based upon factual data and guidance from regulatory agencies and other sources where available and applicable.

The determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved, based to the extent possible on scientific and factual data. An ironclad definition of significant effect is not always possible because the significance of an activity may vary with the setting. For example, an activity which may not be significant in an urban area may be significant in a rural area (CEQA Guidelines §15064(b)). Further, in evaluating the significance of the environmental effect of a project, the Lead Agency shall consider direct physical changes in the environment which may be caused by the project and reasonably foreseeable indirect physical changes in the environment which may be caused by the project (§15064(d)). Significance conclusions must be based on substantial evidence, which includes facts, reasonable assumptions predicated upon facts, and expert opinion supported by facts (CEQA Guidelines §15064(f)(5)).

Each public agency is encouraged to develop and publish thresholds of significance that the agency uses in the determination of the significance of environmental effects. A threshold of significance is essentially a regulatory standard or set of criteria that represent the level at which a lead agency finds a particular environmental effect of a project to be significant. Specifically, a threshold of significance is an identifiable quantitative, qualitative or performance level of a particular environmental effect, non-compliance with which means the effect will normally be determined to be significant

carbon dioxide equivalent per year (MT CO2eq./yr). According to SJVAPCD staff, the agency currently has no plans to formally adopt this significance threshold through a public process.

by the agency and compliance with which means the effect normally will be determined to be less than significant (§15064.7(a)).

Even in the absence of clearly defined significance thresholds for GHG emissions, the California Attorney General has advised that such emissions from CEQA projects must be disclosed and mitigated to the extent feasible whenever the lead agency determines that the project contributes to a significant, cumulative climate change impact.

CONTENTS OF THIS GUIDANCE DOCUMENT

The following subsections provide brief summaries of the chapters contained in this guidance document.

- Summaries of Chapter 1

Chapter 1 is the introductory chapter of this document that contains general background information on GHGs and the determination that GHGs must be analyzed in CEQA documents. There is also information on CEQA legislation related to GHGs and global climate change. Finally, the chapter contains information on the legal authority that allows the SCAQMD to adopt significance thresholds for the purpose of determining the severity of impacts analyzed in CEQA documents

- Summaries of Chapter 2

Chapter 2 contains more detailed background information on GHG emissions relative to global climate change, both internationally and nationally. This chapter also provides more detailed information on legislation to reduce GHG house gas emissions, e.g., Assembly Bill 32 – the Global Warming Solutions Act of 2006, etc. Finally, Chapter 2 contains information on early guidance on evaluating GHG emissions in CEQA documents.

- Summaries of Chapter 3

Chapter 3 contains information on the working group established by the SCAQMD to provide feedback to staff on the development of an interim GHG significance threshold. The chapter also includes discussions on considerations in establishing an interim GHG significance threshold and describes the current staff proposal for an interim GHG significance threshold.

- Summaries of Chapter 4

Chapter 4 contains general recommendations for analyzing GHG emissions in CEQA documents.

- Summaries of Chapter 5

In Chapter 5 it is assumed that the SCAQMD Governing Board will adopt staff's proposed interim GHG significance threshold. Therefore, this chapter discusses future action items, including outreach to interested stakeholders, compiling lists of applicable GHG design features and mitigation measures, and periodic review and update, as necessary of the interim GHG significance threshold.

CHAPTER 2

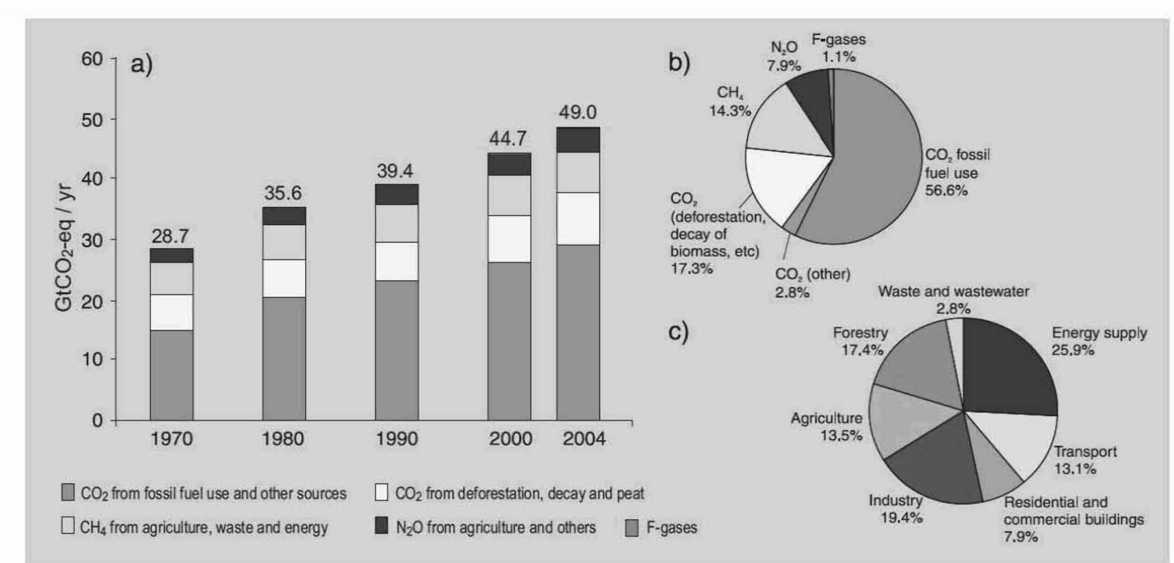
BACKGROUND INFORMATION ON GHGS

GENERAL BACKGROUND INFORMATION ON GHGS

Intergovernmental Panel on Climate Change

In the last few years information and data have been compiled that demonstrate unequivocally that increases in average global air and ocean temperatures are occurring (IPCC, 2007a). For example, 11 of the last 12 years (1995-2006) rank among the 12 warmest years in the instrumental record of global surface temperature (since 1850). The temperature increase is widespread over the globe and is greater at higher northern latitudes. Further, increases in sea level are consistent with global warming. For example, global average sea level rose at an average rate of 1.8 [1.3 to 2.3]mm per year over 1961 to 2003 and at an average rate of about 3.1 [2.4 to 3.8]mm per year from 1993 to 2003. According to the IPCC (2007b), there is very high confidence, based on more evidence from a wider range of species, that recent warming is strongly affecting terrestrial, marine, and freshwater biological systems.

One of the major drivers in global climate change has been directly linked to the increase in greenhouse gas (GHG) emissions due to human activities worldwide (Figure 2-1). Carbon dioxide (CO2) is the most important anthropogenic GHG. Annual CO2 emissions have increased approximately 80 percent between 1970 and 2004 (IPCC, 2007b)



Human activities have been responsible for substantial increases in four long-lived GHGs, including: CO2, methane (CH4), nitrous oxide (N2O) and halocarbons (a group of gases containing fluorine, chlorine or bromine). Global increases in CO2 concentrations are due primarily to fossil fuel use, with land-use change providing another significant but smaller contribution. It is very likely that the observed increase in CH4 concentration is predominantly due to agriculture and fossil fuel use. The increase in N2O concentration is primarily due to agriculture (IPCC, 2007).

According to the IPCC (2007), for the next couple of decades global temperatures are expected to rise approximately 0.2^{o} C per decade under a variety of scenarios. Further, global temperatures are expected to continue for centuries as a result of human activities due to the time scales associated with climate processes and feedbacks, even if GHG concentrations are stabilized. As a result, based on the current understanding of climate-carbon feedback, model studies show that substantial GHG emission reductions are necessary to avoid substantial increases in global air and ocean temperatures.

LEGISLATIVE BACKGROUND – CALIFORNIA

California has taken a leadership role in not only recognizing the future impacts to global climate change from anthropogenic sources of GHG emissions, but in establishing policies and adopting laws to substantially reduce GHG emissions by 2050. In addition to the GHG legislation related to CEQA described in Chapter 1, California has adopted the following policies and laws that specifically address reducing GHG emissions.

- Governor Schwarzenegger's Executive Order (June 2005)

In June 2005, Governor Arnold Schwarzenegger signed Executive Order (EO) S-3-05, which establishes greenhouse gas emission reduction targets in response to projected increases in global air and ocean temperatures. Specifically, EO S-3-05 establishes the following three GHG emission reduction targets:

- Reduce GHG emissions to 2000 emission levels by 2010;
- Reduce GHG emissions to 1990 emission levels by 2020; and
- Reduce GHG emissions to 80 percent below 1990 levels by 2050.

Further, EO S-3-05 charges the California Environmental Protection Agency (CalEPA) secretary to coordinate with the Secretary of the Business, Transportation and Housing Agency, Secretary of the Department of Food and Agriculture, Secretary of the Resources Agency, Chairperson of the CARB, Chairperson of the Energy Commission and President of the Public Utilities Commission to develop a Climate Action Plan. EO S-3-05 also charges the Secretary of CalEPA with the oversight of efforts to meet the above GHG emission reduction targets and the responsibility to prepare biannual reports on progress in meeting the GHG emission reduction targets.

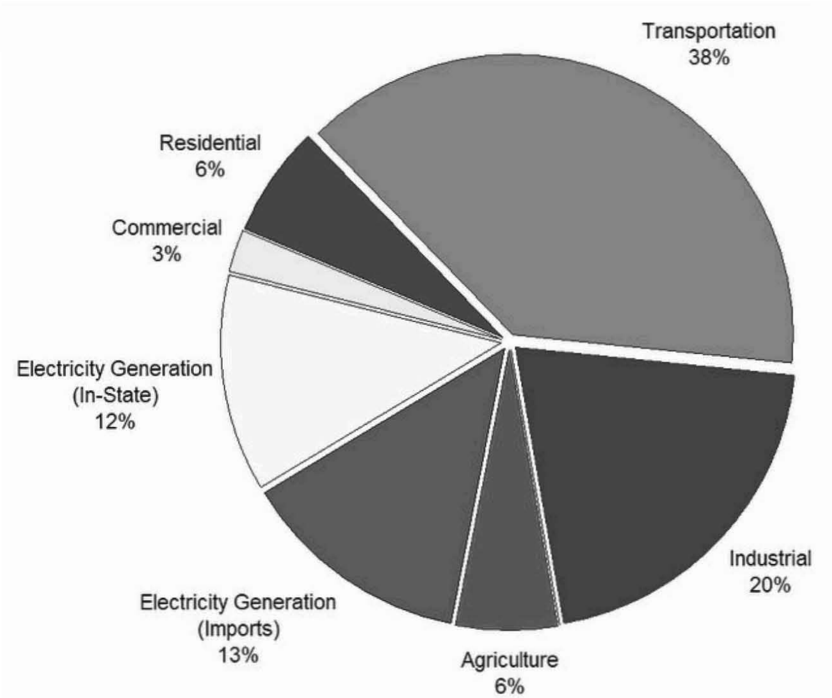
- Global Warming Solutions Act of 2006 (Assembly Bill (AB) 32)

The Global Warming Solutions Act of 2006 (AB 32) was adopted by the California State Legislature in 2006. AB 32 assigns CARB the responsibilities of monitoring and reducing GHG emissions. Specifically, AB 32 requires CARB to:

- Establish a statewide greenhouse gas emissions cap for 2020, based on 1990 emissions, by January 1, 2008;
- Adopt mandatory reporting rules for significant sources of greenhouse gases by January 1, 2009;
- Adopt a plan by January 1, 2009, indicating how emission reductions will be achieved from significant greenhouse gas sources via regulations, market mechanisms and other actions;
- Adopt regulations by January 1, 2011, to achieve the maximum technologically feasible and cost-effective reductions in greenhouse gas, including provisions for using both market mechanisms and alternative compliance mechanisms;
- Convene an Environmental Justice Advisory Committee and an Economic and Technology Advancement Advisory Committee to advise CARB;
- Ensure public notice and opportunity for comment for all CARB actions;
- To adopt rules for "sources" including non-vehicular; and
- Prior to imposing any mandates or authorizing market mechanisms, CARB must evaluate several factors, including but not limited to impacts on California's economy, the environment and public health; equity between regulated entities; electricity reliability; conformance with other environmental laws, and must ensure that the rules do not disproportionately impact low-income communities.

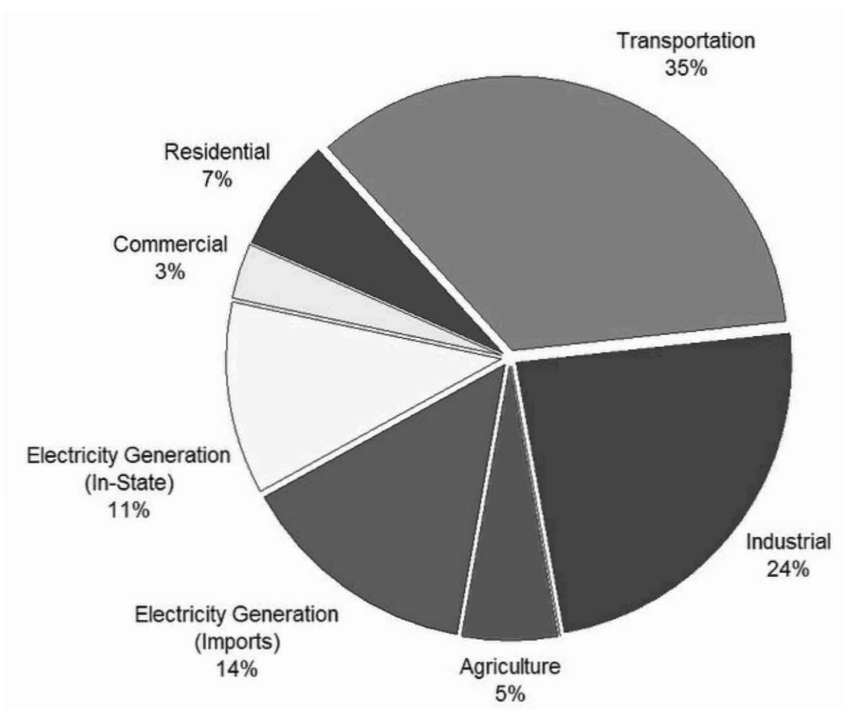
According to the schedule of milestones laid out in AB 32, CARB has made progress in the following areas. Consistent with AB 32's requirement to establish a GHG emission inventory, in December 2007 CARB adopted the California Greenhouse Gas Emission Inventory. The Inventory accounts for all GHG emissions within the state of California and supports the AB 32 Climate Change Program. Figure 2-2 shows CARB's inventory for the year 2004. The Inventory also serves as the basis for developing future year GHG emission forecasts necessary to support measure development and Scoping Plan recommendations. ARB staff has developed a year 2020 "business-as-usual" (BAU) forecast of GHG emissions for use in developing the Draft Scoping Plan. Figure 2-3 shows CARB's inventory for the year 2020, which is AB 32's target inventory.

Figure 2-2
2004 GHG Emissions by Sector (Gross Emissions: 484.4 MMT CO2eq.)



Source: CARB, 2007

Figure 2-3
1990 GHG Emissions by Sector (Gross Emissions: 433.3 MMT CO2eq.)



Source: CARB, 2007

On December 6, 2007, the Air Resources Board (ARB) approved a regulation for the mandatory reporting of greenhouse gas emissions from major sources, pursuant to AB 32. The mandatory reporting regulation specifies the types of facilities that must report their GHG emissions, requirements for reporting and estimating the GHG emissions, and requirements for emissions verification. Upon adoption, the CARB Board directed staff to make other conforming modifications, as may be appropriate, based on comments received. Subsequent to adoption, the mandatory reporting regulation has undergone two sets of modifications.

Consistent with the requirement to develop a scoping plan indicating how GHG emission reductions will be achieved through regulations, market mechanisms, and other actions, the Draft Scoping Plan was released for public review and comment on June 26, 2008, followed by workshops in July and August, 2008.

The Draft Scoping Plan calls for achievable GHG emission reduction in California's carbon footprint to 1990 levels. Reducing greenhouse gas emissions to 1990 levels means cutting approximately 30 percent from BAU emission levels projected for 2020, or about 10 percent from today's levels. Key elements of CARB's preliminary recommendation for reducing California's greenhouse gas emissions to 1990 levels by 2020 contained in the Draft Scoping Plan include the following:

- Expansion and strengthening of existing energy efficiency programs and building and appliance standards;
- Expansion of the Renewables Portfolio Standard for electricity generation to 33 percent;
- Development of a California cap-and-trade program that links with other WCI Partner programs to create a regional market system;
- Implementation of existing State laws and policies, including California's clean car standards, goods movement measures, and the Low Carbon Fuel Standard; and
- Targeted fees to fund the State's long-term commitment to AB 32 administration.

The Scoping Plan is expected go to the CARB Board for adoption in November, 2008.

INITIAL GUIDANCE ON EVALUATING GHGS PURSUANT TO CEQA

As noted in Chapter 1, both the California Attorney General's Office and the OPR determined that GHG emissions contributing to global climate change have the potential to generate adverse environmental impacts that should be evaluated pursuant to CEQA. Until recently, however, there has been little or no guidance relative to analyzing GHG emissions in CEQA documents or determining significance. The first explicit guidance was provided by the Association of Environmental Professionals (AEP) in its White Paper on Global Climate Change (AEP, 2007) and the White Paper on CEQA and Climate Change prepared by the California Air Pollution Control Officers Association (CAPCOA, 2008). The content of each of these White Papers is summarized in the following subsections.

- **Association of Environmental Professionals – White Paper on Global Climate Change**

AEP's White Paper (AEP) was one of the first attempts to discuss GHGs in the context of CEQA. The intent of the White Paper was to provide practical, interim information to CEQA practitioners and to help Lead Agencies determine how to address GHGs and global climate change in CEQA documents prior to the development and adoption of guidance by appropriate government agencies. Further, AEP's White Paper provided a summary of the current regulatory environment surrounding GHG emissions, and the various approaches that a Lead Agency may select in a CEQA document to address the potential impacts of global climate change and a project's cumulative contribution to GHG. The White Paper described several approaches for addressing GHGs and global Climate Change in CEQA documents, but did not recommend a single approach or methodology, leaving that decision to local Lead Agencies. The AEP White Paper identified eight approaches for analyzing GHGs and global climate change, which are summarized in the following bullet points.

- **Approach 1 – No Analysis:** under this approach the Lead Agency would not mention or discuss GHGs or global climate change.
- **Approach 2 – Screening Analysis:** under this approach the Lead Agency would establish a process to screen projects and determine that they would not make significant contributions to GHG emissions or GCC and, therefore, would not need to mitigate accordingly.
- **Approach 3 – Qualitative Analysis without Significance Determination:** this approach involves a qualitative discussion of GHGs and global climate change and potential ways the project will contribute to the generation of GHG emissions, but does not provide any significance conclusions.
- **Approach 4 – Qualitative Analysis with Significance Determination:** under this approach the Lead Agency would qualitatively discuss GHGs and climate change impacts and conclude that the project impacts are significant.
- **Approach 5 – Quantitative Analysis without Significance Determination:** under this approach the Lead Agency would quantify GHG emissions from the proposed project, but the results are not compared to a quantitative significance threshold.
- **Approach 6 – Quantitative Analysis with Net Zero Threshold:** this approach involves quantifying GHG emissions and using zero net carbon dioxide equivalent increase as the threshold.
- **Approach 7 – Quantitative Analysis Relative to California GHG Emission Reduction Strategies:** this approach employs both quantitative and qualitative components. The quantitative analysis contains an inventory of project GHG emissions. The qualitative component involves project compliance with the emission reduction strategies contained in the California Climate Action Team's (CAT) Report to the Governor, which contains recommendations and strategies to help ensure the targets in Executive Order S-3-05 are met.
- **Approach 8 – Use of Partial Exemption, "Within the Scope" of a Program EIR, or Tiering:** this option relies on the preparation of a broad EIR on a plan, program, or zoning action that is certified and contains a cumulative GHG and global climate change

impact analysis and mitigation. A later project that is consistent with the actions, goals, and/or policies in that plan, program, or zoning action need not again evaluate the cumulative impact regarding the project's GHG contribution to global climate change. In this situation, the later project may use the "partial exemption" provision of Public Resources Code §21083.3 and CEQA Guidelines §15183.

Since the date that the AEP White Paper was finalized (June, 2007), it has become clear that any of the above eight options that do not include quantification of GHG emissions and a determination of significance would be vulnerable to legal challenge. In addition, with the exception of the net zero approach in option 6, none of the options evaluated identify potential GHG significance thresholds. Approaches to developing GHG significance thresholds were specifically addressed in CAPCOA's White Paper (CAPCOA, 2008).

- California Air Pollution Control Officers Association – White Paper: CEQA and Climate Change

The intent of CAPCOA's White Paper is to serve as a resource for public agencies as they establish procedures for reviewing GHG emissions from projects under CEQA. It considers the application of thresholds and offers three alternative programmatic approaches toward determining whether GHG emissions are significant. Although the White Paper considers an option of not establishing a GHG significance threshold, as already noted this option is not considered to be a viable approach and will not be considered further. Ultimately, the White Paper is intended to provide consistent approaches for public agencies to ensure that GHG emissions are appropriately considered and addressed under CEQA.

The CAPCOA White Paper identifies three programmatic approaches to establishing GHG significance thresholds and also discusses the benefits and problems associated with each approach. Each approach has inherent advantages and disadvantages. The three basic approaches are:

- No significance threshold for GHG emissions (not discussed further);
- GHG emissions threshold set at zero; or
- GHG threshold set at a non-zero level, two approaches.

The following subsections briefly summarize two of the three major programmatic approaches developed by CAPCOA.

- Zero Threshold

An air district or lead agency may determine that any degree of project-related increase in GHG emissions would contribute considerably to climate change which, therefore, would be considered a significant impact. As a result, the air district or lead agency could adopt a zero-emission GHG threshold. If the zero threshold option is chosen, the lead agency would be required to quantify and mitigate GHG emissions for all projects subject to CEQA, regardless of the size of the project or the availability of GHG reduction measures available to reduce the project's emissions. Projects that could not meet the zero-emission threshold would be required to undergo an environmental impact report (EIR) CEQA process to disclose the unmitigable significant impact, and develop the justification for a statement of overriding consideration to be adopted by the lead agency.

CAPCOA notes in the White Paper that if an air district or lead agency elects to adopt a zero threshold approach, it should consider the administrative costs and the environmental review system capacity. Some projects that previously would have qualified for an exemption could require further substantial analysis, including preparation of a Negative Declaration (ND), a Mitigated Negative Declaration (MND) or an EIR. Moreover, the trade-offs between the volume of projects requiring review and the quality of consideration given to reviews should be considered. It may also be useful to consider whether meaningful mitigation can be achieved from smaller projects.

- *Approach 1: Non-Zero Threshold – Statute and Executive Order Approach*

According to CAPCOA, a non-zero GHG significance threshold could minimize the resources spent reviewing environmental analyses that do not result in real GHG reductions or to prevent the environmental review system from being overwhelmed. The practical advantages of considering non-zero thresholds for GHG significance determinations can fit into the concept regarding whether the project's GHG emissions represent a "considerable contribution to the cumulative impact" and therefore warrant analysis.

The first non-zero GHG significance threshold approach is based on achieving the objectives of AB 32 or executive order EO S-3-05 and explores four possible options under this scenario. A project would be required to meet the target objectives, or reduce GHG emissions to the target objectives, to be considered less than significant. The options under this approach are variations of ways to achieve the 2020 goals of AB 32 from new development, which is estimated to be about a 30 percent reduction from business-as-usual. Table 2-1 summarizes the four statute and executive order approaches identified by CAPCOA. SCAQMD staff has identified and included in Table 2-1 potential pros and cons identified for each option.

- *Approach 2: Non-Zero Threshold – Tiered Threshold Options*

The second non-zero GHG significance threshold approach is comprised of a number of tiered GHG significance threshold options. Within this option, the CAPCOA White Paper discusses seven variations. The tiered threshold options offer both quantitative and qualitative approaches to setting a threshold, as well as different metrics for establishing the various tiers. Variations range from setting the first tier at zero to second tiers set at defined emission levels or based on the size of a project. This approach would then prescribe a set of GHG mitigation strategies that would have to be incorporated into the project in order for the project to be considered less than significant. CAPCOA notes that some applications of the tiered threshold approach may require inclusion in a General Plan or adoption of enabling regulations or ordinances to render them fully effective and enforceable. The various tiered threshold options are summarized in Table 2-2. SCAQMD staff has identified and included in Table 2-2 potential pros and cons identified for each option.

Table 2 – 1
Statute and Executive Order Approach

Threshold Number	Description of Threshold	Pros*	Cons*
1.1	Project must reduce emissions compared to business as usual to be less than significant, two approaches: a. Project must reduce GHG emissions 33 percent compared to business-as-usual (BAU) (2020 target), or b. Project must reduce GHG emissions 80 percent compared to business-as-usual (2050 target).	• Could reduce resource impacts compared to zero threshold, as not every project would require an EIR • Would achieve GHG reductions consistent with AB 32 • A single threshold is easier to apply and understand	• Could be viewed as setting a de minimis level • Fewer projects would trigger significance, thus, less mitigation • BAU should be defined by CARB • BAU may be difficult to define for all projects
1.2	All new projects must reduce GHG emissions compared to BAU by a uniform percentage to be considered less than significant, e.g., 50 percent.	• Same as 1.1 • May produce greater percent reduction of GHGs • Single threshold easier to apply & understand	• Could produce substantially greater GHG reductions than 1.1, but may be difficult to achieve • BAU should be defined by CARB • BAU may be difficult to define for all projects

* Pros and cons reflect only SCAQMD staff's evaluation of the approaches.

Table 2 – 1 (Concluded)
Statute and Executive Order Approach

Threshold Number	Description of Threshold	Pros*	Cons*
1.3	Projects must reduce GHG emissions compared to business-as-usual by a uniform percentage based on economic sector to be less than significant, i.e., different reductions required for different market sectors.	• Sector-specific approach may be more appropriate approach • Would take into account costs & available control technologies • Avoids over- or under-regulation of GHGs per sector	• Requires extensive information on emission inventories • Requires extensive information on control technologies • Difficult to determine percent reduction by sector • Because of information requirements, may be more viable in the long term
1.4	Uniform GHG emission reduction by region. Regional GHG reduction plan developed consistent with AB32 emission reductions, e.g., reduce GHG emissions 33% or 80% compared to BAU. A project is not significant if its GHG emissions are consistent with plan.	• Could tailor GHG reductions to specific regional needs • GHG reduction strategies could be integrated into regional plans	• Would need to establish GHG regions • Requires extensive information on regional emission inventories • Because of the need to develop a regional plan, may be a more viable interim approach

* Pros and cons reflect only SCAQMD staff's evaluation of the approaches.

Table 2 – 2
Tiered Threshold Options

Threshold Number	Description of Threshold	Pros*	Cons*
2.1	This threshold employs a decision tree approach. Tier 1, no increase in GHG emissions, not significant (zero threshold). If GHG emissions greater than zero, tier two, use one of the following threshold options.	• Tiered approach allows flexibility by establishing multiple thresholds to cover a wide range of projects • Tier 2 may minimize administrative burden & costs • Tiers could be set at different levels depending on GHGs, size & other project characteristics • Projects exceeding tier 2 must implement mitigation	• Tier 1 may increase administrative burdens & costs • There may not be meaningful mitigation for small projects • Available mitigation may consist of purchasing offsets • EJ concerns of purchasing offsets because of associated criteria pollutant emissions • Offset markets not well established
2.2	Establish a quantitative threshold based on capturing a percentage, e.g., 90%, of future discretionary projects, CAPCOA's threshold is 900 metric tons CO2eq per year (equivalent to 50 houses or 30,000 square feet of commercial space, i.e., CAPCOA assumes 90% of all projects are this size or greater). Projects less than this would not be significant.	• Would capture a larger percentage of projects in the district than is currently the case • Would exclude small projects from further GHG analysis • Single threshold easier to apply & understand	• Would increase administrative & cost burden, especially in developing & moderate growth areas • May not be amenable to industrial projects because of the diversity of these projects • There may not be meaningful mitigation for small projects

* Pros and cons reflect only SCAQMD staff's evaluation of the approaches.

Table 2 – 2 (Continued)
Tiered Threshold Options

Threshold Number	Description of Threshold	Pros*	Cons*
2.3	This threshold is based on CARB's proposed mandatory reporting threshold of 25,000 metric tons of CO2eq per year. Alternatively, use the Market Advisory Committee of 10,000 metric tons of CO2eq per year. Projects less than either would not be significant.	• CARB estimates this threshold would capture 90 % of all industrial projects • Single threshold easier to apply & understand	• May not be amenable to industrial projects because of the diversity of these projects • There may not be meaningful mitigation for small projects
2.4	This approach establishes a GHG threshold based on and analogous to a NOx/VOC criteria pollutant CEQA significance threshold and is established using the following four steps: a. Define NOx/VOC CEQA thresholds in tons per year (e.g., 10 t/yr) b. Define the regional NOx/VOC inventory in tons per year (e.g., annual NOx inventory for 2005 from 2007AQMP ~ 375,585 t/yr) c. Calculate percentage of NOx/VOC inventory the significance threshold represents (10 / 375,585 = 0.00003) to obtain "minimum percentage of regulated inventory" for NOx/VOC.	• Single threshold easier to apply & understand	• Threshold cumbersome to derive • Threshold would change periodically as inventory goes up or down • Could have widely divergent thresholds by air basin because of varying inventories

* Pros and cons reflect only SCAQMD staff's evaluation of the approaches.

Table 2 – 2 (Continued)
Tiered Threshold Options

Threshold Number	Description of Threshold	Pros*	Cons*
2.4 (Cont.)	d. Define California GHG emission inventory for 2004 in tons CO2eq per year (499 MMT CO2eq). Apply minimum percentage of regulated inventory to California GHG inventory for 2004 to develop a GHG threshold analogous to the CEQA Threshold (e.g., 0.00003 x 499 MMT = 14,970 metric tons CO2eq per year = significance threshold).	•	•
2.5	Establish quantitative unit-based thresholds based on capturing a percentage, e.g., 90%, of future discretionary projects in specific market sectors (similar to 2.2 above). CAPCOA examples include: • 30,000 square-foot (SF) office =800 metric tons CO2eq per year; • 30,000 SF retail = 2,500 metric tons CO2eq per year; • 30,000 SF supermarket = 43,000 metric tons CO2eq per year.	• Would capture a larger percentage of projects in the district than is currently the case • Would exclude small projects from further GHG analysis • Single threshold easier to apply & understand	• Would increase administrative & cost burden, especially in developing & moderate growth areas • May not be amenable to industrial projects because of the diversity of these projects • There may not be meaningful mitigation for small projects

* Pros and cons reflect only SCAQMD staff's evaluation of the approaches.

Table 2 – 2 (Concluded)
Tiered Threshold Options

Threshold Number	Description of Threshold	Pros*	Cons*
2.6	This threshold would include tiered CEQA thresholds based on CEQA's definition of "projects with statewide, regional or areawide significance (§15206(b)), which include: • Residential development > 500 dwellings • Shopping center or business establishment employing > 1,000 persons or > 500,000 SF • Commercial office building employing >1,000 persons or > 250,000 SF • Hotel/motel > 500 rooms • Industrial, manufacturing or processing plant or industrial park employing > 1,000 persons or > 600,000 SF	• Could capture up to 50% of all future commercial development	• May capture substantially less than 50% if future development, resulting less GHG mitigation • Percentage capture of industrial/manufacturing projects currently unknown
2.7	Efficiency-based thresholds would be based on measurements of efficiency compared to intensity. Must be based on reasonable GHG emissions compared to business-as-usual.	• Would benchmark GHG intensity against target levels of efficiency • Thresholds established to provide future foreseeable GHG reductions compared to BAU • Would support AB 32 target objectives	• Would require substantial data & possibly modeling • May be more appropriate as a threshold in the long term

* Pros and cons reflect only SCAQMD staff's evaluation of the approaches.

CHAPTER 3

INTERIM GHG SIGNIFICANCE THRESHOLD STAFF PROPOSAL

INTRODUCTION

Because GHG emissions affect global climate, some have argued that it may be more appropriate for national or state agencies to establish significance thresholds or GHG emission reduction target objectives. However, no agency has established GHG significance thresholds that could assist Lead Agencies with determining the significance of GHG emissions in CEQA documents. In the absence of statewide guidance on this issue and in response to requests from a variety of stakeholders, the SCAQMD established a GHG Significance Threshold Stakeholder Working Group (Working Group) to establish an interim GHG significance threshold until such time as the state establishes a GHG significance threshold or provides recommended guidance on establishing a GHG significance threshold. Staff's goal is to reach consensus regarding an interim GHG significance threshold to the extent possible and take the staff proposal to the SCAQMD Governing for consideration and approval.

The Working Group was formed to assist staff's efforts to develop an interim GHG significance threshold an is comprised of a wide variety of stakeholders including: state agencies, OPR, CARB, and the Attorney General's Office; local agencies, city and county planning departments, utilities such as sanitation and power, etc.; regulated stakeholders, industry and industry groups; and organizations, both environmental and professional. Stakeholders were chosen based on their participation in other related stakeholder working groups and their expressed interest in participating in the developing a GHG significance threshold. Working group meetings are open to the public and have been well attended. The members of the Working Group and other interested parties who have requested to be notified of the meetings are listed in Appendix A. Information on the progress of the Working Group, including agendas, overhead presentations, and letters received from the various stakeholders can be found at the following website: https://www.aqmd.gov/ceqa/handbook/GHG/GHG.html.

Part of the purpose of the Working Group is to provide a forum to solicit comments and suggestions from the various stakeholders to assist SCAQMD staff with developing an interim GHG significance threshold that is consistent with CEQA requirements for developing significance thresholds, is supported by substantial evidence, and provides guidance to CEQA practitioners with regard to determining whether GHG emissions from a proposed project are significant.

SCAQMD staff held the first Working Group meeting in April 2008. Except for September, Working Group meetings have been held on a monthly basis since April. Brief summaries of each Working Group meeting and the topics and staff GHG significance threshold proposals discussed to date are provided in Appendix B. Staff's initial proposed has been modified over time based on comments and concerns raised at Working Group meetings or in written comments. The following sections summarize staff's latest recommended interim GHG significance threshold proposal and some of the concepts necessary to understanding the various components of staff's proposal. The latest staff proposal is considered to be a work-in-progress as staff is continuing to solicit further public input and suggestions.

The following subsections briefly summarize the GHG significance threshold design criteria concepts included as part of staff's proposed interim GHG significance threshold proposal. Following the discussion of design concepts, SCAQMD staff's current interim proposal is described.

GHG ANALYSIS CONSIDERATIONS

Before discussing quantification methodologies, it is necessary to consider design criteria that establish the parameters upon which the actual GHG analysis is based. The following subsections include discussions from the Working Group of some of the most important design criteria to be considered when quantifying GHG emissions. The following topics include some of the most important parameters that should be considered when quantifying GHG emissions and, therefore, should not be considered an exhaustive list of considerations as individual projects may include characteristics that may require additional considerations.

Policy Objective

The overarching policy objective with regard to establishing a GHG significance threshold for the purposes of analyzing GHG impacts pursuant to CEQA is to establish a performance standard or target GHG reduction objective that will ultimate contribute to reducing GHG emissions to stabilize climate change. Full implementation of the Governor's Executive Order S-3-05 would reduce GHG emissions 80 percent below 1990 levels or 90 percent below current levels by 2050. It is anticipated that achieving the Executive Order's objective would contribute to worldwide efforts to cap GHG concentrations at 450 ppm, thus, stabilizing global climate.

As described below, staff's recommended interim GHG significance threshold proposal uses a tiered approach to determining significance. Tier 3, which is expected to be the primary tier by which the AQMD will determine significance for projects where it is the lead agency, uses the Executive Order S-3-05 goal as the basis for deriving the screening level. Specifically, the Tier 3 screening level for stationary sources is base on an emission capture rate of 90 percent for all new or modified projects. A 90 percent emission capture rate means that 90 percent of total emissions from all new or modified stationary source projects would be subject to some type of CEQA analysis, including a negative declaration, a mitigated negative declaration, or an environmental impact.

Therefore, the policy objective of staff's recommended interim GHG significance threshold proposal is to achieve an emission capture rate of 90 percent of all new or modified stationary source projects. A GHG significance threshold based on a 90 percent emission capture rate may be more appropriate to address the long-term adverse impacts associated with global climate change. Further, a 90 percent emission capture rate sets the emission threshold low enough to capture a substantial fraction of future stationary source projects that will be constructed to accommodate future statewide population and economic growth, while setting the emission threshold high enough to exclude small projects that will in aggregate contribute a relatively small fraction of the cumulative statewide GHG emissions. This assertion is based on the fact that staff estimates that these GHG emissions would account for less than one percent of future 2050 statewide GHG emissions target (85 MMTCO2eq/yr). In addition, these small projects would be subject to future applicable GHG control regulations that would further reduce their overall future contribution to the statewide GHG inventory

- GHG Pollutants

Gases that trap heat in the atmosphere are often called greenhouse gases. The Kyoto Protocol, adopted in December 1997, is an agreement under which industrialized countries will reduce their collective emissions of greenhouse gases by specified percentages, depending on the country, compared to 1990 levels. The goal is to lower overall emissions of six greenhouse gases - carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, and perfluorocarbons, averaged over the period of 2008-2012.

Similarly, AB 32 defines GHGs as including the following: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (Health and Safety Code, section 38505(g)). The most common GHG that results from human activity is carbon dioxide, followed by methane and nitrous oxide.

Some greenhouse gases such as carbon dioxide occur naturally and are emitted to the atmosphere through natural processes and human activities. Other greenhouse gases (e.g., fluorinated gases) are created and emitted solely through human activities. The principal greenhouse gases that enter the atmosphere because of human activities are:

- **Carbon Dioxide (CO_2):** Carbon dioxide enters the atmosphere through the burning of fossil fuels (oil, natural gas, and coal), solid waste, trees and wood products, and also as a result of other chemical reactions (e.g., manufacture of cement). Carbon dioxide is also removed from the atmosphere (or “sequestered”) when it is absorbed by plants as part of the biological carbon cycle.

- **Methane (CH_4):** Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills.

- **Nitrous Oxide (N_2O):** Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.

- **Fluorinated Gases:** Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes. Fluorinated gases are sometimes used as substitutes for ozone-depleting substances (i.e., CFCs, HCFCs, and halons). Fluorinated gases are typically emitted in smaller quantities, but because they are potent greenhouse gases, they are sometimes referred to as high global warming potential gases (high GWP gases).

  - Hydrofluorocarbons are manmade chemicals that have historically replaced Chlorofluorocarbons used in refrigeration and semiconductor manufacturing.

  - Perfluorocarbons are manmade chemicals that are by-products of aluminum smelting and uranium enrichment.

  - Sulfur hexafluoride is a manmade chemical that is largely used in heavy industry to insulate high voltage equipment and to assist in the manufacturing of cable cooling systems.

GWP is a measure of how much a given mass of greenhouse gas is estimated to contribute to global warming. It is a relative scale that compares the gas in question to the same mass of carbon dioxide (whose GWP is by definition 1). A GWP is calculated over a specific time interval and the value of this must be stated whenever a GWP is quoted or else the value is meaningless. A substance's GWP depends on the time span over which the potential is calculated. A gas which is quickly removed from the atmosphere may initially have a large effect but for longer time periods as it has been removed becomes less important. For the purposes of a CEQA analysis, especially an analysis of operation emissions, the maximum GWP is typically used, regardless of the actual atmospheric lifetime. This approach simplifies the analysis and provides a very conservative analysis, especially for the fluorinated gases. The GWP of the six Kyoto GHGs is shown in Table 3-1.

The SCAQMD staff recommends that a GHG analysis include the six Kyoto GHGs, to the extent emission factors are available primarily because there is more information on these GHGs than other potential GHGs. Other GHGs would be added to the list as scientific information becomes available and agreed to by national or international protocols and agreements.

Table 3-1

Global Warming Potential of Kyoto GHGs

Gas	Atmospheric Lifetime	GWP
Carbon dioxide (CO2)	50 – 200	1
Methane (CH4)	12 ± 3	21
Nitrous oxide (N2O)	120	310
HFC-23 (Hydrofluorocarbons)	264	11,700
HFC-32	5.6	650

Table 3-1 (Concluded)
Global Warming Potential of Kyoto GHGs

Gas	Atmospheric Lifetime	GWP
HFC-125	32.6	2,800
HFC-134a	14.6	1,300
HFC-143a	48.3	3,800
HFC-152a	1.5	140
HFC-227ea	36.5	2,900
HFC-236fa	209	6,300
HFC-4310mee	17.1	1,300
CF4 (Perfluorocarbons)	50,000	6,500
C2F6	10,000	9,200
C4F10	2,600	7,000
C6F14	3,200	7,400
Sulfer hexafluoride (SF6)	3,200	23,900

Source: U.S. EPA (http://www.epa.gov/)

Carbon black, a form of particulate air pollution most often produced from biomass burning, cooking with solid fuels and diesel exhaust, may also have a warming effect in the atmosphere. It is estimated that carbon black's contribution to climate change is second only to carbon dioxide. Carbon black contributes to global warming by absorbing heat while airborne in the atmosphere. Carbon black is of particular concern in the arctic because it settles on ice and snow, reducing its reflectivity and increasing the rate of melting.

Based on a survey of available information, there are little data available for calculating carbon black effects on global warming. As a result, SCAQMD staff is not recommending analyzing carbon black effects on global warming. As information becomes available, staff will reconsider adding carbon black to the list of GHGs to be analyzed in CEQA documents.

- Business-As-Usual (BAU)

In CARB's Scoping Plan (CARB, 2008) CARB states that the BAU case is a representation of what the state of the California economy will be in the year 2020 assuming that none of the measures recommended in the Scoping Plan are implemented. CARB's projected BAU GHG emissions in 2020 are shown in Table 3-2.

Table 3-2
2002-2004 Average Emissions and 2020 Projected Emissions (Business-as-Usual) (MMTCO2E)

Sector	2002-2004 Average Emissions	Projected 2020 Emissions [BAU]
Transportation	179.3	225.4
Electricity	109.0	139.2
Commercial and Residential	41.0	46.7
Industry	95.9	100.5
Recycling and Waste	5.6	7.7
High GWP	14.8	46.9
Agriculture	27.7	29.8
Forest Net Emissions -	4.7	0.0
Emissions Total	**469**	**596**

Source: CARB, 2008 – Scoping Plan, Table 1

CARB's Scoping Plan states further that continuing increases in global greenhouse gas emissions at BAU rates would result, by late in the century, in California losing 90 percent of the Sierra snow pack, sea level rising by more than 20 inches, and a three to four times increase in heat wave days, flood damage, etc. To avoid future foreseeable environmental impacts to California, the Scoping plan calls for an ambitious but achievable reduction in California's carbon footprint. Reducing greenhouse gas emissions to 1990 levels means reducing approximately 30 percent from BAU emission levels projected for 2020, or about 15 percent from today's levels. On a per-capita basis, that means reducing our annual emissions of 14 tons of carbon dioxide equivalent for every man, woman and child in California down to about 10 tons per person by 2020.

Although CARB's Scoping Plan calls for reducing GHG emissions 30 percent from BAU levels, it does not explicitly define BAU. There is, however, a brief definition of BAU in CARB's GHG inventory document (CARB, 2007). In that document CARB describes BAU as:

- BAU is based on GHG emissions estimates in the absence of policies and reduction measures, and
- BAU is based on forecasted demographic and economic growth.

In its White Paper, CAPCOA provides a more detailed definition of BAU compared to the above definition in CARB's inventory document. In the White Paper BAU is defined as follows:

- The projection of GHGs into the future based on current technologies and regulations;

- The adoption of new GHG reduction regulations, e.g., CARB's Scoping Plan measures, in the future establishes new BAU, i.e., the definition of BAU evolves over time; and
- BAU will normally define the CEQA no project alternative, but does not necessarily form the project baseline.

Based on the above definitions and discussions from the Working Group, SCAQMD staff defines BAU as the following

- Is used to project project's future emissions (consistent with CAPCOA and CARB definitions), i.e., level from which GHG reductions must occur;
- Is based first and foremost on current regulatory requirements (consistent with CAPCOA and CARB definitions);
- Regulatory requirements may determine current technology, e.g., advanced technology may be available, but not required, such as combined cycle gas turbine;
- Will normally define the no project alternative (consistent with CAPCOA and CARB definitions); and
- May be used to establish a project's CEQA baseline, only if consistent with CEQA Guidelines §15125.

The importance of BAU lies not only in the fact that it is a methodology for calculating a project's future emissions, is also forms the emission level from which GHG emission reductions must occur. SCAQMD staff's current GHG significance threshold proposal includes the Tier 4 compliance option 1 that establishes a performance standard of reducing GHG emissions 30 percent below the project's projected BAU emissions through design features and/or mitigation measures. A 30 percent reduction from BAU is consistent with the target objectives of AB 32 and CARB's Scoping Plan. The intent of the Tier 4 compliance option 1 is to provide a feasible target objective, that will not only contribute to achieving the AB 32 target objective, but will also contribute to achieving the 2050 target of the Governor's Executive Order S-3-05, which establishes of target objective of reducing GHG emissions 80 percent below 1990 levels or a 90 percent reduction from current BAU estimates.

As recognized by CAPCOA and SCAQMD, BAU will evolve over time as the current regulatory framework changes to implement GHG reduction strategies, either statewide strategies, e.g., CARB's Scoping Plan, or any future federal strategies. Evolving BAU creates two issues for the CEQA practitioner. First, staff's proposed Tier 4 compliance option 1 target objective is unchanged from 30 percent, then over time as BAU changes to incorporate GHG reduction strategies, achieving the target objective will become more difficult. Second, any GHG significance thresholds that rely on BAU will have higher uncertainties because they rely on a constantly changing BAU, which may be difficult to define.

To resolve some of these issues of an evolving definition of BAU, SCAQMD staff recommends that a statewide definition be developed by CARB that is updated periodically. Until such time as a statewide definition of BAU is developed, the SCAQMD staff will rely on the above definition. Because the SCAQMD's staff's GHG significance proposal is considered to be an interim proposal, future updates or revisions to staff's proposal would also include updates to BAU or the target objective as BAU levels decline over time. It may be that a target objective percent reduction from BAU levels is a short-term GHG threshold proposal and may become less important in the future as other concepts are evaluated and more fully developed.

- GHG Source Categories to Analyze

Life Cycle Analysis

CEQA requires that the lead agency analyze direct and indirect impacts from a proposed project, giving due consideration to short-term and long-term effects (CEQA Guidelines 15126.2(a)). In the case of GHG pollutants a systems approach to evaluating the consequences of a particular product, process or activity may be more appropriate because of the long atmospheric lifetimes of the various GHGs (see Table 3-1). One of the most effective ways of evaluating GHGs using a systems approach is through the preparation of a life cycle analysis (LCA).

The goal of a life cycle analysis is to compare the full range of environmental damages assignable to products and services, to be able to choose the least burdensome one. The term 'life cycle' refers to the concept that a fair, holistic assessment requires the assessment of raw material production, manufacture, distribution, use and disposal including all intervening transportation steps necessary or caused by the product's existence. The sum of all those steps - or phases - is the life cycle of the product.

Performing a life cycle analysis may be difficult for a number of projects or processes because life cycle emission factors may not be well established for many activities or projects and the life cycle process itself may not be known or well-defined. SCAQMD staff, however, recommends that life cycle analyses be prepared for all projects undergoing a CEQA analysis, as this will produce a more defensible approach. If, however, any component of the life cycle analysis is unavailable, unknown, or not supported by scientific evidence, the lead agency should note such an analysis would be speculative pursuant to CEQA Guidelines §15145 and terminate discussion of that impact.

Direct/Indirect Impacts

Consistent with CEQA, indirect and direct impacts of the project, typically within California, are required to be analyzed in the CEQA document for a proposed project. The analysis of direct GHG impacts is relatively straightforward as onsite GHG sources or directly related offsite GHG sources, such as worker commute trips, are generally readily identifiable. Indirect GHG emission sources are less obvious, but may include some of the sources identified in the following paragraphs. In general, for most projects information on direct and indirect emissions may be available, rather than a full life-cycle analysis of emissions. The lead agency has typically been expected to address emissions that are closely related and within the capacity of the project proponent to control and/or influence.

Direct Impacts - are primary effects that are caused by a project and occur at the same time and place, such as emissions from boilers, heaters, or other onsite emissions sources. Direct impacts generated by a project may include offsite sources directly related to the project such as emissions from worker commute trips, haul truck trips to import raw materials and/or export finished products or other goods.

Direct GHG emission impacts will include both construction and operation activities. Because impacts from construction activities occur over a relatively short-term period of time, they contribute a relatively small portion of the overall lifetime project GHG emissions. In addition, GHG emission reduction measures for construction equipment are relatively limited. Therefore, SCAQMD staff is recommending that construction emissions be amortized over a 30-year project lifetime, so that GHG reduction measures will address construction GHG emissions as part of the operational GHG reduction strategies.

Indirect Impacts - The CEQA Guidelines define indirect impacts as the following: an indirect physical change in the environment…which is not immediately related to the project, but which is caused indirectly by the project. If a direct physical change in the environment in turn causes another change in the environment, then the other change is an indirect change in the environment (CEQA Guidelines §15064 (d)(2)). Indirect or secondary effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems (CEQA Guidelines §15358)(a)(2)).

DRAFT STAFF INTERIM GHG SIGNIFICANCE THRESHOLD PROPOSAL

As indicated by the evolution of the staff proposal over time, SCAQMD has generally recommended a tiered decision tree approach to establishing a GHG significance threshold. In CAPCOA's White Paper, eight of the 12 significance threshold options are based on a tiered threshold approach (see also Table 2-2 in Chapter 2). A tiered GHG significance threshold approach is an appealing approach because it provides flexibility in determining whether or not GHG emissions from a project are significant typically using a single methodology to establish various tiers that can be based on the physical size of the project, land use type, or other characteristics. The tiered approach envisioned by SCAQMD staff would require quantification of GHG emissions for all projects that are subject to CEQA and quantification of the GHG reduction effectiveness of design parameters incorporated into the project and any mitigation measures imposed by the lead agency. It may even be necessary to quantify GHG emissions, if any, for projects that would otherwise qualify for a categorical exemption to document that no "cumulative impact of successive projects of the same type in the same place, over time is significant" (CEQA Guidelines §15300.2(b), or that there is no "reasonable possibility that the activity will have a significant effect on the environment due to unusual circumstances." (CEQA Guidelines §15300.2(c)).

The CAPCOA White Paper also includes a discussion of a decision tree approach to tiering. Instead of using a single methodology to establish tiers, a decision tree approach would use multiple methodologies to demonstrate significance for a broad range of projects/plans that may be difficult to address using a single GHG significance threshold methodology. Using a decision tree approach promotes even greater flexibility in determining significance for a variety of project types.

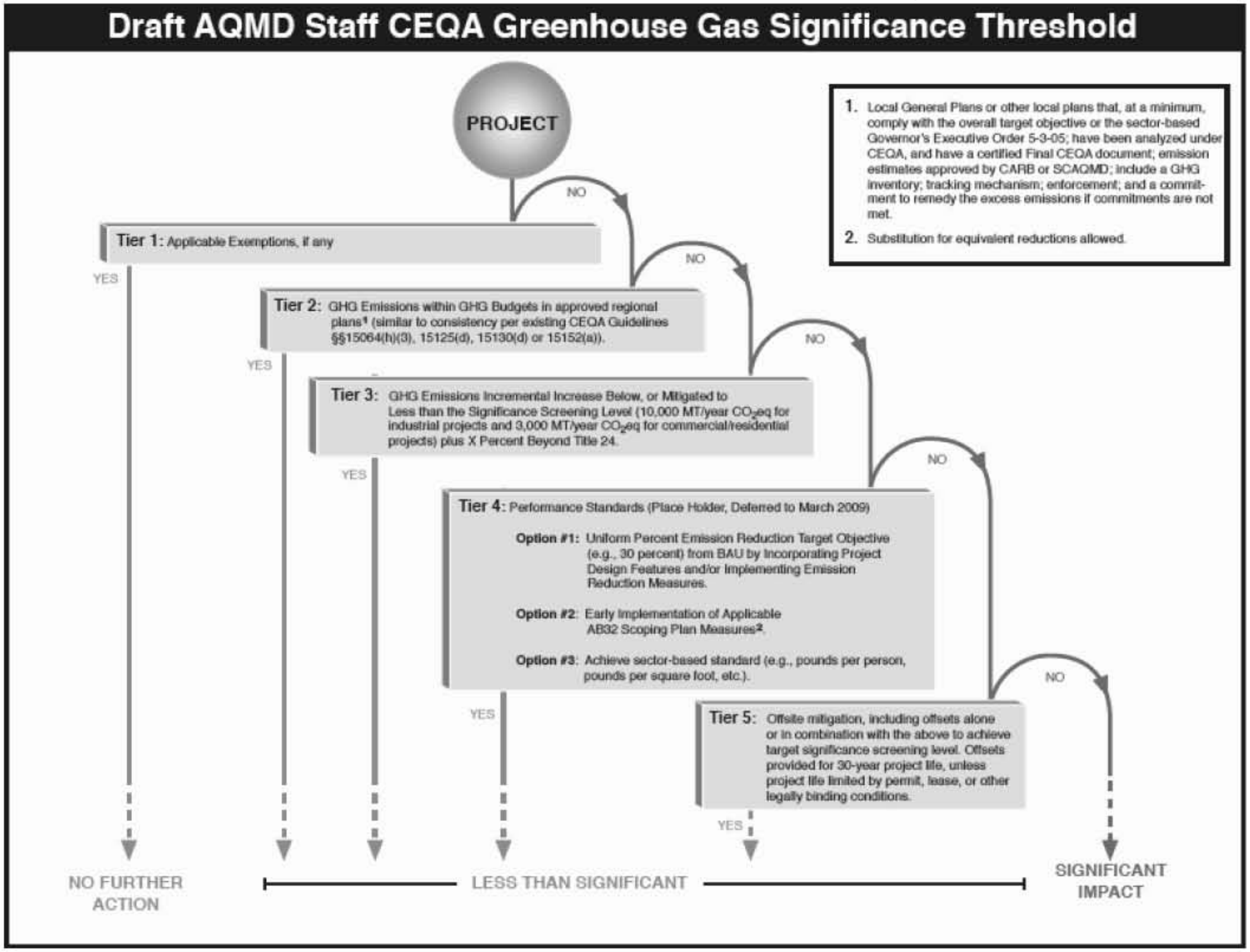
At the August 27, 2008 Working Group meeting #5, staff presented the revised interim GHG significance proposal #3, which included a tiered decision tree approach. Unlike the decision tree approach discussed in CAPCOA's White Paper, some tiers include multiple approaches for determining whether a project's GHG emissions are significant, rather than using a single different methodology for each tier.

For the purposes of determining whether or not GHG emissions from affected projects are significant, project emissions will include direct, indirect, and, to the extent information is available, life cycle emissions during construction and operation. Construction emissions will be amortized over the life of the project, defined as 30 years, added to the operational emissions, and compared to the applicable interim GHG significance threshold tier. The following bullet points describe the basic structure of staff's tiered GHG significance threshold proposal for stationary sources. The components of revised staff proposal #3 are described in the following paragraphs and shown graphically in Figure 3-1.

- **Tier 1 –** consists of evaluating whether or not the project qualifies for any applicable exemption under CEQA. For example, SB 97 specifically exempts a limited number of projects until it expires in 2010. If the project qualifies for an exemption, no further action is required. If the project does not qualify for an exemption, then it would move to the next tier.

- **Tier 2 –** consists of determining whether or not the project is consistent with a GHG reduction plan that may be part of a local general plan, for example. The concept embodied in this tier is equivalent to the existing concept of consistency in CEQA Guidelines §§15064(h)(3), 15125(d), or 15152(a). The GHG reduction plan must, at a minimum, comply with AB 32 GHG reduction goals; include emissions estimates agreed upon by either CARB or the SCAQMD, have been analyzed under CEQA, and have a certified Final CEQA document. Further, the GHG reduction plan must include a GHG emissions inventory tracking mechanism; process to monitor progress in achieving GHG emission reduction targets, and a commitment to remedy the excess emissions if AB 32 goals are not met (enforcement).

Figure 3-1
Revised Staff Proposal #3 Tiered Decision Tree Approach – August 27, 2008



If the proposed project is consistent with the local GHG reduction plan, it is not significant for GHG emissions. If the project is not consistent with a local GHG reduction plan or there is no approved plan, the GHG reduction does not include all of the components described above, or there is no adopted GHG reduction plan, the project would move to tier 3.

- **Tier 3 –** attempts to identify small projects that would not likely contribute to significant cumulative GHG impacts. However, because of the magnitude of increasing global temperatures from current and future GHG emissions, staff is recommending that all projects must implement some measure or measures to contribute to reducing GHG emissions. Therefore, Tier 3 includes a requirement that ~~all~~ residential/commercial projects with GHG emissions less than the screening level must include efficiency components that ~~reduce a certain~~go X percent~~age~~ beyond the requirements of Title 24 (Part 6, California Code of Regulations), California's energy efficiency standards for residential and nonresidential buildings. Project proponents would also have to reduce by a specified percentage electricity demand from water use, primarily electricity used for water conveyance.

  ~~The most recently~~A past recommended screening level proposed by staff was 6,500 MTCO2eq./year. This screening level was derived using the SCAQMD's existing NOx operational threshold as a basis. The daily NOx operational significance threshold, 55 pounds per day was annualized, which results in 10 tons of NOx per year.

  Staff initially considered and then rejected a bifurcated screening level, that is one screening level for residential and commercial projects and a different screening level for industrial projects based on the URBEMIS modeling runs used to derive the 6,500 MTCO3eq/yr screening level because GHG emissions from industrial were of the same magnitude as the GHG emissions from residential and commercial projects. Staff has reconsidered the bifurcated screening level approach as there is a more scientific basis for deriving the different screening levels.

  SCAQMD staff is now recommending a bifurcated screening level approach to address two greatly differing project types: industrial projects as opposed to residential and commercial projects (which are largely indirect sources). The former category typically contains stationary source equipment whose emissions are largely permitted or regulated by the SCAQMD; whereas the latter category is mostly residential, commercial (may also include industrial) building structures that attract or generate mobile source emissions. In light of the GHG reductions needed to stabilize the climate while considering implementation resource requirements, the policy objective used to establish the screening thresholds is to capture projects that represent approximately 90 percent of GHG emissions from new sources. The following paragraphs describe the steps taken to derive the screening threshold values.

Industrial Projects: Since the majority of GHG emissions in the district are comprised of CO2 emissions from burning natural gas rather than other types of fossil fuel, staff compiled reported annual natural gas consumption for 1,297~~115~~ permitted facilities for 2006-2007 and rank-ordered the facilities to estimate the 90th percentile of the cumulative natural gas usage for all permitted facilities. Operators of these facilities are required to report their emissions and associated throughput under the SCAQMD's Annual Emission Reporting (AER) Program if any of their criteria pollutant emissions exceed four tons per year (100 tons per year for CO) or if the facility has any reportable air toxics emission. Figure 3-2 shows that approximately 10 percent of facilities evaluated comprise more than 90 percent of the total natural gas consumption, which corresponds to 10,000 metric tons per year (tpy) of CO2 emissions. This value represents a boiler with a rating of approximately 27 million British thermal units per hour (mmbtu/hour) of heat input, operating at ~~a~~n ~~25~~ 80 percent capacity factor. If the screening threshold of 10,000 MTCO2eq./yr is implemented, based on the permitting activities for 2006-2007 it will result in at least 31 additional MNDs or EIRs being prepared by the SCAQMD as the lead agency unless another tier option is selected to demonstrate no significant impacts for GHG emissions. It should be noted that this analysis did not include other possible GHG pollutants such as methane, N2O; a life-cycle analysis; mobile sources; or indirect electricity consumption. Therefore, under a 10,000 MTCO2eq./yr screening level more projects would be required to go through an MND or EIR environmental analysis than is currently the case. Furthermore, when the SCAQMD acts as a lead agency, the stationary source equipment employed as part of the proposed project typically must comply with BACT or other SCAQMD rules, regulations, programs that require reducing criteria pollutants or air toxics. Therefore, staff is proposing to replace the 6,500 MTCO2/yr screening level with the 10,000 MTCO2eq/yr as the screening level in tier III for industrial projects when the SCAQMD is the lead agency for the project.

Residential and Commercial Projects: To achieve the same 90 percent GHG emission capture rate for this segment of projects GHG emissions from residential and commercial sectors were compared to the GHG emissions from the industrial sector including the in-state power plants. The draft AB32 scoping plan indicates that based on statewide 2002-2004 average GHG emissions, the residential and commercial sectors account for approximately nine percent of the total statewide GHG inventory, while the industrial sector (including instate power plants) accounts for approximately 30 percent of the statewide GHG emission inventory. The inventory methodology for both sectors includes only on-site energy use, consistent with the staff approach taken in deriving the 10,000 tpy threshold. Assuming similar emission characteristics also exist for the residential and commercial sector (i.e., large residential or commercial projects, although fewer in numbers, contribute substantially more to the total emissions), it is estimated that at a threshold of approximately 3,000 MTCO2eq/yr emissions (10,000 x (9 percent / 30 percent)) would capture 90 percent of the GHG emissions from new residential or commercial projects. A series of sensitivity analyses was performed by the staff using URBEMIS to assess the likely project size for 3,000 MTCO2eq/yr emissions. Table 3-3 illustrates various projects by size and shape.

Figure 3-2

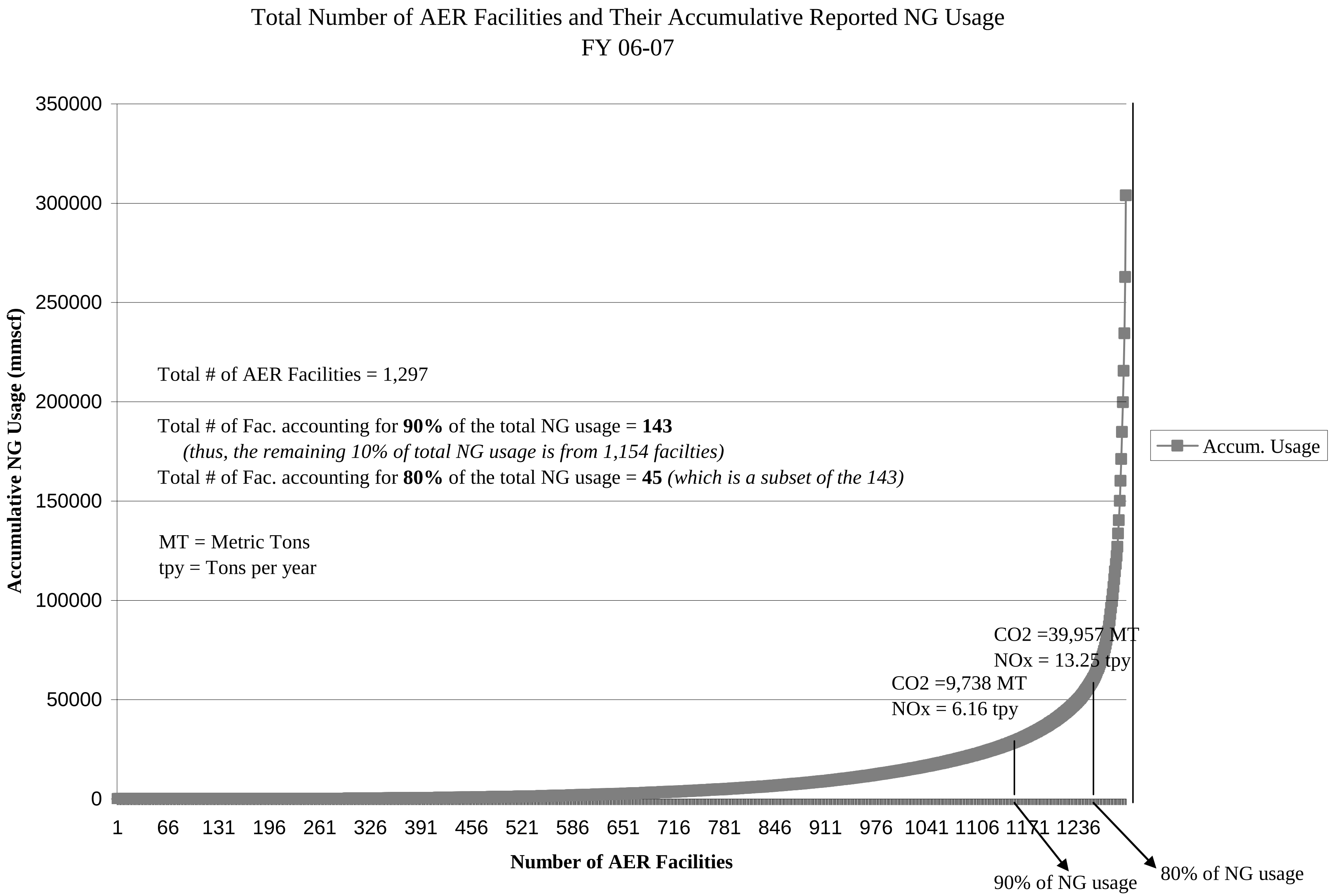

Total Number of AER Facilities and Their Accumulative Reported NG Usage
FY 06-07
Accumulative NG Usage (mmscf)
350000
300000
250000
200000
150000
100000
50000
0
1
66
131
196
261
326
391
456
521
586
651
716
781
846
911
976
1041
1106
1171
1236
Number of AER Facilities
Accum. Usage
Total # of AER Facilities = 1,297
Total # of Fac. accounting for **90%** of the total NG usage = **143**
(thus, the remaining 10% of total NG usage is from 1,154 facilties)
Total # of Fac. accounting for **80%** of the total NG usage = **45** *(which is a subset of the 143)*
MT = Metric Tons
tpy = Tons per year
CO_2 =39,957 MT
NOx = 13.25 tpy
CO_2 =9,738 MT
NOx = 6.16 tpy
90% of NG usage
80% of NG usage

Table 3-3

URBEMIS Run Results for Residential/Commercial Projects Emitting Approximately 3,000 MTCO2 per Year*

			Area Source Emissions		*Operational Emissions*		**TOTAL**
	Weighted Avg Trip Rate	**Size**	**CO2 (tons/year)**	**CO2 (MT/year)**	**CO2 (tons/year)**	**CO2 (MT/year)**	**CO2 (MT/year)**
Res - Single Unit	19.54	80 units	326.86	297.15	3003.56	2730.51	3027.65
Res - Apt	9.17	175 units	422.70	384.27	2971.95	2701.77	3086.05
Comm - Office	6.02	265,000 ft^2	387.41	352.19	2961.75	2692.50	3044.69
Comm - Bank	206.22	9,500 ft^2	14.38	13.07	3192.90	2902.64	2915.71
Single/Apt	19.54 9.17	35 units 100 units	379.59	345.08	2964.82	2695.29	3040.37
Office/Bank	6.02 206.22	170,000 ft^2 3,400 ft^2	254.19	231.08	3042.71	2766.10	2997.18
Office/Single	6.02 19.54	135,000 ft^2 40 units	355.13	322.85	2956.32	2687.56	3010.41
Office/Apt	6.02 9.17	135,000 ft^2 85 units	403.19	366.54	2952.34	2683.95	3050.48
Bank/Single	206.22 19.54	3,700 ft^2 50 units	202.81	184.37	3052.93	2775.39	2959.76
Bank/Apt	206.22 9.17	4,000 ft^2 100 units	248.12	225.56	3042.64	2766.04	2991.60
Single/Apt/Office	19.54 9.17 6.02	20 units 65 units 100,000 ft^2	382.60	347.82	2945.26	2677.51	3025.33
Single/Apt/Bank	19.54 9.17 206.22	20 units 65 units 3,550 ft^2	241.78	219.80	3020.76	2746.15	2965.95
						Avg CO2 (MT/year):	**3009.60**

*Offsite electricity use, water use, or other potential life cycle emissions not included.

As shown in Table 3-3, this threshold would represent a residential development of about 70 single-family dwelling units. It should be noted that the sensitivity analysis did not include GHG emissions from electricity use and water use. As a result, similar to the earlier discussion of industrial projects, this screening level of 3,000 MTCO2eq/yr could capture development projects less than 70 single-family dwelling units.

In CAPCOA's White Paper, it is suggested that a thresholds of 900 MTCO2eq/yr would capture 90 percent of all development projects, which should translate into at least 90 percent of GHG emissions from the residential and commercial sectors[2]. According to CAPCOA 900 MTCO2eq/yr equates to approximately 50 single-family dwelling units. This information appears to corroborate the SCAQMD staff's finding that the policy objective of capturing 90 percent of all GHG emissions for this region can be achieved with a screening level of 3000 MTCO2eq/yr. Therefore, staff is recommending that this value be used by lead agencies for residential and commercial developments, including industrial parks, warehouses, etc.

- **Tier 4 – Decision Tree Options:** consists of three decision tree options to demonstrate that a project is not significant for GHG emissions. The three compliance options are as follows.

  Compliance Option 1 – the lead agency would calculate GHG emissions for a project using a BAU methodology. Once GHG emissions are calculated, the project proponent would need to incorporate design features into the project and/or implement GHG mitigation measures to demonstrate a 30 percent reduction from BAU. Although a 30 percent reduction below BAU is consistent with the target objectives of AB 32, it will continue to reduce GHG emissions beyond 2020, thus, contributing to GHG reductions pursuant to the Governor's Executive Order S-3-05 (a 90 percent reduction compared to current GHG emissions). A 30 percent reduction is also considered to be an achievable GHG reduction target based on current technologies.

  Compliance Option 2 – this option consists of early compliance with AB 32 through early implementation of CARB's Scoping Plan Measures. The intent of this compliance option is to accelerate GHG emission reductions from the various

[2] Although the CAPCOA White Paper implies that 900 metric tons per year equates to a 90 percent capture rate, there is no explicit information provided in the White Paper that demonstrates this correlation. Indeed, the CAPCOA authors state that 900 metric tons, which represents approximately 50 residential units, corresponds to widely divergent capture rate percentile rankings depending on the project location (see discussion on page 43 of the White Paper). Percentile rankings were based on a survey of four cities in California. A project of 900 metric tons per year representing a 90 percent capture rate appears to be a working assumption for which there appears to be no factual basis. Further, although not explicitly stated, it is assumed that the 900 metric tons were derived using the URBEMIS2007 model. It should be noted that that the URBEMIS2007 model only quantifies CO2 emissions and direct emissions primarily from on-road mobile sources. It does not capture other GHG pollutants or indirect GHG emissions such as emissions from energy generation, water conveyance, etc. Therefore, it is likely that a 50-unit residential project would actually generate higher GHG emissions than 900 metric tons per year.

sectors subject to CARB's Scoping Plan to eliminate GHG emission, especially for those GHGs that have a long atmospheric lifetime such as CO2, sulfur hexafluoride, etc., to minimize future projected impacts to California from global climate change.

Compliance Option 3 – this compliance option consists of establishing sector-based performance standards. For example, it may be possible to use the 1990 inventory required under AB 32 to establish an efficiency standard such as pounds per person, pounds per worker, pounds per square feet, pounds per item manufactured, etc. When calculating GHG emissions from a project, if they are less than the established efficiency standard the project would not be significant relative to GHG emissions, while projects exceeding the efficiency standard would be significant.

If the lead agency or project proponent cannot achieve the performance standards on any of the compliance options in Tier 4, GHG emissions would be considered significant.

- **Tier 5 –** under this tier, the lead agency would quantify GHG emissions from the project and the project proponent would implement offsite mitigation (GHG reduction projects) or purchase offsets to reduce GHG emission impacts to less than the proposed screening level. In addition, the project proponent would be required to provide offsets for the life of the project, which is defined as 30 years. If the project proponent is unable to obtain sufficient offsets, incorporate design features, or implement GHG reduction mitigation measures to reduce GHG emission impacts to less than the screening level, then GHG emissions from the project would be considered significant. Since it is currently uncertain how offsite mitigation measures, including purchased offsets, interact with future AB 32 Scoping Plan measures, the AQMD would allow substitution of mitigation measures that include an enforceable commitment to provide mitigation prior to occurrence of emissions and to prevent mitigating the same emissions twice.

  Mitigation Preference – If a project generates significant adverse impacts, CEQA Guidelines §15126.4 requires identification of mitigation measures to minimize potentially significant impacts. Because GHG emissions contribute to global change, mitigation measures could be implemented locally, nationally, or internationally and still provide global climate change benefits. Because reducing GHG emissions may provide co-benefits through concurrent reductions in criteria pollutants, when considering mitigation measures when the AQMD is the lead agency under CEQA, staff will implement mitigation measures that are real, quantifiable, verifiable, and surplus in the following order of preference.

  - Incorporate GHG reduction features into the project design, e.g., increase a building's energy efficiency, use materials with a lower global warming potential than conventional materials, purchase building materials locally, etc.

  - Implement onsite measures that provide direct GHG emission reductions onsite, e.g., replace onsite combustion equipment (boilers, heaters, steam generators, etc.) with more efficient combustion equipment, replace existing high global warming potential refrigerants with low global warming refrigerants, eliminate or minimize fugitive emissions, etc.

- Implement neighborhood mitigation measure projects that could include incentives for installing solar power, increasing energy efficiency by exceeding Title 24 building standards through replacing low efficiency water heaters with high efficiency water heaters, increasing building insulation, using fluorescent bulbs, replacing old inefficient refrigerators with efficient refrigerators using low global warming potential refrigerants, etc.

- Implement in-district mitigation measures such as any of the above identified GHG reduction measures; reducing vehicle miles traveled (VMT) through greater rideshare incentives, transit improvements, etc.

- Implement in-state mitigation measures, which could include any of the above measures.

- Implement out of state mitigation measure projects, which may include purchasing offsets if no other options are available.

CARB's Interim GHG Significance Threshold Proposal

In October 2008 CARB released its interim GHG significance threshold proposal and held a public workshop on October 27, 2008. CARB's threshold is considered to be an interim threshold because CARB staff intends to periodically review and change its threshold proposal as necessary. CARB's Preliminary Draft Staff Proposal (Proposal) states that non-zero GHG significance thresholds can be supported by substantial evidence. Futher, different GHG significance thresholds may be established for different sectors. Therefore, as part of its initial interim GHG significance threshold proposal CARB is proposing two separate GHG significance thresholds, one for new industrial projects and another for residential/commercial projects subject to CEQA. CARB's proposal uses a tiered approach (see Table 3-4).

Table 3-4
Comparison of CARB's and AQMD's Interim GHG Significance Thresholds Approaches

	Stationary/Industrial Sector Projects		Residential/Commercial Sector Projects	
	CARB	AQMD	CARB	AQMD (Not Recommended at this Time)
Policy Objective	Capture 90% of statewide stationary project emissions	Capture 90% of district wide GHG emissions (industrial)	Capture X% of statewide residential/commercial project emissions	Capture 90% of district wide residential/commercial project GHG emissions
Exemption	Apply applicable exemption	Apply applicable exemption	Apply Applicable Exemption	Apply Applicable Exemption
Regional GHG Reduction Plan	N.A.	Project Consistent with Applicable GHG Reduction Plan with GHG inventorying, monitoring, enforcement, etc.	Project Consistent with Applicable GHG Reduction Plan with GHG inventorying, monitoring, enforcement, etc.	Project Consistent with Applicable GHG Reduction Plan with GHG inventorying, monitoring, enforcement, etc.
Thresholds	Project < 7,000 MTCO2eq/yr & meets construction & transportation performance standards	GHG emissions from industrial project is < 10,000 MTCO2eq/yr, includes construction emissions amortized over 30 years & added to operational GHG emissions	Project meets construction & operation performance tandards, e.g., energy, water use, waste & ransportation & < X MTCO2eq/yr	Project is < 3,000 MTCO2eq/yr & exceeds Title 24 Energy Efficiency Standards by X%, if applicable – construction emissions amortized over 30 years & added to operational GHG emissions
Performance Standards	See above	NA	See above	3 Compliance Options: 1) Reduce GHG emissions 30% below BAU; 2) Early Implement AB 32 Measure; 3) Comply with Performance Standard
Offsets	Offsite substitution allowed	Implement offsite mitigation for life of project, i.e., 30 years, with mitigation preference	Offsite substitution allowed	Implement offsite mitigation for life of project, i.e., 30 years with mitigation preference
Determination	GHG emissions significant, EIR is prepared, if meeting none of the above	GHG emissions significant, EIR is prepared, if meeting none of the above	GHG emissions significant, EIR is prepared, if meeting none of the above	GHG emissions significant, EIR is prepared, if meeting none of the above

CARB's interim GHG significance threshold for industrial sources was developed to capture "the vast majority (~90% statewide) of the GHG emissions from new industrial projects being subject to CEQA's requirement to impose feasible mitigation." According to CARB's Proposal, CARB staff used data from a survey of industrial boilers performed by the Oak Ridge National Laboratory in which it was concluded that small boilers with an input capacity of 10 MMBtu/hr corresponded to 93 percent of total industrial boiler input capacity, or 4,660 MTCO2e/yr. Using this result and accounting for process losses, purchased electricity, and water usage and wastewater discharge, CARB staff is recommending 7,000 MTCO2eq/yr as a GHG significance threshold for industrial projects. The following bullet points summarize CARB's proposed interim GHG significance threshold for industrial sources.

- Box 1 – Apply any applicable categorical or statutory exemptions. If the project does not qualify for an exemption, move to Box 2.

- Box 2 – The industrial project must meet both of the following performance standards or equivalent mitigation measures to be deemed insignificant for GHGs:

    - Construction – Project must meet an interim performance standard for construction- related emissions (performance standard not yet defined).

    - Transportation – Project must meet an interim performance standard for transportation (performance standard not yet defined).

AND

- Project with mitigation will emit no more than 7,000 MTCO2eq/yr. If the project does not qualify for either of the performance standards or exceeds 7,000 MTCO2eq/yr, move to Box 3.

- Box 3 – Project is deemed significant and an EIR must be prepared.

- CARB's Preliminary Draft Proposal for Residential and Commercial projects is summarized in the following bullet points.

- Box 1 – Apply any applicable categorical or statutory exemptions. If the project does not qualify for an exemption, move to Box 2.

- Box 2 – Project complies with a previously approved plan that addresses GHG emissions and must: include a GHG reduction target consistent with AB 32; be consistent with transportation-related target adopted by CARB pursuant to SB 375; include a GHG inventory and mechanism for monitoring GHG emissions; include enforceable GHG requirements; include a mechanism for periodic updates to plan; and have a certified CEQA document. If the project is consistent with a GHG plan that includes all of these elements, it is presumed to be insignificant for GHGs. If the project is not consistent with a GHG plan or there is no adopted GHG plan that includes all of the above elements, move to Box 3.

- Box 3 – The residential/commercial project must meet all of the following performance standards or equivalent mitigation measures to be deemed insignificant for GHGs:

    - Construction – Project must meet an interim performance standard for construction- related emissions (performance standard not yet defined).

    - Operations – Project must meet the following performance standards: energy use performance standard defined in CEC's Tier II Energy Efficiency goal; an interim performance standard for water use (performance standard not yet defined); an interim performance standard for waste (performance standard not yet defined); and an interim performance standard for transportation (performance standard not yet defined).

AND

The project with performance standards or equivalent mitigation will emit no more than X MTCO2eq/yr (criterion to be developed). If the project does not qualify for any one of the performance standards or exceeds X MTCO2eq/yr, move to Box 4.

- Box 4 – Project is deemed significant and an EIR must be prepared.

For a detailed description of CARB's interim GHG significance threshold proposal, refer to the following URL:
http://www.arb.ca.gov/cc/localgov/ceqa/meetings/102708/prelimdraftproposal102408.pdf.

CARB is currently accepting comments on its Draft Proposal and has scheduled a second public workshop on December 9, 2008. CARB staff currently anticipates taking their proposal to their Board in February 2009.

CHAPTER 4

CONSIDERATIONS WHEN ANALYZING GHG EMISSIONS

INTRODUCTION

As noted in Chapter 1, on June 19, 2008, OPR, in collaboration with the California Resources Agency, the California Environmental Protection Agency and the California Air Resources Board, released a *Technical Advisory* containing informal guidance for public agencies as they address the issue of climate change in their CEQA documents. With regard to analyzing GHG emission impacts OPR states,

"Each public agency that is a lead agency for complying with CEQA needs to develop its own approach to performing a climate change analysis for projects that generate GHG emissions. A consistent approach should be applied for the analysis of all such projects, and the analysis must be based on best available information… Lead agencies should determine whether greenhouse gases may be generated by a proposed project, and if so, quantify or estimate the GHG emissions by type and source."

Other than this general advice, the *Technical Advisory* does not provide explicit details for quantifying GHG emissions.

CAPCOA's White Paper provides a comprehensive discussion of modeling tools that are currently available for analyzing GHG emissions[3]. As indicated in the White Paper, no one model is currently available that is capable of estimating all of a project's direct and indirect GHG emissions. It is likely, however, that the Urban Emissions (URBEMIS) Model will be the most commonly used model for calculating GHG emissions because it currently calculates CO2 emissions (in addition to criteria pollutant emissions) during both construction and operation of proposed projects, it is publicly available, and already widely used in California. Statewide use of the URBEMIS model would provide consistency throughout California with regard to quantifying GHG emissions. For a list of currently available models that calculate GHG emissions and summaries of the capabilities, advantages, and disadvantages of each model refer to Table 10 on pages 75 through 78 in the CAPCOA White Paper.

The purpose of this chapter is to provide more explicit guidance to CEQA practitioners with regard to quantifying GHG emissions than OPR's *Technical Advisory*, while building on the information provided CAPCOA's White Paper.

GHG ANALYSIS RECOMMENDATIONS

Direct/Indirect Impacts

As noted in Chapter 3 of this Guidance Document, consistent with CEQA, indirect and direct impacts of the project, typically within California, are required to be analyzed in the CEQA document for a proposed project. The analysis of direct GHG impacts is

[3] For maximum transparency with regard to quantifying GHG emissions and disclosure to the public, SCAQMD staff recommends using only publicly available models.

relatively straightforward as onsite GHG sources or directly related offsite GHG sources, such as worker commute trips, are generally readily identifiable. Indirect GHG emission sources are less obvious, but may include some of the sources identified in the following paragraphs. In general, for most projects information on direct and indirect emissions may be available, rather than a full life-cycle analysis of emissions. The lead agency has typically been expected to address emissions that are closely related and within the capacity of the project proponent to control and/or influence.

Direct Impacts - are primary effects that are caused by a project and occur at the same time and place, such as emissions from boilers, heaters, or other onsite emissions sources. Direct impacts generated by a project may include offsite sources directly related to the project such as emissions from worker commute trips, haul truck trips to import raw materials and/or export finished products or other goods. The following paragraphs provide general guidance on quantifying direct GHG emissions.

CAPCOA's White Paper provides a comprehensive discussion of modeling tools that are currently available for analyzing GHG emissions. Further, no one model is currently available that is capable of estimating all of a project's direct and indirect GHG emissions. Although there are a number of modeling tools available to calculate GHG emissions the following discussion focuses on a combination of approaches using the URBEMIS model as the basis for analyzing GHG emission impacts. Other approaches for calculating GHG emissions can be used, as long as they are supported by scientific evidence and include publicly available information.

The URBEMIS model is a publicly available model that is currently used statewide to calculate criteria pollutant emissions from construction and operation activities for a wide variety of land use projects. The model is regularly updated through a collaboration of air pollution control agencies, including the SCAQMD, to reflect the most current data, methodologies, and emission factors for quantifying criteria pollutant emissions. The most current update to the model is URBEMIS2007 version 9.2.4, which quantifies CO2 emissions in addition to criteria pollutant emissions.

Currently, there are several disadvantages to using the URBEMIS model to calculate GHG emissions from a proposed project and, as a result, it should not be the only tool used to calculate GHG emissions. For example, currently the URBEMIS model only quantifies CO2 emissions and not other GHG pollutants, with the exception of methane from mobile sources, which is converted to CO2eq. emissions. Since CO2 emissions comprise the bulk of GHG emissions from most projects, URBEMIS GHG results are fairly representative of GHG emissions from a project.

To quantify mobile source emissions from on-road mobile sources, the URBEMIS model uses trip rate information from the Institute of Transportation Engineers Trip Generation Handbook (ITE, 2001) as the trip rate default factor for all land uses. ITE trip rate information is widely used and is considered legally defensible as they rely on substantial reports and surveys of trip rates in cities with little or no transit. As a result, the ITE trip rates are also considered to provide a conservative estimate of trip rates and associated emissions. The model, however, treats each trip as a separate trip and doesn't consider that a single trip may be used for more than one purpose, referred to as "internalization." The model also does not fully account for interaction between land uses in its estimation of mobile source operational emissions. URBEMIS does allow the user to overwrite the default trip rates and characteristics with more project-specific data from a traffic study prepared for a project.

In spite of the disadvantages of the URBEMIS model described above, it can be used as the first step in quantifying GHG emissions for typical land use projects because it establishes default parameters for the most common emission sources from a project including construction equipment types and activity profiles, area of site disturbed during construction, building size, number vehicle trips, etc., if the level of information about the project is low. If more information about the project is available such as a precise profile of construction equipment and activity levels, number of vehicle trips based on a traffic study prepared for the project, etc., this information can be incorporated into the model. The model can then quantify CO2 emissions from both construction and operation.

The URBEMIS construction analysis quantifies criteria pollutant and CO2 emissions from both off-road sources (primarily construction equipment) and on-road sources (worker commute trips, haul truck trips, etc.). To further flesh out the construction analysis, the lead agency would have to identify emission factors for other GHG pollutants likely to be emitted during construction, i.e., methane and nitrous oxide[4], for both off-road and on-road emissions sources and then quantify the GHG emission results using spreadsheets or other available tools.

The off-road CO2 emission factors in the URBEMIS model are generated from CARB's off- road model (http://www.arb.ca.gov/msei/offroad/offroad.htm). Methane emission factors for off-road equipment can also be obtained from CARB's OFFROAD2007 model. CO2 and methane emission factors for off-road equipment that are based on CARB's OFFROAD2007 model can also be found on the SCAQMD's CEQA webpages at the following URL: http://www.aqmd.gov/ceqa/handbook/offroad/offroad.html. Other sources of off-road GHG emissions factors for equipment used in California may be used, as long as they are supported by scientific evidence and are publicly available.

The URBEMIS model is able to quantify mobile source CO2 emissions during construction from on-road mobile sources such as construction worker commute trips, heavy-duty truck trips to haul away demolition debris, soil hauling to and from the site etc., and during operation, primarily vehicle trips using ITE's Trip Generation Manual (ITE, 2001). The on-road CO2 emission factors in the URBEMIS model for both construction and operation are generated from CARB's on- road mobile source emissions model, EMFAC2007 (http://www.arb.ca.gov/msei/onroad/onroad.htm). Methane emission factors for on-road mobile sources can also be obtained from

[4] Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are not combustion emissions, so would not normally be emitted during construction.

CARB's EMFAC2007 model. CO2 and methane emission factors for on-road mobile sources that are based on CARB's EMFAC2007 model can also be found on the SCAQMD's CEQA webpages at the following URL: http://www.aqmd.gov/ceqa/handbook/onroad/onroad.html.

The analysis of operation emissions from all types of land uses in the URBEMIS model focuses primarily on mobile source emissions and some area sources. The model does not quantify emissions from stationary sources. For stationary sources that require a permit from the SCAQMD, emission calculation procedures and methodologies are available in the SCAQMD's Best Available Control Technology Guidelines (http://www.aqmd.gov/bact/partd7-9-2004update.pdf). Examples of facilities that use stationary sources requiring a permit from the SCAQMD include: fossil fuel power plants[5], cement plants, landfills, wastewater treatment plants, gas stations, dry cleaners and industrial boilers. The SCAQMD has procedures and methodologies for projects subject to SCAQMD permits to calculate criteria pollutants and air toxics. It is anticipated that these same procedures and methodologies could be extended to estimate a permitted facility's GHG calculations. For are any stationary and area sources that do not require SCAQMD permits, the same methodologies used for permitted sources could be used. It will be necessary to contact the SCAQMD to obtain information on GHG emission calculation methodologies applicable to stationary source equipment.

Indirect Impacts - Indirect or secondary effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems (CEQA Guidelines §15358)(a)(2)). The examples of facilities that use stationary sources requiring a permit from the SCAQMD that may contribute to direct environmental impact (fossil fuel power plants, cement plants, landfills, wastewater treatment plants, gas stations, dry cleaners and industrial boilers) may also contribute to indirect impacts and, therefore, should be included, as necessary in the CEQA analysis of GHGs.

Quantification Methodologies and GHG Emission Factors

Methodologies for calculating GHG emissions and GHG emission factors are currently not readily available. Until such time as GHG calculation methodologies and emission factors become well established and more readily available, lead agencies may want to consult the following references to identify acceptable methodologies and emission factors.

1. The first useful reference for GHG emission factors for stationary sources is EPA's Air Pollutant (AP)-42, which is a compilation of air pollutant emission

[5] According to CEQA Guidelines §15227, CEQA does not apply to projects outside of California. The California Attorney General's Office has rendered an opinion stating that the definition of the environment in CEQA does not stop at the borders of California. Further, California public agencies that take an action outside of California is still bound by the requirements of CEQA to prepare an EIR if the action may cause a significant effect on the environment.

factors for stationary point and area sources. Each of the first 13 chapters of AP-42 is dedicated to a specific source activity such as solid waste disposal, petroleum industry, and metallurgical industry. Since the publication of the fifth edition (and supplementals) in 2001, there have been a number of updates to the various specific stationary sources such as hot asphalt plants, organic liquid storage tanks, and coke production. In addition to the criteria pollutant emissions, some of the updated AP-42 chapters provide GHG emission factors for a variety of sources. For example, Chapter 15 of AP-42 focuses on GHG emissions from biogenic sources such as soils, termites, lightning, and enteric fermentation (animal digestive fermentation).

2. Second, the California Climate Action Registry (C-CAR) has prepared a General Reporting Protocol (GRP), which is a relatively easy-to-follow user's manual that outlines the principles, concepts, calculation methodologies and procedures required for effective participation in the California Registry. The appendices of the GRP provide GHG emissions factors, specifically CO2, CH4 and N2O, for electricity use, mobile combustion and stationary combustion based on fuel usage type.

3. Third, a thorough internet search should be conducted to find reliable sources of emissions factors that would assist in accurately determining GHG emissions from a specific source being evaluated. Again, all potential GHGs, such as CO2, CH4 and N2O, should be evaluated to the best of one's ability to locate dependable information.

4. Finally, a material balance approach also may provide reliable average emission estimates for specific sources. A material balance is when one accounts for (or "balances") all the materials going into and coming out of the process in order to make a credible emissions estimation. For some sources, a material balance may provide a better estimate of emissions especially in situations where a high percentage of material is lost to the atmosphere (e. g., sulfur in fuel, or solvent loss in an uncontrolled coating process.) In other cases, material balances may be inappropriate where material is consumed or chemically combined in the process, or where losses to the atmosphere are a small portion of the total process throughput.

Reporting GHG Emissions – Daily vs. Annual Emissions

The analysis of GHGs is a much different analysis than the analysis of criteria pollutants for the following reasons. For criteria pollutants, significance thresholds are based on daily emissions because attainment or non-attainment is based on daily exceedances of applicable ambient air quality standards. Further, several ambient air quality standards are based on relatively short term exposure effects on human health, e.g., one-hour and eight-hour. Since the half-life of CO2 is approximately 100 years, the effects of GHGs are longer-term, affecting global climate over a relatively long time frame (see also Table 3-1).

Typical GHG emission inventories (EPA5, ARB6, etc.) represent directly emitted GHGs during a given year. As a result, the current convention is to present GHG emissions as annual emissions. The URBEMIS model can be set to calculate annual emissions for a project. When using the URBEMIS model to calculate annual GHG emissions, it may be useful to modify the trip rate for each land use using a weighted trip rate average to more accurately reflect annualized trip rates. A weighted trip rate average reflects the trip rates during the week, as well as trip rates during Saturdays and Sundays. Trip rate information for weekdays and weekend days can be found in the ITE Trip Rate Handbook.

CHAPTER 5

CONCLUSION

INTRODUCTION

CEQA Guidelines §15064.7(a) encourages lead agencies to establish thresholds of significance to determine the significance of an environmental impact. Further, thresholds of significance to be adopted for general use as part of the lead agency's environmental review process must be adopted by ordinance, resolution, rule, or regulation, and developed through a public review process and be supported by substantial evidence (CEQA Guidelines §15064.7(b)). Staff's proposed interim GHG significance threshold proposal has been developed through a public process consisting of a series of Stakeholder Working Group meetings. Staff proposals have been modified over time based on written and oral feedback from the Working Group. Staff's intent was to reach consensus to the extent feasible, but for some items staff could not find common ground with some of the stakeholders.

The next immediate step for SCAQMD staff is to present a final interim GHG significance threshold proposal to the SCAQMD Governing Board for consideration. If the Governing Board approves staff's final interim GHG significance threshold proposal, then staff will embark on a number of short-term and intermediate term activities to provide outreach to public agencies that might use staff's interim GHG significance threshold to determine whether or not their projects' GHG emissions are significant, periodically revisit and revise as necessary the interim proposal, and accommodate stakeholders' requests for more information on GHG calculation methodologies and mitigation measures. The following sections provide discussions on future anticipated action items

FUTURE ACTION ITEMS

Interim GHG Significance Threshold Outreach Program

It is currently anticipated that staff's interim GHG significance threshold proposal will be presented to, and considered by the Board at the November 7, 2008 public hearing. Consistent with other significance threshold proposals adopted by the Governing Board, if the draft GHG significance threshold proposal is adopted, staff will meet with local cities, councils of governments, and leagues of cities to discuss the staff proposal and address any questions or concerns.

Once the interim GHG significance threshold is adopted, this Guidance Document will be posted on the SCAQMD's CEQA web pages. Staff will also send notice of the adoption of the staff proposal to all agencies, organizations, and individuals on the SCAQMD's CEQA "Interested Parties" mailing list. In addition, it is expected that staff will prepare and make available an informational brochure that summarizes information about the interim GHG significance proposal in addition to this Guidance Document.

Starting in January 2009, as part of its intergovernmental review (IGR) responsibilities under CEQA, where the SCAQMD reviews and CEQA documents prepared by other public agencies, SCAQMD will begin more thorough evaluations of CEQA documents with regard to their GHG analyses and the basis by which they make a determination of significance. Staff will begin recommending use of the staff's interim GHG significance threshold proposal or other available GHG significance thresholds based on substantial evidence in comment letters on notices of preparation of an EIR. As of March 1, 2009, staff will formally recommend use of staff's interim GHG significance threshold proposal or other available GHG significance thresholds based on substantial evidence in comment letters on NDs and MNDs. As of July 1, 2009, staff will formally recommend use of staff's interim GHG significance threshold proposal or other available GHG significance thresholds based on substantial evidence in comment letters on EIRs.

Compile Lists of GHG Design Features and Mitigation Measures

CEQA Guidelines §15126.4 requires an EIR to "describe feasible measures which could minimize significant adverse impacts, including where relevant, inefficient and unnecessary consumption of energy." Ideally, it is desirable to avoid impacts altogether through incorporating design features into the proposed project. Because staff's recommended interim GHG significance threshold includes performance standards (see tier 4 compliance options 1 and 3) or a project proponent may try to reduce GHG emissions to less than the applicable screening levels, mitigation measures or design features are important components of the overall GHG significance threshold strategy. As a result, a number of GHG Working Group stakeholders has requested that SCAQMD compile lists of design features or mitigation measures to assist with reducing GHG emissions for all land use types.

In response to the request from GHG Working Group stakeholders to develop GHG design features and mitigation measures, over the next year SCAQMD staff will compile lists of GHG reduction strategies, including control efficiencies, by sector and make the lists available online with other recommended mitigation measures. There is already a robust body of mitigation measures available (see in particular the CAPCOA bullet point discussion below), but in most cases, they do not include control efficiencies. SCAQMD staff will use the following mitigation sources as a basis from which to compile mitigation strategies.

- **CEQA Guidelines, Appendix F –** this appendix includes a list of general energy conservation measures that may be used as a basis to identify GHG reduction strategies. The measures do not contain GHG control efficiencies, so they would need further review to determine if control efficiencies are available.

- **CAPCOA White Paper –** this document provides a comprehensive discussion of GHG reduction strategies and specific mitigation measures are listed in Table 16 in Appendix B. The mitigation measures are grouped by emissions source type, such as transportation measures, parking measures, commercial and residential design features, etc. Table 16 also provides other useful information about each mitigation measure including source of each measure, comments and descriptions about each control measure, etc. Most importantly, for many of the mitigation measures CAPCOA has included an emission reduction score. In most cases, the emission reduction score is given as a range. As a result, further evaluation would be necessary to provide a single more precise emission reduction score or a defensible average. Otherwise, it is likely that the high end of the emission reduction score would be used.

- **CARB -** is actively working to develop and adopt GHG protocols to support the Climate Change Program. CARB is working in collaboration with other agencies and organizations, including the California Climate Action Registry, to adopt consistent and standardized methods to accurately report GHG emissions. There are two kinds of GHG protocols, a reporting protocol and a project protocol. The project protocol may be useful as it sets standards and provides specific guidance to define GHG reduction projects and quantify and report GHG reductions from project activities. Some example protocols include manure management and urban forestry. It is expected that additional protocols will be developed and adopted by CARB. It is also expected that CARB's Scoping Plan may provide guidance on regulatory guidance that could be used to develop GHG emission reduction measures. GHG reduction strategies that may also serve as GHG mitigation measures to be developed by CARB over the next two years are shown in Table 5-1.

Table 5-1
California Air Resources Board GHG Emission Reduction Strategies

Strategy	Description of Strategy
Other Light Duty Vehicle Technology	New standards would be adopted to phase in beginning in the 2017 model year
Hydrofluorocarbon Reduction	1) Ban retail sale of HFC in small cans; 2) Require that only low global warming potential (GWP) refrigerants be used in new vehicular systems; 3) Adopt specifications for new commercial refrigeration; 4) Add refrigerant leak-tightness to the pass criteria for vehicular Inspection and Maintenance programs; 5) Enforce federal ban on releasing HFCs.
Transportation Refrigeration Units, Off-Road Electrification, Port Electrification	Strategies to reduce emissions from TRUs, increase off-road electrification, and increase use of shore-side/port electrification.
Manure Management	San Joaquin Valley Rule 4570 (adopted 6/15/06) reduces volatile organic compounds from confined animal facilities through implementation of control options.
Alternative Fuels: Biodiesel Blends	CARB would develop regulations to require the use of 1 to 4 percent biodiesel displacement of California diesel fuel.

Table 5-1 (Concluded)
California Air Resources Board GHG Emission Reduction Strategies

Strategy	Description of Strategy
Alternative Fuels: Ethanol	Increased use of ethanol fuel.
Heavy-Duty Vehicle Emission Reduction Measures	Increased efficiency in the design of heavy duty vehicles and an education program for the heavy duty vehicle sector.
Reduced Venting and Leaks in Oil and Gas Systems	Rule considered for adoption by the Air Pollution Control Districts for improved management practices.
Hydrogen Highway	The California Hydrogen Highway Network (CA H2 Net) is a State initiative to promote the use of hydrogen as a means of diversifying the sources of transportation energy.
Achieve 50% Statewide Recycling Goal	Achieving the State's 50 percent waste diversion mandate as established by the Integrated Waste Management Act of 1989, (AB 939, Sher, Chapter 1095, Statutes of 1989), will reduce climate change emissions associated with energy intensive material extraction and production as well as methane emission from landfills. According to the California Integrated Waste Management Board, in 2005 the statewide waste diversion rate was 52 percent.[6]
Landfill Methane Capture	Install direct gas use or electricity projects at landfills to capture and use emitted methane.
Zero Waste - High Recycling	Additional recycling beyond the State's 50% recycling goal.

- CEC and CPUC – These agencies are actively developing GHG emission reduction strategies that may also be used to develop GHG mitigation measures for specific energy production sources. Examples of CEC and CPUC GHG emission reduction strategies are shown in Table 5-2.

Other sources of potential GHG emission reduction measures will be evaluated and incorporated, as applicable into any GHG mitigation measure lists developed by the SCAQMD.

[6] CIWMB, 2007; http://www.ciwmb.ca.gov/LGCentral/Rates/Diversion/2005/Default.htm

Table 5-2

GHG Emission Reduction Strategies Implemented by CEC and CPUC

Strategy	Description of Strategy
ENERGY COMMISSION (CEC)	
Building Energy Efficiency Standards in Place and in Progress	Public Resources Code 25402 authorizes the CEC to adopt and periodically update its building energy efficiency standards (that apply to newly constructed buildings and additions to and alterations to existing buildings).
Appliance Energy Efficiency Standards in Place and in Progress	Public Resources Code 25402 authorizes the Energy Commission to adopt and periodically update its appliance energy efficiency standards (that apply to devices and equipment using energy that are sold or offered for sale in California).
Cement Manufacturing	Cost-effective reductions to reduce energy consumption and to lower carbon dioxide emissions in the cement industry.
Municipal Utility Strategies	Includes energy efficiency programs, renewable portfolio standard, combined heat and power, and transitioning away from carbon intensive generation.
Alternative Fuels: non-Petroleum Fuels	Increasing the use of non-petroleum fuels in California's transportation sector, as recommended in the CEC's 2003 and 2005 Integrated Energy Policy Reports.
PUBLIC UTILITIES COMMISSION (PUC)	
Accelerated Renewable Portfolio Standard (33 percent by 2020)	The Governor has set a goal of achieving 33 percent renewables in the State's resource mix by 2020. The joint PUC/Energy Commission September 2005 Energy Action Plan II (EAP II) adopts the 33 percent goal.
California Solar Initiative	The solar initiative includes installation of 1 million solar roofs or an equivalent 3,000 MW by 2017 on homes and businesses, increased use of solar thermal systems to offset the increasing demand for natural gas, use of advanced metering in solar applications, and creation of a funding source that can provide rebates over 10 years through a declining incentive schedule.
Investor-Owned Utility	This strategy includes energy efficiency programs, combined heat and power initiative, and electricity sector carbon policy for investor owned utility.

Periodically Review the Interim GHG Significance Threshold

SCAQMD staff will periodically review and revise staff's GHG proposal to incorporate applicable updated information on GHGs and GHG reduction strategies resulting from regulatory requirements or advances in technology. Some areas of the current proposal that may be reevaluated include the tier 3 screening levels, and the tier 4 compliance option 1 GHG reduction target objective. Further, staff will evaluate whether or not sector based performance standards can be developed for tier 4 compliance option 3.

If a statewide GHG significance threshold is developed by CARB, staff will review that threshold and report to the Governing Board by March 2009 considering such a threshold for adoption.~~regarding any implementation issues and ways to transition into the recommended GHG significance threshold within six months of formal approval by the CARB Board~~.

REFERENCES

Association of Environmental Professionals (AEP). 2007. *White Paper on Global Climate Change – Final Version*. June 2007

California Air Pollution Control Officers Association (CAPCOA). 2008. *CEQA and Climate Change Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act*. January 2008.

California Air Resources Board (CARB). 2007. *California Greenhouse Gas Emissions Inventory*. December 2007.

California Air Resources Board (CARB). 2008. *Climate Change Proposed Scoping Plan A Framework for Change*. October 2008.

Institute of Transportation Engineers (ITE). 2001. *Trip Generation Handbook An ITE Recommended Practice (7th ed.)*. March 2001.

Intergovernmental Panel on Climate Change (IPCC). 2007a. *Climate Change 2007 – Synthesis Report.* Contribution of Working Group I to the Fourth Assessment Report of the IPCC.

Intergovernmental Panel on Climate Change (IPCC). 2007b. *Climate Change 2007* - *The Physical Science Basis.* IPCC Plenary XXVII (Valencia, Spain, 12-17 November 2007).

South Coast Air Quality Management District (SCAQMD). 2004. Best Available Control Technology Guidelines. July 2004. (http://www.aqmd.gov/bact/partd7-9-2004update.pdf)

APPENDIX A

WORKING GROUP MEMBERS AND CONTRIBUTORS

WORKING GROUP MEMBERS AND AFFILIATION:

Greg M Adams	Los Angeles County Sanitation District
James Arnone	Latham and Watkins
Jonathan Evans	Center for Biological Diversity
Doug T. Feremenga	San Bernardino County Land Use Planning Department
Mark Grey	Building Industry Association (BIA) of Southern California
Gretchen Hardison	City of Los Angeles, Environmental Affairs
Mike Harrod	Riverside County Planning Department
Michael Hendrix	Association of Environmental Professionals
Thomas Jelenic	Port of Long Beach
Ruby Maldonado	Orange County Planning Department
Bill La Marr	California Small Business Alliance
Julia Lester	Dairies/California Farmers Bureau
Shari Libicki	Green Developers Coalition
Lena Maun-DeSantis	Port of Los Angeles
Daniel Mc Givney	Southern California Alliance of Public Owned Treatment Works
Clayton Miller	Construction Industry Air Quality Coalition (CIAQC)
Jonathan Nadler	Southern California Association of Governments
Peter Okurowski	California Environmental Associates
Bill Piazza	Los Angeles Unified School District
Bill Quinn	California Council for Environmental and Economic Balance (CCEEB)
Cathy Reheis-Boyd	Western States Petroleum Association
Janill L Richards	California Department of Justice, Public Rights Division, Environment Section
Jamesine Rogers	California Air Resources Board (CARB)
Terry Roberts	Office of Planning and Research (OPR)
David Somers	City of Los Angeles - Planning
Debbie Stevens	Refineries
Jocelyn Thompson	Weston, Benshoof, Rochefort, Rubalcava, MacCuish Attorneys at Law
Carla Walecka	Realtors Committee on Air Quality (RCAQ)
Lee Wallace	The Gas Company

INVITED AS MEMBERS BUT HAVE NOT ATTENDED:

Rick Bishop	Western Riverside Council of Governments
Adrene K Briones	City of Los Angeles, LADWP
Rick Cameron	Port of Long Beach
Bahram Fazeli	Communities for a Better Environment (CBE)
Daniel Fierros	Los Angeles County Regional Planning, Impacts Analysis Section
Timothy Grabiel	Natural Resources Defense Council (NRDC)
Andrea M Hricko	USC Keck School of Medicine, Environmental Health Sciences Center
Angela Johnson Meszaras	California Environmental Rights Alliance
Janea Scott	Environmental Defense Fund
Martin Shlageter	Coalition for Clean Air (CCA)
Bryan Speegle	Orange County Planning Department

ALTERNATES AND AFFILIATION:

Jeannie Blakeslee	CARB
Frank Caponi	Los Angeles County Sanitation District
Andrew Cheung	Los Angeles Unified School District
Mark Elliott	CCEEB
Jay Golida	Los Angeles Unified School District
Andy Henderson	BIA of Southern California
Carrie Hyke	San Bernardino County Land Use Planning Department
Michael Lewis	CIAQC
John Pastore	Southern California Alliance of Public Owned Treatment Works
Sharon Rubalcava	Weston, Benshoof, Rochefort, Rubalcava, MacCuish Attorneys at Law
Andrew Skanchy	Latham and Watkins
Justis Stewart	SCAG
Allyson Teramoto	Port of Long Beach
Cindy Thielman-Braun	Riverside County Planning Department
Matt Vespa	Center for Biological Diversity
Michael Wang	WSPA

INTERESTED PARTIES:

Lysa Aposhian	Sanitation Districts of Los Angeles
Gregory K Arifian	MWH Americas Inc
Leila Barker	LADWP
Jack Bean	Tesoro
Joe Becca	Universal Studios
Aaron Dean Burdick	ICF International
Curtis L. Coleman	Law Offices of Curtis L. Coleman
Keith Cooper	ICF Jones & Stokes
Kris Flaig	LA Bureau of Sanitation, Department of Public Works, Regulatory Affairs
Howard D Gollay	Southern California Edison
Bill Gorham	ENSR Consulting and Engineering
Jay Grady	California Portland Cement Co.
Patrick Griffith	Los Angeles Unified School District
Tony Held	ICF, Jones & Stokes
Miles T. Heller	BP
Jonathan A. Hershey	City of Los Angeles
Vijaya Jammalamadaka	Santa Barbara County APCD
Stephen L Jenkins	Michael Brandman Associates
Robert Jenne	CARB
Diana Kitching	LA City Department of Planning
Chandra Knott	City of Irvine
Vladimir Kogan	Orange County Sanitation District, Air Quality & Special Projects Div.
Leslie Krinsk	CARB
Martin Ledwitz	Southern California Edison
Rina Leung	City of Rancho Cucamonga
Serena Lin	Environmental Defense Fund
Allen Lind	CCEEB
Sung Key Ma	Riverside County Waste Management Department
Josh Margolis	Cantor Cole

Marty Meisler	Metropolitan Water District
Denise Michelson	BP
Vince Mirabella	Michael Brandman Associates
Danielle K Morone	Gatzke Dillon & Ballance LLP
Pang Mueller	Tesoro Refining & Marketing Co - Los Angeles Refinery
Krishna Nand	City of Vernon
Jan Nguyen	Exxon Mobil
Maurice Oillataguerre	City of Glendale Public Works Dept.
Lynn Perkinton	URS Corp.
Haseeb Qureshi	Urban Crossroads
Ron Ricks	BP
Leonard Scandura	San Joaquin Valley APCD
Darren W Stroud	Valero Energy Corporation
Ryan Taylor	Brian F. Associates
Greg Tholen	Bay Area Air Quality Management District (BAAQMD)
Dave Vintze	BAAQMD
Sarah Weldon	California Environmental Associates
Darcy Wheeles	California Environmental Associates
Janet Whittich	CCEEB
A.L. Wilson	Southern California Edison
Cori Wilson	Michael Brandman Associates
Lisa Wunder	The Port of Los Angeles
Robert A Wyman Jr.	Latham & Watkins
Rick Zbur	Latham & Watkins
Michael H Zischke	Cox Castle & Nicholson LLP

APPENDIX B

SUMMARIES OF WORKING GROUP MEETINGS

WORKING GROUP MEETING #1 (APRIL 30, 2008)

At the first Working Group meeting SCAQMD staff presented the Working Group with a number of policy objectives and design criteria for consideration to establish the framework for developing a GHG significance threshold. Policy objectives include the following concepts. First, the GHG significance threshold should minimize environmental degradation, that is, it should not make impacts worse. To this end, it may be useful to develop a GHG significance threshold that achieves GHG emissions reductions that are consistent with the goals of AB 32 estimated to be approximately 30 percent reduction of GHG emissions from business-as-usual. Although CEQA or a GHG significance threshold established pursuant to CEQA may be useful tools in reducing GHG emissions, they would act in parallel with regulatory requirements, e.g., AB 32, but they do not replace them. As a result, there is no requirement that a GHG significance threshold must reduce GHG emissions consistent with AB 32 or EO S-3-05.

In addition to policy considerations, a number of GHG significance threshold design criteria were also considered. An important consideration in developing a GHG significance threshold is the potential administrative burden it may create on lead agencies through increased resource impacts such as increased costs and staff if the significance threshold is established too low. For example, a zero threshold might result in eliminating or substantially reducing the number of projects that qualify for a categorical exemption, a negative declaration, or a mitigated negative declaration. Other design considerations discussed included establishing a single GHG threshold, such as a "bright line" numerical threshold or multiple thresholds, such as the tiered approaches identified by CAPCOA, etc.

WORKING GROUP MEETING #2 (MAY 28, 2008)

At the second Working Group meeting, staff presented design criteria recommendations based on the discussion at the first Working Group meeting and correspondence received subsequent to the first Working Group meeting. With regard to analyzing life cycle GHG emissions, staff's initial recommendation was to exclude an analysis of life cycle emissions because life cycle process are not well established. Instead, the GHG emissions analysis should focus on direct and indirect impacts, consistent with current CEQA requirements (CEQA Guidelines §15064(d)). Feedback from the Working Group suggested that a CEQA analysis may be considered deficient without making an effort to conduct a life cycle analysis. Further, if life cycle emissions data are not available, the lead agency should note this consider further analysis speculative and terminate the discussion (CEQA Guidelines §15145).

Another design criteria recommendation made by staff was to take into consideration the administrative burden and resources impacts when establishing a GHG significance threshold. Staff recommended that the GHG significance threshold should not be set too low, which could result in all projects going through the EIR process. It was pointed out that requiring an EIR for all projects does not necessarily result in more mitigation, no meaningful mitigation may be available for small projects, and it may provide a disincentive for implementing mitigation if the measures are unable to reduce GHG impacts to less than significant.

Other design criteria recommended by staff included analyzing the six Kyoto GHGs, any GHG significance threshold established would be considered interim and would be periodically evaluated and updated as necessary, etc. Staff also introduced the concept of preferred GHG mitigation strategies using a hierarchy from the most to least preferred strategies as shown below.

1. Incorporate GHG reduction strategies into project design
2. Mitigate GHGs from other onsite sources for modification projects
3. Mitigate offsite GHG emission reduction projects
4. Mitigate both construction & operational GHG impacts
5. Consider feasible mitigation based on economic factors (cost) pursuant to CEQA Guidelines §15364
6. Purchase acceptable GHG offsets with preference toward GHG reduction projects occurring in-basin or in-state (offset cost a consideration). The following points should be considered:
   a. Offset market still developing, so it is necessary to ensure offsets are obtained from a credible source
   b. Offsets should be provided for at least 10 years of project operation (see SJVAPCD indirect source Rule 9510 §6.2 mitigation requirements)

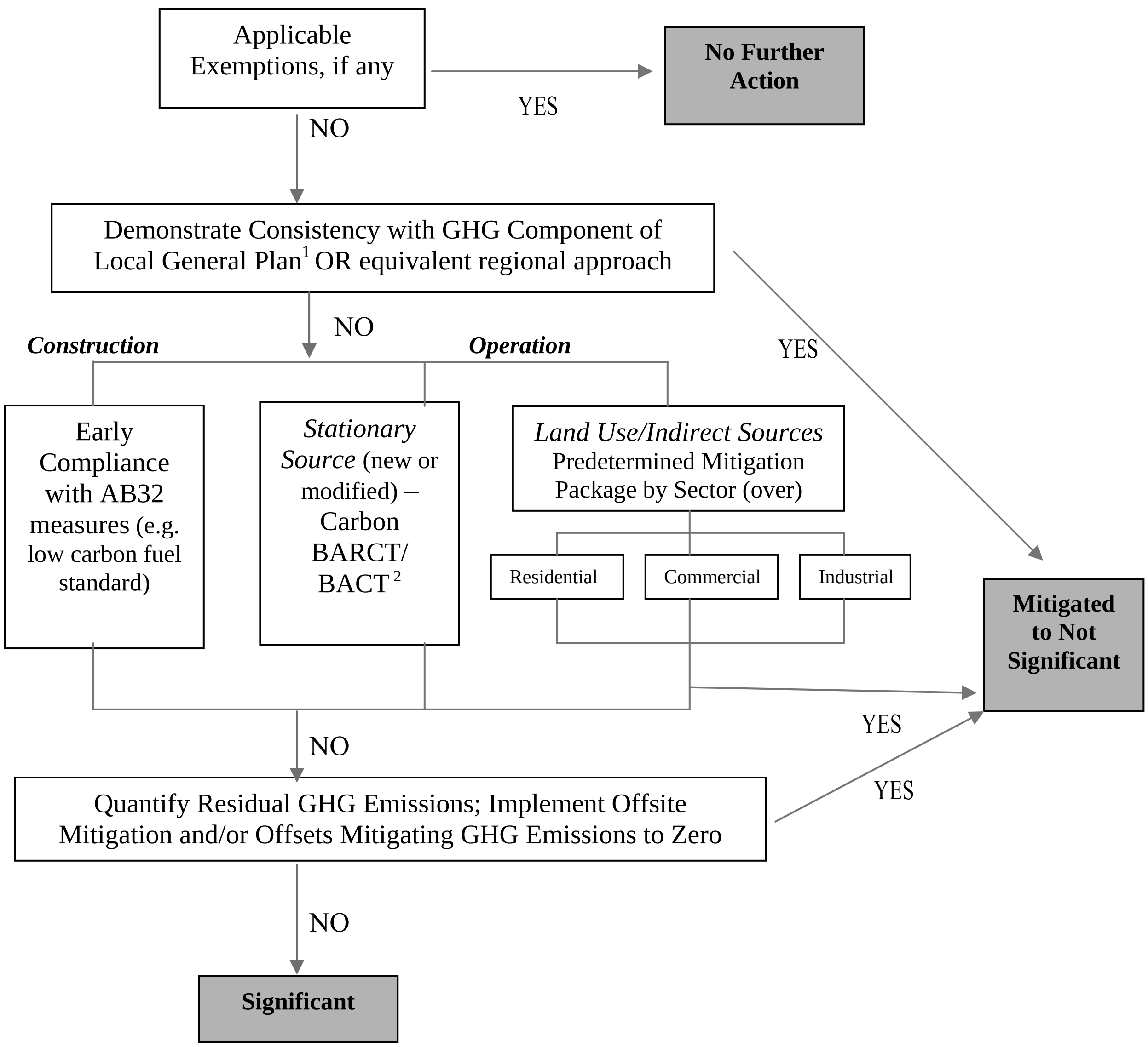
Finally, SCAQMD staff introduced the initial staff proposal. The initial staff proposal consisted of a tiered approach, similar to CAPCOA's Approach 2 with mandatory GHG mitigation measures. Each tier of this proposal is briefly described in the following bullet points and shown graphically in Figure B-1.

- The first tier consists of evaluating whether or not the project qualifies for any applicable exemption under CEQA. For example, SB 97 specifically exempts a limited number of projects until it expires in 2010. If the project qualifies for an exemption, no further action is required. If the project does not qualify for an exemption, then move to the next tier.

Figure B-1

Initial Staff Proposal – Proposed Tiered Approach – May 28, 2008

Significance determination of Cumulative Impacts from GHG emissions:



1. Local General Plans, at a minimum, must comply with AB32 reduction goals; have been analyzed under CEQA, and have a certified Final CEQA document; emission estimates approved by CARB or SCAQMD; include a GHG inventory tracking mechanism; and a commitment to remedy the excess emissions if AB32 goals are not met.

2. SCAQMD will work with CAPCOA to develop a list of mitigation measures.

- The second tier consists of determining whether or not the project is consistent with a GHG reduction plan that is part of a local general plan for example. The GHG reduction plan must, at a minimum, comply with AB 32 reduction goals; include emission estimates approved by CARB or SCAQMD, have been analyzed under CEQA, and have a certified Final CEQA document. Further, the GHG reduction plan must include a GHG inventory tracking mechanism; process to monitor progress in achieving GHG emission reduction targets, and a commitment to remedy the excess emissions if AB 32 goals are not met (enforcement). If the proposed project is consistent with the local GHG reduction plan, it is not significant for GHG emissions.

  The concept of consistency with a GHG reduction plan, is similar to the concept of consistency in CEQA Guidelines §15125(d). If the proposed project does not comply with the local GHG reduction plan or no GHG reduction plan has been adopted, then move to the third tier.

- Under the third tier there are three options that can be used to demonstrate that a project would not have significant emissions. The first significance option is early compliance with AB 32 Scoping Plan measures. The second significance option, primarily for stationary source equipment, would be to install carbon best available retrofit control technology (BARCT) or best available control technology (BACT). Carbon BARCT/BACT would be established by the SCAQMD. The third significance option for industrial, commercial, and residential land use projects would be to implement a menu of prescribed mitigation measures. Mitigation measures would be developed for each land use sector by SCAQMD staff. Implementing one of these three options would result in a determination that GHG emission impacts from the proposed project are not significant. If the proposed project is unable to implement any one of these three options or cannot fully implement any option, then it would move to the fourth tier.

- Under the fourth tier, the lead agency would quantify GHG emissions from the project and implement offsite mitigation (GHG reduction projects) or purchase offsets. Under this tier, GHG emission impacts the lead agency would be required to mitigate or offset GHG emissions to zero. If GHG emissions can be offset to zero, GHG emissions from the project are concluded to be insignificant. If GHG impacts cannot be reduced to zero, the project is concluded to be significant for GHGs.

WORKING GROUP MEETING #3 (JUNE 19, 2008)

Subsequent to Working Group meeting #2, SCAQMD staff received feedback on the initial staff proposal. Issues and concerns raised by the stakeholders on the initial staff proposal were addressed at the third Working Group meeting and are summarized in the following bullet points.

- The staff proposal does not explicitly state any quantitative or qualitative target objectives. If there are no explicit target objectives, how is it possible to determine whether or not a project is insignificant for GHG emissions?

- Concerns were raised regarding the lack of detail relative to the sector-specific mitigation measures and the potentially lengthy lag time between implementing the GHG significance threshold and developing the mitigation measures.

- For most projects, GHG emissions would not need to be calculated as long as the prescribed menu of sector-specific mitigation measures is implemented. Without quantifying GHG emissions and the control efficiencies of the mitigation measures, a project would be vulnerable to a "Fair Argument" that GHG emissions are still significant even after implementing prescribed mitigation measures.

- A CEQA document may be vulnerable in court if control efficiencies of mitigation measures are not identified.

- Is the staff proposal really a zero GHG significance?

  Based on Working Group feedback, staff presented revised staff proposal #1, which consisted of a tiered decision tree approach. The components of revised staff proposal #1 are described in the following bullet points and shown graphically in Figure B-2. As shown in Figure B-2, some of the tier components of the revised staff proposal are similar to those in the initial staff proposal.

- **Tier 1 –** no change from the initial proposal.

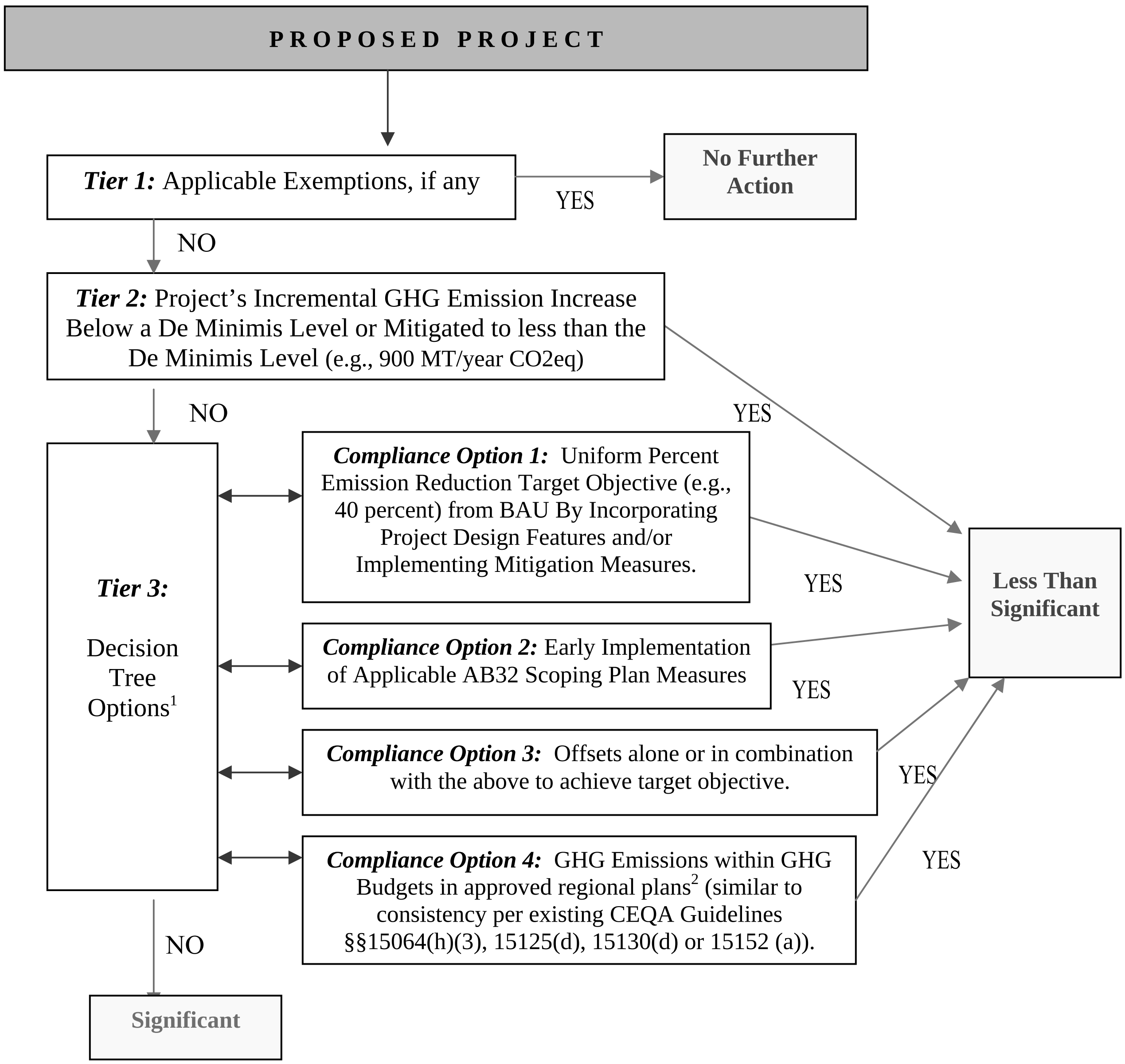
- **Tier 2 –** is a new component of the revised staff proposal. Tier 2 attempts to identify small projects that would not likely contribute to significant cumulative GHG impacts. The de minimis or screening level of 900 metric tons per year is the level that is estimated by CAPCOA to capture 90 percent of the residential units or office space in pending application lists7. CAPCOA infers that projects that emit less than 900 metric ton per year would not likely be considered cumulatively considerable. Further, the 900 metric ton per year level would capture 90 percent

[7] Although the CAPCOA White Paper implies that 900 metric tons per year equates to a 90 percent capture rate, there is no explicit information provided in the White Paper that demonstrates this correlation. Indeed, the CAPCOA authors state that 900 metric tons, which represents approximately 50 residential units, corresponds to widely divergent capture rate percentile rankings depending on the project location (see discussion on page 43 of the White Paper). Percentile rankings were based on a survey of four cities in California. A project of 900 metric tons per year representing a 90 percent capture rate appears to be a working assumption for which there appears to be no factual basis. Further, although not explicitly stated, it is assumed that the 900 metric tons were derived using the URBEMIS2007 model. It should be noted that that the URBEMIS2007 model only quantifies CO2 emissions and direct emissions primarily from on-road mobile sources. It does not capture other GHG pollutants or indirect GHG emissions such as emissions from energy generation, water conveyance, etc. Therefore, it is likely that a 50-unit residential project would actually generate higher GHG emissions than 900 metric tons per year.

Figure B-2

Revised Staff Proposal #1 Tiered Decision Tree Approach – June 19, 2008

Significance Determination of Cumulative Impacts from GHG Emissions:



1. Substitution for equivalent reductions allowed.
2. Local General Plans or other local plans local plans that, at a minimum, comply with the overall target objective or the sector-based CARB Scoping Plan; have been analyzed under CEQA, and have a certified Final CEQA document; emission estimates approved by CARB or SCAQMD; include a GHG inventory; tracking mechanism; enforcement; and a commitment to remedy the excess emissions if commitments are not met.

of all pending projects, which means that 90 percent of all projects would have to implement GHG reduction measures.

If a project is less than 900 MT/year CO2eq or can mitigate to less than 900 MT/year CO2eq, it would be considered insignificant for GHGs. Projects larger than 900 MT/year CO2eq would move to tier 3.

- Tier 3 Decision Tree Options – consists of four decision tree options to demonstrate that a project is not significant for GHG emissions. The four compliance options are as follows.

Compliance Option 1 – the lead agency would calculate GHG emissions for a project using a business-as-usual (BAU) methodology. Once GHG emissions are calculated, the project proponent would have to incorporate design features into the project and/or implement GHG mitigation measures to demonstrate a 40 percent reduction from BAU. A 40 percent reduction below BAU was selected for the following reason. To comply with the AB 32 requirement of reducing GHG emissions to 1990 levels, an approximately 30 percent reduction from current BAU is necessary.

Since CEQA is not applicable to all GHG emission sources, i.e., existing projects that are not undergoing expansion or modifications, staff chose a 40 percent reduction below BAU requirement, which goes beyond the target GHG reduction objective of AB 32, but is still a potentially feasible GHG reduction for a variety of different projects.

Compliance Option 2 – this option is the same as the early compliance with AB 32 option in the third tier of the initial staff proposal.

Compliance Option 3 – this option is similar to the fourth tier of the initial staff proposal where GHG emissions would be reduced through offsite GHG reduction projects and/or use of offsets. This compliance option, however, would require offsetting GHG emissions by the same target objective as compliance option 1, that is, 40 percent below BAU instead of reducing GHG emissions to less than the de minimis or screening level.

Compliance Option 4 – this option is the same as the consistency with the greenhouse gas reduction plan component in the second tier of the initial staff proposal.

If the lead agency or project proponent cannot implement any of the compliance options in Tier 3, GHG emissions would be considered significant.

WORKING GROUP MEETING #4 (JULY 30, 2008)

Subsequent to Working Group meeting #3, SCAQMD staff received feedback on the revised staff proposal #1. Issues and concerns raised by the stakeholders on the initial staff proposal were addressed at the third Working Group meeting and are summarized in the following bullet points.

- Compliance with a GHG reduction plan should not be a compliance option in Tier 3, but should be its own tier, earlier in the tiering process.

- There is a large disconnect between screening level and remaining emissions under the Tier 4 compliance options. For example, large projects that can reduce GHG emissions by the target objective of 40 percent would do so, which means GHG emissions would not be significant, could have substantially higher emissions than projects with GHG emissions less than the screening level.

- Compliance with a target objective should not be through offsets alone. Because of the uncertainties regarding the validity of offsets, preferred mitigation should consist of actual GHG emission reductions.

- The Tier 3 compliance option 1, GHG emissions reductions from BAU, is not the proper metric for determining significance. How can a lead agency be sure that the projected BAU emissions for a project are not artificially inflated to make it easier to achieve the required target objective?

- The Tier 3 compliance option 1, reducing GHG emission reductions from BAU, could penalize projects in environmentally progressive areas where BAU may be much lower than in other areas, thus, making it more difficult to achieve the target objectives.

Based on Working Group feedback and internal discussions, staff presented revised staff proposal #2, which further refined the previous tiered decision tree approach. The components of revised staff proposal #2 are described in the following bullet points and shown graphically in Figure B-3. As shown in Figure B-3, some of the tier components of the revised staff proposal are similar to those in the initial staff proposal.

- **Tier 1 –** no change from the initial proposal.

- **Tier 2 –** compliance option 4 in Tier 3 has been moved back a stand-alone tier.

- **Tier 3 –** the screening level that was previously Tier 2 has been moved to Tier 3. In response to feedback from the Working Group, the screening level has been increased to 6,500 MT/year CO2eq. The new screening level was derived using the SCAQMD's existing NOx operational threshold as a basis. The daily NOx operational significance threshold, 55 pounds per day was annualized, which results in 10 tons of NOx per year. Using the URBEMIS2007 model, staff initially modeled a mixed-use project that emits just under 10 tons per year to determine what the equivalent CO2 emissions would be. Resulting CO2 emissions from the mixed use project were approximately 6,500 MT/year CO2. To further corroborate the 6,500 MT/year CO2 staff performed 19 modeling runs on a variety of projects including residential, commercial, industrial, and various combinations of land uses. In addition, since the analysis was an annual analysis, a weighted trip rate was derived for each land use category to obtain a more accurate estimate of trip rates throughout the week. Although the results from the 19 modeling runs were approximately 16 percent higher than staff's original estimate of 6,500 MT/year CO_2, 7,304 to 7,723 MT/year CO_2, staff continued to recommend the 6,500 MT/year CO_2 provides a margin of safety when deriving CO_2 emissions based on the annualized NO_x level of 10 tons per year and when evaluating different types of land use projects.

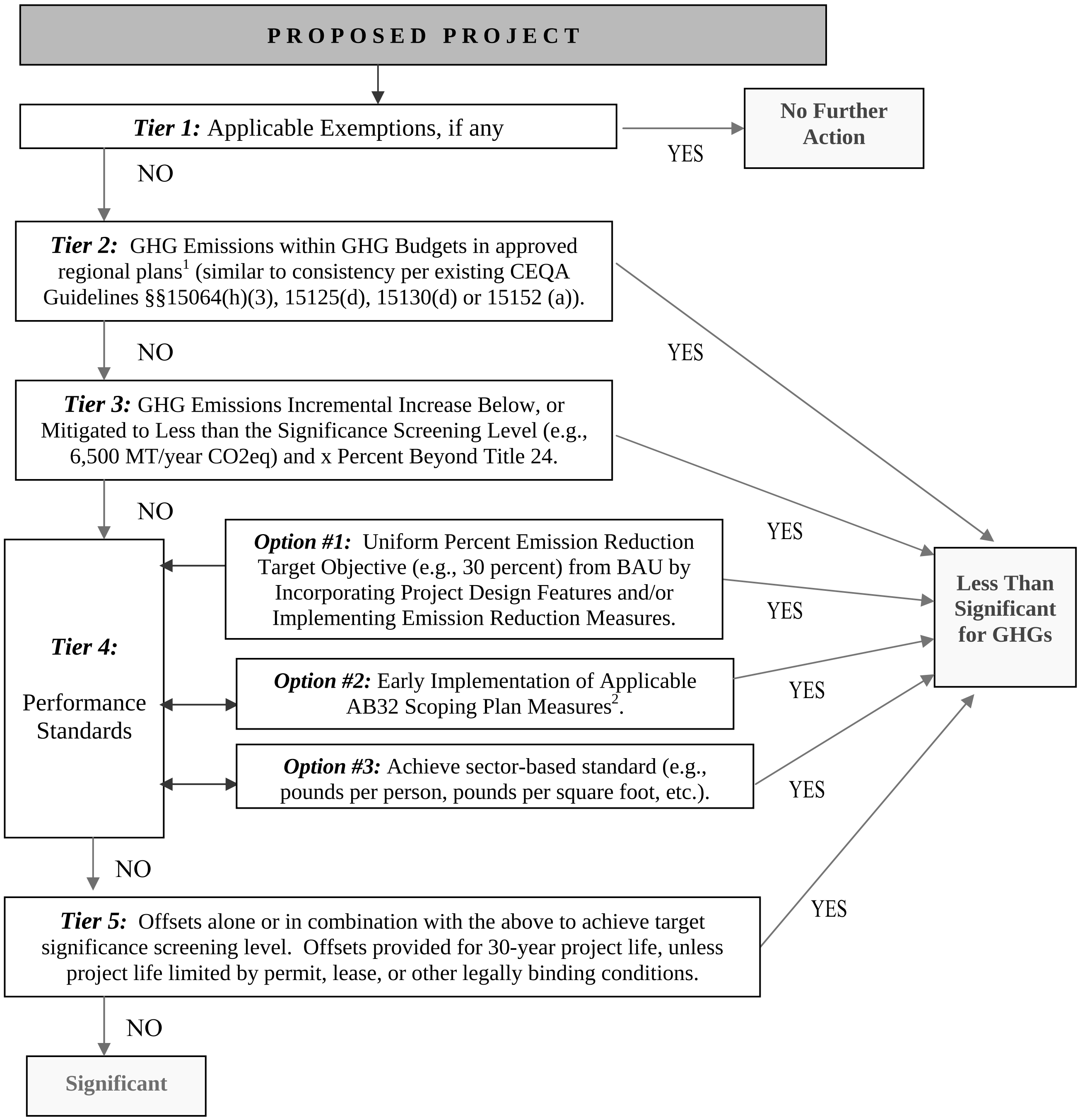
> Projects with GHG emissions less than the screening level are considered to be small projects, that is, they would not likely be considered cumulatively considerable. However, because of the magnitude of increasing global temperatures from current and future GHG emissions, staff recommended that all projects must implement some measure or measures to contribute to reducing GHG emissions. Therefore, Tier 3 includes a requirement that all projects with GHG emissions less than the screening level must include efficiency components that reduce to a certain percentage beyond the requirements of Title 24 (Part 6, California Code of Regulations), California's energy efficiency standards for residential and nonresidential buildings.

- Tier 4 Performance Standards – Tier 3 from the revised staff proposal #1 has been moved to Tier 4 and renamed.

Figure B-3

Proposed Tiered Decision Tree Approach – July 30, 2008

Significance Determination of Cumulative Impacts from GHG Emissions:



1. Local General Plans or other local plans local plans that, at a minimum, comply with the overall target objective or the sector-based CARB Scoping Plan; have been analyzed under CEQA, and have a certified Final CEQA document; emission estimates approved by CARB or SCAQMD; include a GHG inventory; tracking mechanism; enforcement; and a commitment to remedy the excess emissions if commitments are not met.

2. Substitution for equivalent reductions allowed.

Compliance Option 1 – is essentially the same as the previously recommended, except that the target objective has been changed from reducing GHG emissions 40 percent below BAU to 30 percent below BAU to be more consistent with AB 32 target objectives.

Compliance Option 2 - – no change from the previous proposal.

Compliance Option 3 – this is a new compliance option and consists of establishing sector-based performance standards. For example, it may be possible to use the 1990 inventory required under AB32 to establish an efficiency standard such as pounds per person, pounds per worker, pounds per square feet, pounds per item manufactured, etc. When calculating GHGs from a project, if they are less than the established efficiency standard the project would not be significant relative to GHG emissions, while projects exceeding the efficiency standard would be significant.

Projects that cannot comply with any of the compliance options in Tier 4 would then move on to Tier 5.

- **Tier 5 –** consists generally of the Tier 3 compliance option 3 from the previous staff proposal. The only difference is that the project proponent would be required to provide offsets for the life of the project, which is defined as 30 years. If the project proponent is unable to obtain sufficient offsets, incorporate design features, or implement GHG reduction mitigation measures, then GHG emissions from the project would be considered significant.

WORKING GROUP MEETING #5 (AUGUST 27, 2008)

Subsequent to Working Group meeting #3, SCAQMD staff received feedback on the revised staff proposal #2. Issues and concerns raised by the stakeholders on the initial staff proposal were addressed at the third Working Group meeting and are summarized in the following bullet points.

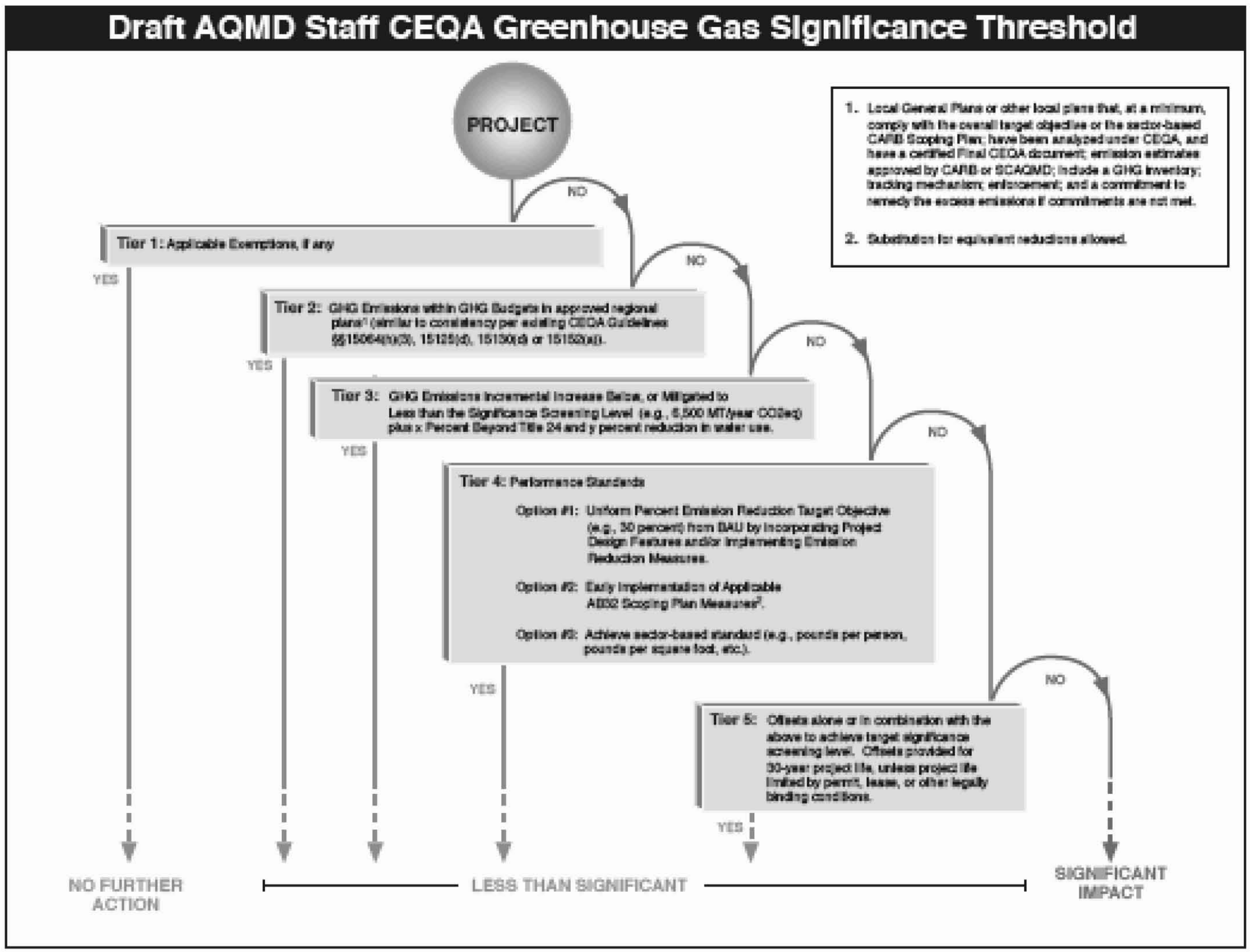
- A recommendation was made to modify the target objective of Tier 5 to be consistent with the target objective of Tier 4 compliance option 1, that is require emissions to be offset 30 percent from BAU rather than offset down to the screening level.

- A Working Group member asked for clarification on the early implementation of applicable AB 32 Scoping Plan measures in Tier 4-Option 2. In addition, a question was asked regarding whether or not this compliance option was applicable after the requirements of AB 32 have become effective.

At Working Group meeting #5, staff presented revised staff proposal #3, which consisted primarily of minor refinements to the previous tiered decision tree approach in revised staff proposal #2. The components of revised staff proposal #3 are shown graphically in Figure B-4.

Aside from changing the graphic layout of the staff proposal to make it easier to understand, revised staff proposal #3 has only one minor modification. A second energy efficiency requirement has been added to the screening level in Tier 3. In addition to requiring projects to go a certain percentage beyond Title 24, projects would also have to reduce by a specified percentage electricity demand from water use, primarily electricity used for water conveyance.

Figure B-4
Revised Staff Proposal #3 Tiered Decision Tree Approach – August 27, 2008



051. Letter from Center for Biological Diversity and Endangered Habitats League, dated August 25, 2009

Response 1

The comment is an introduction to comments that follow.[1] No further response is required.

Response 2

The comment restates information contained in the draft environmental documentation and does not raise an environmental issue within the meaning of CEQA or NEPA. The comment will be included as part of the record and made available to the decision makers prior to a final decision on the proposed Project. However, because the comment does not raise an environmental issue, no further response is provided.

Response 3

The comment addresses general subject areas, which received extensive analysis in the draft environmental documentation. The comment does not raise any specific issue regarding that analysis and, therefore, no more specific response is provided.

With that said, the amount of annual greenhouse gases (*i.e.*, excluding land use change/vegetation and construction) that would be emitted as a result of proposed Project (*i.e.*, about 250,000 tonnes of carbon dioxide equivalents (CO_2e) per year) would be more than 31 percent below the level that would be anticipated if the proposed Project were constructed in a manner consistent with the California Air Resources Board's (CARB) inventorying assumptions for year 2020 if "no actions are taken." In determining what emission reductions would be required to return California's emissions to 1990 levels by 2020, consistent with Health & Safety Code section 38550, CARB prepared emission estimates, which found that a reduction of 29 percent below the "no actions are taken" scenario is required to meet the mandates of Assembly Bill 32 (AB 32), Global Warming Solutions Act of 2006. (See "Climate Change Proposed Scoping Plan: A Framework for Change" (Scoping Plan; as adopted in December 2008), p. ES-1 ["Reducing greenhouse gas emissions to 1990 levels means cutting approximately 30 percent from business-as-usual emission levels projected for 2020."]; see also Health & Saf. Code, § 38500 *et seq.*) As the proposed Project's emissions would exceed the 29 percent requirement, the proposed Project would not impede the implementation of AB 32 and is consistent with the overall trajectory the State of California has established for greenhouse gas reductions. (Please see ENVIRON's "Climate Change Technical Addendum" (October 2009), which can be found in **Appendix F8.0** of the Final EIS/EIR. Additionally, please see **Topical Response 13: Global Climate Change Update**, and **Section 8.0** of the Final EIS/EIR, which compare and assess the consistency of Project emissions with the AB 32 reduction mandate.)

Response 4

This comment is an introduction to comments that follow. With that said, please see **Response 5** for responsive information regarding the proposed Project's mobile source emissions and related assumptions

[1] Please note that all documents referenced in these responses are incorporated by reference, and available for public inspection and review at the Valencia Library, 23743 Valencia Boulevard, Santa Clarita, California 91355. (See Cal. Code Regs., tit. 14, §15150.)

regarding vehicle trip length. Please also see **Response 6** for responsive information regarding the Project applicant's design commitments relative to the 2008 Title 24 standards, which took effect on January 1, 2010. Finally, see **Response 28** for responsive information regarding why the recirculation standards under the California Environmental Quality Act ("CEQA") and National Environmental Policy Act ("NEPA") have not been triggered. The comment will be included as part of the record and made available to the decision makers prior to a final decision on the proposed Project.

Response 5

The comment questions whether the internal capture rate presented in the Draft EIS/EIR is supported by substantial evidence. The trip distribution patterns utilized in the Draft EIS/EIR for the Santa Clarita Valley, and the corresponding internal capture rates, were determined based on application of the Santa Clarita Valley Consolidated Traffic Model (SCVCTM). (Draft EIS/EIR, **Subsection 4.8.2.2**.) Please see **Topical Response 10: Vehicle Trip Distribution Methodology**, for a detailed explanation regarding the SCVCTM and the basis for derivation of the internal capture rate. As explained in **Topical Response 10: Vehicle Trip Distribution Methodology**, the internal and external capture rates were determined by the SCVCTM based on demographic data and mathematical functions and are not, as the comment states, based on speculation. Accordingly, the Draft EIS/EIR analysis of air quality and GHG emission impacts, like the traffic impacts analysis, is well- founded.

The comment also refers to the Institute of Transportation Engineers' (ITE) "Trip Generation Handbook" (2001) (ITE Handbook) as the most widely accepted method for estimating multi-use trip generation. However, while the ITE Handbook is widely used, it is not applicable to large-scale projects such as the proposed Project.

The data and methods outlined in the ITE Handbook are based on a limited number of case studies (6), all observed in Florida. Additionally, according to the ITE Handbook, most multi-use developments typically are between 100 thousand square feet and 2 million square feet, and the data presented in the Handbook corresponds to multi-use developments within that size range. (ITE Handbook, 2nd Ed. (2004), p. 85.) In comparison, the proposed Project would facilitate the development of over 9 million square feet of non-residential uses and approximately 22,000 residential units, which equates to another 35-45 million square feet, for a total Project size in the range of 50 million square feet. Therefore, the scale of the proposed Project is well beyond the range addressed by the ITE Handbook.

Moreover, while the ITE Handbook states that the recommended procedures are "likely applicable" at even larger sites, the Handbook encourages the analyst to collect additional data when evaluating projects larger than 2 million square feet. (ITE Handbook, 2nd Ed., p. 85.) In this case, the procedure utilized to determine the internal capture rate is consistent with the recommendations in the ITE Handbook since a computerized traffic model (the SCVCTM), with the capability of evaluating large scale projects, was utilized to determine trip distribution patterns in light of the fact that the proposed Project would result in a significantly larger project than the projects the ITE method was derived to address.

The comment further states that "under optimal circumstances a mixed use development would probably only justify an internal capture rate of 10-20 percent." However, the ITE Handbook identifies unconstrained internal capture rates that range from as little as 0 percent up to 53 percent, which is consistent with the internal capture percentage derived based on the SCVCTM.

Related to the comment's statements regarding the internal capture rate, the comment also questions the trip lengths utilized in the Draft EIS/EIR for home-work, home-shop, and home-other trips of 10.7 miles, 5.2 miles, and 7.0 miles, respectively. As explained in **Topical Response 10: Vehicle Trip Distribution Methodology**, the trip distribution percentage was derived using a travel demand model that takes into account both the Project's mix of land uses and the land uses of the surrounding area. The related trip lengths are calculated by the model based on the calibrated trip distribution functions. See **Topical Response 10: Vehicle Trip Distribution Methodology**, for additional information responsive to this comment.

With respect to the comment that "[e]xperts have found a maximum internal home-work capture rate of 38 percent in isolated developments," the residential home-work internal capture for the Project is only 22 percent, which is substantially below the referenced 38 percent. Please see **Topical Response 10: Vehicle Trip Distribution Methodology**, for further information responsive to this comment.

As to the comment that "[t]he EIR also fails to recognize that commercial and maintenance jobs at the Project site will attract workers who do not live there and must commute," the SCVCTM determined that 74 percent of the Home-Based-Work Trips to the proposed Project's non-residential uses would be external (*i.e.*, from a starting point outside of the Project). Please see **Topical Response 10: Vehicle Trip Distribution Methodology**, for further information responsive to this comment.

Additionally, the greenhouse gas emissions quantification and analysis, prepared by ENVIRON International Corporation, addressed such trips. (Please see Section 4.3, Evaluation of "New" Emissions, and Section 4.9, Mobile Sources, of ENVIRON's "Climate Change Technical Report" (February 2009), which is found in **Appendix 8.0** of the Draft EIS/EIR.)

Specifically, the Draft EIS/EIR concludes that increases in greenhouse gas emissions are directly tied to population growth and increased standards of living. The analysis further found that new housing in California is a response to both population increase and increasing standards of living for new California residents that relocate from less economically developed areas. Therefore, operational emissions (including vehicular/mobile source emissions) associated with new residential development result in emissions growth, particularly as residences are rarely removed from the housing supply once constructed. Accordingly, the greenhouse gas emission inventories presented in the Draft EIS/EIR account for the following emission sources, among others, associated with new residential development: (i) emissions from electricity and natural gas consumption by residential units; (ii) emissions from electricity and natural gas consumption by commercial and retail establishments that are built to support new residences; and, (iii) emissions from vehicle trips generated by residential units.

With respect to greenhouse gas emissions from mobile sources, the emission inventories in the Draft EIS/EIR accounted for the fact that, in many cases, the proposed Project would result in a re-routing and/or re-directing of mobile source-related emissions from one destination to another but would not create any new emissions. (Draft EIS/EIR, **Subsection 8.5.2.1.1**, RMDP Direct/Indirect Impacts, pp. 8.0-38 - 8.0-41.) As explained in the EIS/EIR, increases in GHG emissions are caused by population growth. Therefore, non-residential development is not considered "new growth" for purposes of calculating greenhouse gas emissions from vehicular travel because non-residential development does not result in population growth or new permanent housing to accommodate population growth. Specifically, the construction of new commercial and/or retail-serving land uses does not increase traffic, unless the average trip distance to that commercial or retail establishment increases as a result of the new construction. If, however, the new non-residential area results in shorter trip lengths for its workers and occupants than previously would have been made, the new non-residential land uses decrease the amount of greenhouse gas emissions.

Accordingly, GHG emissions from vehicle miles traveled (VMT) serving non-residential areas are only counted if the non-residential development contributes to greater VMT as a result of its location. If the non-residential development lowers VMT, then it should be considered to have a zero or negative GHG contribution as a result of its shortened operational vehicle trips. Although the non-residential development associated with the Newhall Ranch Specific Plan likely reduces trip lengths from existing residences, as explained above, the GHG emissions inventory conservatively assumed that the non-residential land uses enabled by Project approval would contribute to a net zero increase in mobile source-related emissions throughout the United States.

The GHG emissions inventory included trips made by future residents of the Project area, analyzing trips originating or ending at residences that would be built within the three planning areas (*i.e.*, Newhall Ranch Specific Plan area, Entrada planning area, and Valencia Commerce Center planning area). This approach avoids counting trips made by non-residents that visit the Project area to shop; such trips, as discussed above, do not represent true growth because they would have been made in the absence of the population growth accommodated by the Project area. In fact, build-out within the three planning areas contemplated in the Draft EIS/EIR likely would reduce trip lengths as it would provide local shopping and employment opportunities for existing residents of the Santa Clarita Valley.

To assess the validity of using only home-based trips, VMT estimated from traffic model outputs using only the home-based trip method were compared to actual traffic counts for Los Angeles County. The SCAG traffic model covers all of Ventura, Los Angeles, and Orange counties and the western half of San Bernardino and Riverside counties. The VMT, based upon the SCAG computer model for home-based trips, was 6,545 VMT per capita. The SCAG computer model result is consistent with the California Department of Transportation's 2005 VMT estimate (5,953 VMT per capita) for the County. The traffic study relied on the SCVCTM model to quantify the mobile source GHG emissions for the proposed Project as that model covers a smaller area than the SCAG model, is more specific to the Santa Clarita Valley, and was developed by the City of Santa Clarita and the Los Angeles County Department of Public Works (DPW).

The GHG emissions from mobile sources were then calculated by running URBEMIS 9.2.2 with the trip rates and trip lengths, as provided above. Fleet distribution types from EMFAC2007 from the year 2030 also were used in conjunction with URBEMIS default trip speeds. However, the only GHG for which URBEMIS 9.2.2 calculates emissions is CO_2. Because other GHGs are emitted from mobile sources, the USEPA recommends assuming that CH_4, N_2O, and HFCs account for five percent of mobile source GHG emissions, taking into account their GWPs. Therefore, CO_2 emissions were divided by 0.95 to account for non-CO_2 GHGs. Thus, the total approximate amount of GHGs emitted by mobile sources would be 162,001 tonnes of CO_2e/year.[2] As noted above, this is likely an overestimate of GHG emissions from

---

[2] Please also see ENVIRON's "Climate Change Technical Addendum" (October 2009), which can be found in **Appendix F8.0** of this Final EIS/EIR. This technical addendum provides updated emissions estimates for mobile source-related emissions through the incorporation of: (i) an updated mobile source emissions factor; and (ii) the Pavley (Assembly Bill 1493) regulations, which improve vehicle emission

mobile sources located on the Specific Plan site following build-out due to the fact that the addition of proximate commercial development in the Project area results in a negative GHG contribution.

Therefore, as presented in Draft EIS/EIR **Section 8.0**, the EIS/EIR accurately accounted for GHG emissions.

Response 6

The comment states that the Project applicant's commitment to exceed the 2005 Title 24 standards is "illusory and misleading" due to the pending implementation date (*i.e.*, January 1, 2010) of the 2008 Title 24 standards.

To preface, the lead agencies acknowledge that since circulation of the Draft EIS/EIR for public review and comment, the 2008 Title 24 standards became effective, thereby superseding the 2005 standards. As noted in the comment, any development facilitated by approval of the EIS/EIR likely would be required to conform with the recently enacted and more stringent 2008 Title 24 standards. With that said, it is critical to acknowledge the long-term planning process leading up to distribution of the Draft EIS/EIR; the supporting technical analysis prepared by ENVIRON has been developed over a multi-year process, during which the applicable version of the Title 24 standards has changed.

As stated by the California Energy Commission, the 2008 Title 24 standards were adopted for a "number of compelling reasons:"

1. "To provide California with an adequate, reasonably-priced, and environmentally-sound supply of energy.
2. To respond to Assembly Bill 32, the Global Warming Solutions Act of 2006, which mandates that California must reduce its greenhouse gas emissions to 1990 levels by 2020.
3. To pursue California energy policy that energy efficiency is the resource of first choice for meeting California's energy needs.
4. To act on the findings of California's Integrated Energy Policy Report (IEPR) that the [Building Energy Efficiency] Standards are the most cost effective means to achieve energy efficiency, expects the Standards to continue to be upgraded over time to reduce electricity and peak demand, and recognizes the role of the Standards in reducing energy related to meeting California's water needs and in reducing greenhouse gas emissions.
5. To meet the West Coast Governors' Global Warming Initiative commitment to include aggressive energy efficiency measures into updates of state building codes.
6. To meet the Executive Order in the Green Building Initiative to improve the energy efficiency of nonresidential buildings through aggressive standards."

(California Energy Commission website, 2008 Building Energy Efficiency Standards, http://www.energy.ca.gov/title24/2008standards/ (last visited September 14, 2009), which is incorporated by reference.) The above criteria demonstrate that the 2008 standards were adopted in direct response to

---

standards by requiring a 30 percent reduction in greenhouse gas emissions by 2016. Mobile source-related emissions from the proposed Project are now projected to be 112,138 tonnes of CO_2e per year.

mandates and goals calling for the reduction of greenhouse gas emissions from residential and nonresidential buildings throughout the State of California.

While the California Energy Commission is striving to place California on the trajectory towards achieving its emission reduction mandates, through the adoption of more stringent building criteria, the Project applicant is committed to exceeding the Title 24 standards currently deemed appropriate and adequate by the California Energy Commission at this time. Specifically, in light of the import of building energy efficiency standards to reducing California's carbon footprint and the developing building methods that have made higher energy efficiency more technically feasible, the project design features and corresponding mitigation measures presented in the Draft EIS/EIR have been revised to express the Project applicant's commitment to exceed the Title 24 standards by 15 percent. As build-out of the development that would be facilitated by Project approval likely would occur over an extended horizon, the Project applicant's commitment, incorporated via mitigation measures, is to exceed whatever is the currently applicable version of the Title 24 standard by 15 percent. Accordingly, the statements in the comment suggesting that the proposed Project only would comply with the status quo (*i.e.*, the 2008 standards, and not any exceedance thereto) is incorrect.

Mitigation Measures GCC-1 and GCC-2 have been revised, with additions shown in <u>underline</u> and deletions in ~~strikethrough~~, as follows:

GCC-1 All residential buildings on the Project applicant's land holdings that are facilitated by approval of the proposed Project shall be designed to provide improved insulation and ducting, low E glass, high efficiency air conditioning units, and radiant barriers in attic spaces, as needed, or equivalent to ensure that all residential buildings operate at levels fifteen percent (15%) better than the standards ~~presently~~ required by <u>the version of</u> Title 24 ~~(2005)~~ <u>applicable at the time the building permit applications are filed</u>.

GCC-2 All commercial and public buildings on the Project applicant's land holdings that are facilitated by approval of the proposed Project shall be designed to provide improved insulation and ducting, low E glass, high efficiency HVAC equipment, and energy efficient lighting design with occupancy sensors or equivalent to ensure that all commercial and public buildings operate at levels fifteen percent (15%) better than the standards ~~presently~~ required by <u>the version of</u> Title 24 ~~(2005)~~ <u>applicable at the time the building permit applications are filed</u>.

ENVIRON's "Climate Change Technical Addendum" accounts for the Project applicant's commitment relative to the 2008 Title 24 standards in the updated greenhouse gas emissions inventory for the proposed Project. It is important to acknowledge the conservative nature of the emissions inventory in the sense that increasingly more stringent building standards will be phased-in as the Title 24 residential and nonresidential building standards are revisited periodically by the California Energy Commission to allow for the consideration and possible incorporation of new energy efficiency technologies and methods. As the emissions inventory assumes that all build-out that would be facilitated by the proposed Project would be subject to the 2008 standards, the estimates are conservative; in all likelihood, various aspects of the development facilitated by the proposed Project would be subject to subsequent (and more restrictive) versions of the Title 24 standards, thereby reducing the emissions inventory.

Please also see **Topical Response 13: Global Climate Change Update**, and **Section 8.0** of the Final EIS/EIR for additional information relating to the incorporation of the 2008 Title 24 standards into the emissions inventories and significance assessments.

Response 7

The comment states that the Draft EIS/EIR fails to acknowledge that the Title 24 standards do not address operational performance energy use, such as that associated with plug-in appliances. However, this statement is incorrect. The Draft EIS/EIR fully discloses the scope of the Title 24 standards for residential and nonresidential buildings:

> "Title 24 governs energy consumed by the built environment for commercial and residential buildings in California. This includes the HVAC system, water heating, and some fixed lighting. (Non-building energy use, or "plug-in" energy use, is not covered by Title 24."

(See Draft EIS/EIR, **Subsection 8.3.3.6**, Title 24, p. 8.0-18.)

> "Energy use in residential buildings is divided into two categories: (1) energy consumed by the built environment; and (2) energy consumed by uses that are independent of the construction of the building, such as plug-in appliances. In California, Title 24 governs the first category (energy consumed by the built environment), which includes the HVAC system, water hearing, and some fixed lighting. Examples of "plug-in" energy use include refrigeration, cooking, lighting, *etc*. Energy uses for the two categories identified above were calculated separately, and the resulting energy use quantities were then converted to GHG emissions by using the appropriate emission factors."

(See Draft EIS/EIR, **Subsection 8.5.2.1.1**, RMDP Direct/Indirect Impacts, p. 8.0-33.)

> "As with residential buildings, energy use in nonresidential buildings is divided into two categories: (1) energy consumed by the built environment; and (2) energy consumed by uses that are independent of the construction of the building, such as plug-in appliances."

(See Draft EIS/EIR, **Subsection 8.5.2.1.1**, RMDP Direct/Indirect Impacts, p. 8.0-36.)

The comment also states that the Draft EIS/EIR does not address the extent to which the Project applicant has committed to exceed existing requirements for operational performance emissions. In response, mitigation measures requiring the installation of ENERGY STAR appliances are not recommended;[3] instead, the decision to install more efficient appliances is left to the preference of individual homeowners and operators/renters of non-residential building space. As the proposed Project's direct and cumulative impacts associated with global climate change are less than significant, the inclusion of an exceedance commitment relative to emissions associated with plug-in appliances is not necessary to reduce Project-related impacts to a less-than-significant level.

---

[3] ENERGY STAR is a joint program, sponsored by the U.S. Environmental Protection Agency and U.S. Department of Energy, which identifies energy efficient appliances for consumer purchase. (See Energy Star website, About Energy Star, http://www.energystar.gov/index.cfm?c=about.ab_index (last visited September 14, 2009).)

Response 8

The comment first states that compliance with AB 32 is not the appropriate standard for determining the significance of the proposed Project's greenhouse gas emissions. However, this significance criterion is supported by substantial record evidence and reasonable in light of the current scientific and factual debate regarding the interface of greenhouse gas emissions with global climate change (*i.e.*, the uncertainty regarding when emissions become "too much" and significantly effect the global phenomenon of climate change).

By way of background, CEQA requires lead agencies to assess the significance of environmental impacts, and requires that significance determinations be based on substantial evidence in the record. (Pub. Resources Code, § 21082.2, subd. (a).) Here, the lead agencies first quantified the Project-related emissions, as measured against the existing, on-site conditions. AB 32, and specifically Health & Safety Code section 38550, which codifies the *only* statewide mandate for reducing California's greenhouse gas emissions inventory to 1990 levels by 2020, was then utilized as a benchmark to inform the agencies' judgment as to the significance of those emissions. Because Project-related emissions would not impede California's attainment of the AB 32 mandate, Project impacts were found to be less than significant.

As noted in the Draft EIS/EIR, at present time, no relevant federal, state, regional, or local agencies have adopted significance thresholds for the analysis of greenhouse gas emissions pursuant to State CEQA Guidelines section 15064.7.[4] (See Cal. Code Regs., tit. 14, § 15064.7, subd. (b).) That said, the California Natural Resources Agency's adopted amendments to the State CEQA Guidelines, effective March 18, 2010, affirm the discretion afforded to local lead agencies in identifying appropriate significance criteria and do not establish rigid thresholds. For example, newly added State CEQA Guidelines section 15064.4, subdivision (b), provides:

> "A lead agency should consider the following factors, among others, when assessing the significance of impacts from greenhouse gas emissions on the environment:
>
> (1) The extent to which the project may increase or reduce greenhouse gas emissions as compared to the existing environmental setting;
>
> (2) Whether the project emissions exceed a threshold of significance that the lead agency determines applies to the project;

---

[4] CARB appears to have halted its efforts to adopt thresholds of significance for global climate change, and left the matter to local air districts and lead agencies. And, while the South Coast Air Quality Management District (SCAQMD) is working towards the adoption of CEQA significance criteria for greenhouse gases associated with residential and non-residential development, such thresholds have not been adopted at this time.

In December 2009, the San Joaquin Valley Unified Air Pollution Control District adopted guidance for use by local lead agencies in assessing the significance of a project's GHG emissions under CEQA. The guidance relies on the use of performance-based standards, and requires that projects demonstrate a 29 percent reduction in GHG emissions, from business-as-usual, to determine that a project would have a less-than-significant cumulative impact. The San Joaquin threshold is not relevant for purposes of the EIS/EIR as the proposed Project is not located within the jurisdiction of the San Joaquin Valley Unified Air Pollution Control District. That said, the San Joaquin threshold is not so dissimilar from the criteria utilized in the EIS/EIR, which effectuates a 29 percent emission reduction in order to support a finding that a project's emissions are not significant.

> (3) The extent to which the project complies with regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of greenhouse gas emissions."

Of note, the lack of adopted thresholds is not inconsistent with the State CEQA Guidelines, which "encourage" but do not require the adoption of thresholds of significance. (*Id.* at subd. (a); see also Draft EIS/EIR, **Subsection 8.4**, Impact Significance Criteria, p. 8.0-29.) And, in light of the lack of adopted regulatory standards by agencies with expertise in global climate change, the lead agencies determined it is appropriate to rely on AB 32 as a benchmark and use the goals identified in AB 32 to inform their judgment of the proposed Project's significance. Specifically, the significance analysis presented in the global climate change section asks:

> Will the proposed Project's GHG emissions impede compliance with the GHG emission reductions mandated in AB 32?

The lead agencies elected to rely on AB 32 because it represents the only identifiable reduction target for California adopted at this time. Of note, the California Legislature has affirmed the relevance of AB 32's reduction mandate in the CEQA context: "The California Environmental Quality Act (CEQA) is California's premier environmental statute. New provisions of CEQA should be enacted so that the statute encourages developers to submit applications and local governments to make land use decisions that will help the state achieve its climate goals under AB 32, assist in the achievement of state and federal air quality standards, and increase petroleum conservation." (Stats. 2008, ch. 728, §1(f).)

As explored in **Section 8.0** of the Final EIS/EIR, a 29 percent reduction from the 2020 emission levels forecasted by CARB is required to establish that emissions are consistent with AB 32 and less than significant. Of note, while the 29 percent emission reduction is treated in the analysis as a sector-wide reduction requirement, various sectors will, in fact, be responsible for various reduction requirements. That is, not every sector (e.g., industry; ports; power generation; land use; etc.) is responsible for achieving a 29 percent reduction. In fact, at least one agency has determined that the land use/housing sector will not need to achieve a 29 percent reduction. An analysis of CARB's December 2008 Scoping Plan conducted by the Bay Area Air Quality Management District showed that the emissions attributable to "land use-driven" sectors need to demonstrate a 26.2 percent reduction in GHG emissions by 2020.[5]

The significance analysis also considered the long-term objective identified in Governor Schwarzenegger's Executive Order S-03-05 for 2050; that goal aspires for California to emit 80 percent less greenhouse gas emissions in 2050 than it emitted in 1990. (Draft EIS/EIR, **Subsection 8.5.2.3.1**, Comparison with AB 32's 2020 Goal, pp. 8.0-62-8.0-64.) The analysis concluded that:

> "In light of the uncertainties regarding the specific reduction strategies and methods needed for California to achieve the 2050 reduction goal identified in Governor

---

[5] See Bay Area Air Quality Management District, "California Environmental Quality Act Guidelines Update: Proposed Thresholds of Significance" (November 2, 2009), pp. 10-11, 14 [identifying 26.2 percent reduction requirement, and the "land use-driven" sectors as including transportation (on-road passenger vehicles, on-road heavy duty); electric power (electricity, cogeneration); commercial and residential (residential fuel use, commercial fuel use); and recycling and waste (domestic waste treatment)].

> Schwarzenegger's Executive Order S-03-05, the impact of the proposed Project on the 2050 reduction goal is considered too speculative to assess at this time. (See Cal. Code Regs., tit. 14, § 15145.)"

(*Id.* at p. 8.0-64.) That said, because the proposed Project would not impede California's attainment of the AB 32 reduction mandate, it also is placing the State of California "on track" towards achieving the 2050 reduction goal established by Governor Schwarzenegger's Executive Order.

The significance criterion utilized in the Draft EIS/EIR and the subsequent analysis reflects the "careful judgment" of the lead agencies and is based on, to the extent possible, scientific and factual data. (Cal. Code Regs., tit. 14., § 15064, subd. (b).) Lead agencies cannot ignore the gaps in the understanding of global climate change and the ambiguities regarding the site-specific effects. With that said, lead agencies must use their "best efforts to find out and disclose all that it reasonably can." (Cal. Code Regs., tit. 14, § 15144.) The lead agencies have done just that in preparing an extensive climate change section that presents the existing regulatory and scientific setting, summarizes the quantitative greenhouse gas emissions inventories for the proposed Project and its alternatives, undertakes a significance analysis tied to California's only adopted greenhouse gas emissions reduction mandate, and recommends the incorporation of "green" project design features as mitigation measures.

The comment further states that development like the proposed Project, which allegedly is built in locations far from jobs and public transit, preclude California from avoiding dangerous climate change. However, the comment is incorrect in its characterization of the development that would be facilitated by approval of the EIS/EIR and the related approval of the proposed Project or one of its alternatives.

Importantly, the proposed Project would facilitate the build-out of a mix of residential and non-residential land uses, which would entail a high concentration of jobs and numerous public transit features. The County of Los Angeles has determined that build-out of the Specific Plan alone will foster regional economic development and job creation by creating approximately 20,000 jobs.

As to the characterization of the proposed Project as being far from jobs and public transit, the Santa Clarita Valley is a readily emerging community that is both self-sustaining and self-financing. Reductions in many greenhouse gas emissions associated with mobile sources will result from federal and state efforts to increase vehicle fuel efficiency, which is beyond the purview and authority of the lead agencies for the EIS/EIR. With that said, the Project applicant is committed to implementing numerous transit-oriented design features. (Draft EIS/EIR, **Subsection 8.6.4**, Consistency with Recommended Mitigation Programs, pp. 8.0-117-8.0-118.) Specifically, within the Project site, many residents will be located within walking distance of commercial and mixed-use areas, schools, community parks and trails. (*Ibid*.) In addition, bike and pedestrian trails would connect the Specific Plan and VCC planning areas. (*Ibid*.) Further, mass transit (*e.g.*, transit station; park-and-ride lot(s); bus stops; 5-mile right-of-way for potential Metrolink extension) would be conveniently located throughout the Project site. (*Ibid*.)

Please see **Response 10**, below, for further responsive information.

Response 9

The comment states that while regulatory standards can serve as proxies for significance, CEQA only permits reliance on such regulatory standards when the standards accurately reflect the level at which project impacts are less than significant. The comment further suggests that the emission reduction targets set forth in AB 32 and Executive Order S-3-05 are not appropriate proxies for significance.

Under CEQA, reliance on a valid regulatory standard as a significance proxy is permitted provided that the lead agency's reliance on the standard does not foreclose consideration of substantial evidence of project impacts. (See *Mejia v. City of Los Angeles* (2005) 130 Cal.App.4th 572, 289.) That is, although it may not always be appropriate for an agency to solely consider regulatory compliance, a regulatory standard can serve as a meaningful tool to frame an agency's analysis. (See *Communities for a Better Environment v. California Resources Agency* (2002) 103 Cal.App.4th 98, 112-113; see also Cal. Code Regs., tit. 14, § 15064.7, subd. (a), italics added ["A threshold of significance is an identifiable quantitative, qualitative or performance level of a particular environmental effect, non-compliance with which means the effect will *normally* be determined to be significant by the agency and compliance with which means the effect *normally* will be determined to be less than significant."].)

The comment cites *Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th 1099 decision in support of its claim that AB 32 and Executive Order S-3-05 are not valid bases to inform the significance analysis. In that decision, the court held that the lead agency's finding that the project would not result in significant impacts associated with the seasonal reduction in the surface flow of streams was an error. (*Id.* at p. 1110.) However, the court did not reject the agency's use of regulatory significance criteria in principle; instead, the court faulted the agency for failing to explain why the impacts would not be significant and providing only blanket conclusions without a statement of reasons. (*Id.* at pp. 1111-1112.)

Unlike in *Protect the Historic Amador Waterways* decision, where the court held that compliance with a regulatory standard, by itself, could not ensure that a project's impacts were less than significant, the Draft EIS/EIR's assessment of whether the proposed Project would comply with the State of California's only adopted greenhouse gas emissions reduction mandate (*i.e.*, AB 32's mandate that emissions return to 1990 levels by 2020) does not result in the avoidance of a meaningful analysis of project impacts. The Draft EIS/EIR did not rely on bare conclusions; instead, the global climate section is supported by a thorough technical analysis that explains the methodologies utilized to calculate the proposed Project's greenhouse gas emissions inventory, the analyses used to assess the potential significance of the resulting emissions, and discusses the project design features and mitigation measures intended to ensure that emissions remain less than significant. Given the current uncertainties in the science and the evolving regulatory framework, the lead agencies believe the analysis satisfies the spirit and letter of CEQA.

The comment also refers to the emission reduction goals included in Executive Order S-3-05. As discussed in the Draft EIS/EIR, Governor Schwarzenegger signed Executive Order No. S-3-05 on June 1, 2005. (Draft EIS/EIR, **Subsection 8.3.3.1**, Executive Orders, p. 8.0-11.) This order set forth the following emission reduction goals for California: by 2010, reduce emissions to 2000 levels; by 2020, reduce emissions to 1990 levels; and, by 2050, reduce emissions to 80 percent below 1990 levels. (*Ibid*.)

When the California Legislature passed and Governor Schwarzenegger signed AB 32 into law, Executive Order No. S-3-05's direction to reduce emissions to 1990 levels by 2020 became state law; however, AB 32 did not incorporate a mandate to reduce emissions to 80 percent below 1990 levels by 2050.[6] (See

---

[6] That said, the incorporation of the 2020 reduction mandate into state law via AB 32 has placed the State of California on the right track towards achieving the 2050 reduction goal established by

Health & Saf. Code, §38501.) Accordingly, the emission reduction mandate set forth in AB 32, which incorporates Governor Schwarzenegger's reduction goal for year 2020 (but not year 2050), represents the only legally enforceable emission limits under state law, and represents the Legislature's and Governor's policy-making determination of the appropriate steps for California to take now to address climate change impacts, while still encouraging the growth and development that are critical to maintaining (perhaps now, rebuilding) a vibrant economy. (See, *e.g.*, Health & Saf. Code, § 38501, subd. (h).)

Whether the Legislature and Governor elect to revisit the scope of California's statutorily mandated emissions reduction mandate, and extend that commitment to later years (*i.e.*, sometime beyond year 2020), is beyond the control of the lead agencies and the Project applicant. Further, neither NEPA nor CEQA require such speculative forecasting with respect to the anticipation of legal and regulatory developments.

Moreover, AB 32 itself acknowledges that addressing short-term and long-term greenhouse gas emission reductions will require many efforts from sectors around the world. (See Health & Saf. Code, § 38501, subd. (d).) These uncertainties also are reflected in the Scoping Plan, adopted in December 2008, by CARB to achieve the 1990 emission levels by 2020:

> "Reducing our greenhouse gas emissions by 80 percent will require California to develop new technologies that dramatically reduce dependence on fossil fuels, and shift into a landscape of new ideas, clean energy, and green technology.
>
> [T]he measures needed to meet the 2050 goal are too far in the future to define in detail . . ..
>
> . . . Governor Schwarzenegger signed Executive Order S-3-05, calling for the State to reduce greenhouse gas emissions to 1990 levels by 2020 and to reduce greenhouse gas emissions to 80 percent below 1990 levels by 2050. The 2020 goal was established to be an aggressive, but achievable, mid-term target, and the 2050 greenhouse gas emissions reduction goal represents the level scientists believe is necessary to reach levels that will stabilize climate."

(Scoping Plan, pp. ES-2, 4; see also Draft EIS/EIR, **Subsection 8.5.2.3.1**, Comparison with AB 32's 2020 Goal, p. 8.0-62.)

In light of the moving target, relying upon the 2050 reduction goals identified in the referenced order to inform the significance analysis would be speculative at this time. And, while CEQA requires agencies to forecast environmental circumstances to a reasonable degree, CEQA does not require speculation. (Cal. Code Regs., tit. 14, § 15144.)

Finally, to the extent that the comment suggests that the greenhouse gas emission reduction targets in AB 32 and Executive Order No. S-3-05 are not supported by science, the comment's suggestions is unsubstantiated, as discussed in further detail in **Response 10** and **Response 11**, below. The international scientific community recognizes that climate change is a *global* phenomenon that must be addressed

---

Governor Schwarzenegger's Executive Order. Stated differently, a regression trend in California's emission levels is required by state law, such that emissions cannot continue to increase.

across geographic and sector boundaries. Throughout the comment letter, there are subtle indications that the comment authors are seeking implementation of a zero emissions significance threshold, which is not required by federal or state law. Moreover, in any event, CEQA only requires the adoption of *feasible* mitigation measures and/or alternatives.

Response 10

DANGEROUS ANTHROPOGENIC INTERFERENCE

The comment first correctly notes that "it is the intent of the Legislature that the government of the state take immediate steps to identify any critical thresholds for the health and safety of the people of the state and take all coordinated actions necessary to present such thresholds [from] being reached." (Pub. Resources Code, § 21000, subd. (d).) The comment further contends that, with respect to greenhouse gas emissions, the "critical threshold" is not compliance with AB 32 but the avoidance of dangerous anthropogenic interference (DAI) with the climate system. In support of this conclusion, the comment relies on Article 2 of the United Nations Framework Convention on Climate Change (UNFCCC).

By way of background, Article 2 of the UNFCCC reads in full:

> "The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."

Therefore, Article 2 indicates that the UNFCCC's goal is to prevent DAI by stabilizing greenhouse gas emissions. Of significant note, the UNFCCC's only quantitative reduction goal is a return to 1990 levels of GHG emissions. (UNFCCC, Art. 4, § (2)(b).) The UNFCC, therefore, appears to links the reduction of greenhouse gas emissions to 1990 levels to the stabilization of the climate and the prevention of DAI.

If the comment's contention is correct that "[w]ith the United States and over 180 other countries as signatories, the UNFCCC's objective of avoiding DAI with the climate is widely viewed as the international regulatory standard for protecting the global climate," which is not the understanding of the lead agencies, then the emission reduction mandate of AB 32 is consistent with the UNFCCC as it calls for the return of emissions to 1990 levels by 2020. (Health & Saf. Code, § 38550 ["By January 1, 2008, [CARB] shall . . . determine what the statewide greenhouse gas emissions level was in 1990, and approve in a public hearing, a statewide greenhouse gas emissions limit that is equivalent to that level, to be achieved by 2020."].) Moreover, as indicated by its findings and declarations, it cannot be said that the California Legislature did not fully appreciate the potential threat of global climate change to the public health, safety and welfare when adopting AB 32; instead, the findings and declarations indicate that the Legislature intended for AB 32 to set the "critical threshold" to avoid such threats:

> "(a) Global warming poses a serious threat to the economic well-being, public health, natural resources, and the environment of California . . .

> (b) Global warming will have detrimental effects on some of California's largest industries . . . It will also increase the strain on electricity supplies . . .
>
> (d) National and international actions are necessary to fully address the issue of global warming. However, action taken by California to reduce emissions of greenhouse gases will have far-reaching effects by encouraging other states, the federal government, and other countries to act."

(Health & Saf. Code, § 38501.) As the only measure that has been adopted in law to achieve these goals, AB 32 represents the Legislature's and Governor's determination of the appropriate emission reduction goal, and is considered consistent with the UNFCCC.

CARB'S RELIANCE ON DAI

The comment next states that CARB has recognized the importance of avoiding DAI in its "Preliminary Draft Staff Proposal: Recommended Approaches for Setting Interim Significance Thresholds for Greenhouse Gases Under the California Environmental Quality Act" (CARB Preliminary Draft Interim CEQA Thresholds; dated October 24, 2008).

By way of background, after receiving a request from the California Office of Planning and Research (OPR) to develop recommendations for CEQA thresholds of significance for greenhouse gases, CARB released its Preliminary Draft Interim CEQA Thresholds. While the report does not directly reference DAI, CARB does acknowledge that:

> "There is a scientific consensus that human activities, chief among them the burning of fossil fuels, profound affect the world's climate by increasing the atmospheric concentration of GHG beyond natural levels. . . .
>
> In response to the challenge of climate change, California has taken a leadership role by committing to reduce its GHG emissions to 1990 levels by 2020 (about a thirty percent reduction in business-as-usual emissions in 2020) and to an 80 percent [reduction] below 1990 levels by 2050. The latter target is consistent with the scientific consensus of the reductions needed to stabilize atmospheric levels of GHGs at 450 ppm by mid-century."

(CARB Preliminary Draft Interim CEQA Thresholds, p. 3.) As AB 32's reduction regulations will phase in over time, and not fully be in place until 2012, CARB recommended using CEQA as a means to address greenhouse gas emissions in the near term. (*Id.* at p. 4.)

Accordingly, CARB issued for public review and comment proposed significance thresholds for industrial and commercial/residential projects. With respect to commercial/residential projects, CARB proposed a tiered framework for assessing significance:

> A project's impact would be presumptively less than significant if:
>
> (a) The project is exempt from CEQA under existing statutory or categorical exemptions.

(b) The project complies with a previously approved plan that addresses greenhouse gas emissions, and satisfies all of the following attributes:

(i) meets a community level target consistent with AB 32 or, where applicable, Executive Order No. S-3-05;

(ii) is consistent with Senate Bill 375's reduction target for transportation-related emissions;

(iii) includes an emissions inventory and mechanisms to regularly monitor emissions;

(iv) includes specific, enforceable requirements;

(v) incorporates mechanisms that allow the plan to be revised; and,

(vi) is supported by a certified CEQA document.

(c) The project meets certain minimum performance standards or includes equivalent mitigation measures, *and* will emit no more than a to-be-determined amount of greenhouse gas emissions.

(*Id.* at Attachment B.) As proposed by CARB, if the project failed to satisfy one of the three tiers summarized above, the project would have a presumptively significant GHG impact, requiring preparation of an EIR and the implementation of all feasible mitigation measures.

Contrary to the comment's characterization of the CARB Preliminary Draft Interim CEQA Thresholds, at least one tier within CARB's proposed significance framework relied on AB 32 to establish the parameters of insignificance. Specifically, CARB proposed requiring adopted greenhouse gas emission reduction plans to be consistent with AB 32 and Executive Order S-3-05, if such plans would apply beyond 2020.

Development of the CARB Preliminary Draft Interim CEQA Thresholds has been terminated, or, at the very least, placed in an indefinite holding pattern. (See CARB's CEQA and Greenhouse Gases website, http://www.arb.ca.gov/cc/localgov/ceqa/ceqa.htm, last visited March 28, 2010, which is incorporated by reference.) Moreover, while CARB intended to provide final recommended thresholds to OPR before OPR issued its draft CEQA Guideline revisions and transmitted those revisions to the California Natural Resources Agency (pursuant to Senate Bill 97), CARB did not accomplish its goal. (See CARB Preliminary Draft Interim CEQA Thresholds, p. 1.) Instead, the amendments to the State CEQA Guidelines were adopted and finalized on December 30, 2009.

Importantly, neither NEPA nor CEQA requires lead agencies to rely on draft documentation for purposes of assessing the significance of environmental impacts; nonetheless, the Draft EIS/EIR disclosed CARB's preliminary efforts. (See Draft EIS/EIR, **Subsection 8.3.3.4**, Senate Bill 97, pp. 8.0-14-8.0-17.)

SCAQMD'S RELIANCE ON DAI

The comment further cites SCAQMD's policy objectives for their interim threshold for industrial projects as evidence of the appropriateness of relying on DAI for purposes of assessing significance.

By way of background, on April 30, 2008, SCAQMD held its first stakeholders working group meeting for the development of thresholds of significance for greenhouse gas emissions. The working group is comprised of a variety of stakeholders, including state agencies, local agencies, city and county planning departments, utilities, regulated groups, and environmental and professional organizations. (See SCAQMD's GHG CEQA Significance Thresholds website, http://www.aqmd.gov/ceqa/handbook/GHG/GHG.html, last visited September 25, 2009, which is incorporated by reference.)

In December 2008, SCAQMD's governing board adopted an interim significance threshold that is applicable to industrial (stationary source) projects only when SCAQMD assumes the lead agency role. Similar to the approach proposed by CARB, SCAQMD adopted a tiered threshold for industrial projects:

A project's impact would be presumptively less than significant if:

(1) The project is exempt from CEQA.

(2) The project is consistent with a locally adopted greenhouse gas emissions reduction plan.

(3) The project's emissions are less than or mitigated to less than 10,000 metric tons of carbon dioxide equivalents per year.

(4) [Adoption of compliance option efficiency standards were deferred until future time.]

(5) Offsets for project lifetime to reduce project emissions to less than the screening quantity (*i.e.*, 10,000 metric tons).

SCAQMD is still working on the development of a threshold for residential/commercial projects. As of SCAQMD staff's November 2009 meeting, the draft tiered threshold for residential/commercial projects provides the following guidance:

- **Tier 1:** Is the project exempt from CEQA? If yes, the project is not significant and no further analysis is required.

- **Tier 2:** Is the project consistent with an approved regional climate action plan? If yes, the project is not significant and no further analysis is required.

- **Tier 3:** Would the project result in emissions below the screening level criteria? If yes, the project is not significant and no further analysis is required.

  Non-Land Use Type Specific Screening Level Criteria

    3,000 metric tons per year

  Land Use Type Specific Screening Level Criteria

    Residential: 3,500 metric tons per year

    Commercial: 1,400 metric tons per year

    Mixed-Use: 3,000 metric tons per year

- **Tier 4:** Would the project comply with certain performance-based standards? If yes, the project is not significant and no further analysis is required.

  The performance-based standard asks whether a project would achieve *either* a 28 percent reduction below business-as-usual levels or a 4.6 metric ton per service population per year efficiency metric, *and* emit no more than 25,000 metric tons per year.

- **Tier 5:** Would the project secure sufficient carbon offsets or credits to reduce emissions to a level at or below the screening level criteria presented in Tier 3, assuming a 30-year project life. If yes, the project is not significant and no further analysis is required.

While neither NEPA nor CEQA requires lead agencies to rely on draft documentation for purposes of assessing the significance of environmental impacts, the Draft EIS/EIR disclosed SCAQMD's adoption of a threshold for stationary source projects, and the uncertainty regarding whether a threshold for residential or commercial projects would be adopted. (See Draft EIS/EIR, **Subsection 8.3.4.2**, South Coast Air Quality Management District Significance Threshold, p. 8.0-20.)

In closing, by utilizing a significance criterion that requires consistency with AB 32, the Draft EIS/EIR has not rejected a goal of DAI. Specifically, attaining 1990 greenhouse gas emissions levels by 2020 will put California on a path towards the avoidance of DAI.

Please also see **Section 8.0** of the Final EIS/EIR, which provides an updated regulatory setting that addresses the status of CARB's and SCAQMD's significance threshold planning efforts in greater detail.

Response 11

Citing a number of various sources, the comment states that reducing greenhouse gas emissions to 1990 levels is not adequate to place atmospheric concentrations of greenhouse gases on a trajectory that would substantially reduce the risk of dangerous climate change. To preface further discussion of the various sources cited in the comment, the overall gist of the comment is that the use of AB 32 as a benchmark to inform the significance analysis is not appropriate and insufficient. Please see **Response 8 through Response 10**, above, which detail the basis for utilizing AB 32 in connection with the significance assessment provided in the EIS/EIR.

IPCC REPORT

First, the comment references the Intergovernmental Panel on Climate Change's (IPCC) 2007 mitigation analysis for the Fourth Assessment Report for the position that "developed countries need to reduce emissions to 25-40 percent below 1990 levels by 2020 to stabilize atmospheric greenhouse gas concentrations." (Intergovernmental Panel on Climate Change, Climate Change 2007: Mitigation of Climate Change (2007), p. 776, Box 13.7.) However, the comment does not note that the text is generalized and that the individual reductions for each country would vary. In addition, the IPCC's mitigation working group found that:

> "Decision-making about the appropriate level of global mitigation over time involves an iterative risk management process that includes mitigation and adaptation, taking into account actual and avoided climate change damages, co-benefits, sustainability, equity, and attitudes to risk. Choices about the scale and timing of GHG mitigation involve

> balancing the economic costs of more rapid emission reductions now against the corresponding medium-term and long-term climate risks of delay."

(IPCC, "Climate Change 2007: Mitigation of Climate Change, Summary for Policymakers" (2007), p. 27.) Point being, the IPCC recognizes that cost-benefit analysis plays an important role in determining how best to curb and reduce greenhouse gas emissions. For present purposes, the State of California has identified a specific reduction goal for year 2020 that requires returning emissions to 1990 levels.

UNION OF CONCERNED SCIENTISTS AND MEINSHAUSEN ANALYSES

The comment next cites the Union of Concerned Scientists and Malte Meinshausen in support of the statement that a stabilization target of 450 parts per million (ppm) of CO_2e provides only a 50 percent chance of limiting the global average temperature increase to 2 degrees Celsius above pre-industrial levels. (See Union of Concerned Scientists, "How to Avoid Dangerous Climate Change: A Target for U.S. Emissions" (2007); Malte Meinshausen, "What Does a 2ºC Target mean for Greenhouse Gas Concentrations? A Brief Analysis Based on Multi-Gas Emission Pathways and Several Climate Sensitivity Uncertainty Estimates, in Avoiding Danger Climate Change" (2006).[7]) However, neither of the cited references comes to this limited conclusion.

The report by the Union for Concerned Scientists simply references Meinshausen in its statements regarding climate stabilization probabilities. (Union of Concerned Scientists, pp. 4, 8.9.) And, Meinshausen presents probabilities at levels other than and higher than 450 ppm. For example, Table 28.1 shows that, at 450 ppm, the probability of exceeding a 2ºC warming is 26-78 percent. Meinshausen indicates that the link between a particular atmospheric concentration of greenhouse gases with a specific temperature increase is uncertain.

Moreover, in the introduction to the section containing Meinshausen work, in the book Avoiding Dangerous Climate Change, it states that "the range of climate sensitivity values that are possibly consistent with the historical record is much wider than suggested by the [IPCC]." (Schellnhuber, Hans Joachim (ed.), Section VI: Emission Pathways, in "Avoiding Dangerous Climate Change" (2006), p. 251.) Further, many studies similar to Meinshausen's indicate "that the various density functions that have been authored recently are products not only of the underlying data, but also of subjective expert judgments employed in their construction." (*Id.*) Thus, these functions and the conclusions from these functions are not based purely on scientific evidence, but rather subjective opinion.

Meinshausen also states "[d]espite the increasing knowledge on climate impacts, science will never be able to suggest a single threshold of w*hat constitutes 'dangerous' climate change, as this is a value judgment, a political decision to take*." (*Ibid*., italics added.) Meinshausen explicitly recognizes the challenges of identifying a single point at which DAI will occur and the inherent political judgment involved in setting a threshold.

---

[7] The referenced reports are incorporated by reference, and available for public inspection and review as part of the Final EIS/EIR at the Valencia Library, 23743 Valencia Boulevard, Santa Clarita, California 91355.

In summary, the literature cited by the comment does not suggest AB 32's reduction to 1990 levels by 2020 goal is not supported, but rather that the consequences of selecting a particular stabilization goal are not entirely certain and require some subjective decision making. While there remains a great deal of scientific debate as to how DAI should be defined, the State of California has made that political judgment through AB 32, the only adopted, legally-binding reduction level.

WARREN ARTICLE

The comment also relies on an article by Rachel Warren to support its claim that an increase in global mean temperature of 2°C above pre-industrial levels has potential to trigger many effects, mostly in the arctic area. (Rachel Warren, Impacts of Global Climate Change at Different Annual Mean Global Temperature Increases, in "Avoiding Dangerous Climate Change" (2006), pp. 95, 98.[8]) However, Warren's article contains many uncertainties that call these conclusions regarding the potential impacts of climate change into question.

First, Warren's article is a compilation of peer-reviewed literature regarding climate change impacts that may occur at different global mean temperature changes. In the article, Warren makes adjustments to the original authors' data to attempt to normalize values to a common basis for increase in temperature (mainly pre-industrial versus 1990). The normalization value was chosen by Warren and not the original authors; therefore, the value may not be appropriate, depending upon the methodology and assumptions used by the original authors to determine their findings.

Second, the article makes several conclusions that have a range associated with them, as the authors of each of the compiled peer-review articles identify different temperatures at which specific impacts will occur. The range of conclusions highlights the uncertainty in the underlying analyses, and the corresponding uncertainty in Warren's conclusions that are based on the compilation of peer-reviewed articles.

The comment also cites the Warren article for impacts associated with increases in global mean temperatures beyond 2°C, and nearly assumes a collapse in the global carbon cycle and an inability of humans and ecosystems to adapt to climate change. However, adaptation is one of the key components of Article 2 of the UNFCCC. And, California is not ignoring the import of climate adaptation. In fact, a multi-sector strategy to help guide California's efforts in adapting to climate change impacts was recently finalized: the "2009 California Climate Adaptation Strategy." (See California Climate Change Portal website, http://www.climatechange.ca.gov/adaptation/ (last visited March 28, 2010), which is incorporated by reference.) This strategy report summarizes the best known science on climate change impacts in seven specific sectors (*i.e.*, public health; biodiversity and habitat; ocean and coastal resources; water management; agriculture; forestry; and transportation and energy infrastructure) and provides recommendations on how to manage against those threats. Please also see **Section 8.0** of the Final EIS/EIR, which contains a more detailed summary of this recently adopted statewide adaptation strategy.

According to an article by Farhana Yamin:

---

8 The referenced report is incorporated by reference, and available for public inspection and review as part of the Final EIS/EIR at the Valencia Library, 23743 Valencia Boulevard, Santa Clarita, California 91355.

> ". . . [C]limate change differs from other environmental problems in that there may be much room for adaptation. This means the calculus of 'dangerous' cannot be made simply on the grounds of impacts and their consequences. There are the 'gross impacts' that have been the subject of much research and comment as reported in successive IPCC reports. Then there are the 'net impacts' which are the impacts that will remain after adaptation . . . But there are few studies that examine what might be achieved by adaptation or that estimate the limits to or cost of adaptation."

(Yamin, Farhana *et al.*, Perspectives on 'Dangerous Anthropogenic Interference' or How to Operationalize Article 2 of the UN Framework Convention on Climate Change, in "Avoiding Dangerous Climate Change" (2006).[9]) Thus, even if some of the impacts mentioned in the comment do occur, their actual consequences may be much lower if humans and the environment adapt to a certain degree of climate change, as is predicted by members of the scientific community. (See also Warren, p. 96 [qualifying that the comment regarding the potential displacement of coastal populations due to sea level rise is ". . . less those protected by adaptation schemes"]; see also *id*. at p. 97 [qualifying that the population impacted by water stress also is contingent upon the socioeconomic scenario and global climate change model utilized to calculate the potential impacts].)

ELZEN & MEINSHAUSEN AND HANSEN ARTICLES

The comment suggests that carbon dioxide concentrations in the atmosphere need to be reduced below current levels. However, this conclusion is not the focus of Elzen and Meinshausen article cited in support of the statement, who suggest that "[o]nly for a stabilization at 400ppm CO_2-eq. (approximately 350-375 ppm CO_2 stabilization) and, to a lesser extent, at 450 ppm CO_2-eq. (about 400 ppm CO_2 only stabilization), is the possibility of equilibrium warming exceeding 2°C strongly reduced, to less than about 13% and 40% respectively." (Michel den Elzen & Malte Meinshausen, Multi-Gas Emission Pathways for Meeting the EU 2ºC Climate Target, in "Avoiding Dangerous Climate Change" (2006).[10]) This suggests that it is possible for stabilization to be higher than suggested by the comment.

Moreover, if there was a majority consensus in the scientific community that levels need to be below current levels, there would not still be the considerable amount of recent literature discussing atmospheric stabilization targets. (See, *e.g.*, E. Roeckner *et al.*, "A GCM Study on CO_2 Emission Pathways to Climate Stabilization" (2009); Kirsten Zickfeld *et al.*, "Setting Cumulative Emissions Targets to Reduce the Risk of Dangerous Climate Change" (2009).[11]) For example, although research by Matthews and Caldeira concludes "any future anthropogenic emissions will commit the climate system to warming that is essentially irreversible on centennial timescales," the report states that the data supporting the conclusion is based on "a series of idealized climate simulations to assess the centennial-scale climate response to

---

[9] The referenced report is incorporated by reference, and available for public inspection and review as part of the Final EIS/EIR at the Valencia Library, 23743 Valencia Boulevard, Santa Clarita, California 91355.

[10] The referenced report is incorporated by reference, and available for public inspection and review as part of the Final EIS/EIR at the Valencia Library, 23743 Valencia Boulevard, Santa Clarita, California 91355.

[11] The referenced reports are incorporated by reference, and available for public inspection and review as part of the Final EIS/EIR at the Valencia Library, 23743 Valencia Boulevard, Santa Clarita, California 91355.

anthropogenic CO_2 emissions." (H. Damon Matthews and Ken Caldeira, Stabilizing Climate Requires Near-Zero Emissions, in "Geophysical Research Letters," Vol. 35. L04705 (2008).[12]) In other words, the finding is based on a series of hypotheticals and does not provide hard scientific evidence to support the argument that global mean temperatures already have exceeded DAI.

MIT REPORT

In September 2009, the Massachusetts Institute of Technology's (MIT) Joint Program on the Science and Policy of Global Change issued the "Analysis of Climate Policy Targets under Uncertainty."[13] This report confirms that science currently cannot predict a definitive temperature change from any specified atmospheric greenhouse gas emissions level; instead, science can only predict the *probability* of certain temperature changes from given emission levels. As noted in the introductory text:

> "Though the climate policy challenge is essentially one of risk management, requiring an understanding of uncertainty, most analyses of the emissions implications of these various policy targets have been deterministic, applying scenarios of emissions and reference (or at best median) values of parameters that represent aspects of the climate system response, and the cost of emissions control. . . .These efforts provide insight to the nature of the human-climate relationship, but necessarily they fail to represent the effects of uncertainty in emissions, or to reflect the interacting uncertainties in the natural cycles of CO_2 and other gases or the response of the climate system to these gases."

("Analysis of Climate Policy Targets under Uncertainty," pp. 2-3.) Accordingly, the MIT report quantified the distribution of selected climate and cost outcomes for specific emission scenarios, using the MIT Integrated Global Systems Model, in order to provide "a formal estimate of uncertainty given processes that can be modeled and whose input probability distributions reasonably are constrained." (*Id.* at p. 3.)

In light of the numerous scientific uncertainties and variables that have yet to be resolved, the MIT report also notes that policy must be made in spite of said uncertainties in responding to global climate change:

> "Deciding a response to the climate threat is a *challenge of risk management,* where choices about emissions mitigation must be made in the *face of a cascade of uncertainties:* the emissions if no action is taken (and thus the cost of any level of control), the response of the climate system to various levels of control, and the social and environmental consequences of the change that may come. In policy deliberations, analysis of the very complex issues of climate change effects frequently is put aside, to be replaced with a global target intended to avoid "danger" - stated, depending on the context, in terms of a maximum allowable global temperature change, a maximum allowable increase in radiative forcing, or a maximum total of anthropogenic emissions

---

[12] The referenced report is incorporated by reference, and available for public inspection and review as part of the Final EIS/EIR at the Valencia Library, 23743 Valencia Boulevard, Santa Clarita, California 91355.

[13] The referenced report is incorporated by reference, and available for public inspection and review as part of the Final EIS/EIR at the Valencia Library, 23743 Valencia Boulevard, Santa Clarita, California 91355.

> of greenhouse gases over some long run period, usually a century. And, usually, the relationship between these different measures is expressed without representing the uncertainty among them, stating uncontrolled emissions in the form of a set of scenarios and representing climate processes in the form of single "reference" or sometime median values. . . . Here we have . . . shown . . . [that] the impression of the effectiveness of commonly-discussed emissions limits can look very different when this human-climate system is subjected to a more complete uncertainty analysis than normally is available."

(*Id.* at pp. 37-38, italics added; see also MIT report abstract ["Although policymaking in response to the climate change is essentially a challenge of risk management, most studies of the relation of emissions targets to desired climate outcomes are either deterministic or subject to a limited representation of the underlying uncertainties."].) Therefore, while science can inform, ultimate determinations, often based on a cost-benefit analysis of potential risk, are dictated by policy. In this instance, the State of California, particularly the Legislature and Governor, was informed by the science showing the projected impacts of global climate change, and, exercising its policy making authority, decided on AB 32.

In closing, despite scientific analyses indicating the high level of uncertainty surrounding higher atmospheric emission levels and temperature rises, the comment incorrectly characterizes the scientific literature by stating that specific atmospheric concentrations of greenhouse gases in the environment are unacceptable according to scientific evidence. In addition, the articles cited by the comment are narrow in their scope, do not represent the *complete* viewpoint of the scientific field, and have a large degree of uncertainty indicated in their analyses.

Response 12

The comment contends that the Draft EIS/EIR relied on a "conclusory assertion that Project impacts are insignificant," and that the significance assessment "does not withstand scrutiny." However, the analysis provided in the Draft EIS/EIR was thorough, substantiated and informational, thereby complying with both NEPA and CEQA, as well as the applicable statutory and regulatory requirements. For example, after disclosing the existing state of science and regulatory setting, **Section 8.0** of the Draft EIS/EIR presented detailed emissions inventories for the proposed Project and each of its alternatives, and measured the significance of those emissions in relation to AB 32. The analysis can not fairly be characterized as "conclusory."

The comment more specifically states that the per capita emissions assessment presented in **Section 8.0** of the Draft EIS/EIR compares apples-to-oranges and is not determinative as to whether the proposed Project would result in significant impacts associated with global climate change. The Draft EIS/EIR disclosed that the per capita emissions assessment did not provide an apples-to-apples comparison. Specifically, after identifying the per capita emissions estimate for the proposed Project (*i.e.*, 5.4 tonnes CO_2e per capita per year), the analysis included the following caveat:

> "Notably, the California per capita CO_2 emissions quantity includes additional carbon producing sectors, such as heavy industry, refining, and transportation of materials, while the per capita CO_2 emissions quantity for the proposed Project does not include these emissions-these two per capita quantities, therefore, do not represent a straight apples-to-apples comparison."

(Draft EIS/EIR, **Subsection 8.5.2.3.1**, Comparison with AB 32's 2020 Goal, p. 8.0-58, fn. 68.) In light of the incongruity of the per capita emissions analysis, the significance analysis also presented the results of a business-as-usual analysis. (*Id.* at pp. 8.0-59-8.0-62.) Therefore, the per capita emissions assessment alone was not treated as determinative of the proposed Project's significance, contrary to the comment's suggestion.

Further, as discussed in ENVIRON "Climate Change Technical Addendum," there has been an evolution in the methods used to evaluate whether greenhouse gas emission are significant. The method used in the ENVIRON's addendum relies on CARB's 2020 "no actions are taken" baseline in order to evaluate whether the proposed Project would impede achievement of AB 32's reduction mandate for 2020. CARB has determined that a reduction of 29 percent below the "no actions are taken" scenario is required to meet the goals of Assembly Bill 32 (AB 32), Global Warming Solutions Act of 2006. (See, *e.g.*, Scoping Plan, p. ES-1 ["Reducing greenhouse gas emissions to 1990 levels means cutting approximately 30 percent from business-as-usual emission levels projected for 2020."]; see also Health & Saf. Code, § 38500 *et seq.*) As the proposed Project's emissions would exceed the 29 percent requirement, the proposed Project would not impede the implementation of AB 32 and is consistent with the overall trajectory the State of California has established for greenhouse gas reductions.

Please also see **Topical Response 13: Global Climate Change Update**, and **Section 8.0** of the Final EIS/EIR for additional information regarding the updated methodologies used to assess the significance of the Project's emissions relative to California's codified emissions reduction mandate.

Response 13

The comment states that the AB 32 reduction target (*i.e.*, reduce greenhouse emissions to 1990 levels by 2020) does not identify specific reduction obligations for existing and new development. This information is disclosed in the Draft EIS/EIR, which expressly notes that "[w]hile AB 32 sets out a timeline for the adoption of measures to evaluate and reduce GHG emissions across all source categories, it does not articulate these measures itself; instead, these measures are being determined in subsequent regulatory processes." (Draft EIS/EIR, 8.3.3.3, Assembly Bill 32, p. 8.0-13.)

However, in December 2008, CARB adopted its Scoping Plan, which identifies the reduction strategies, to be adopted via formal rulemaking processes, that will reduce California's emissions to 1990 levels by 2020 in accordance with AB 32. (*Id.* at p. 8.0-14.) "The Scoping Plan contains a comprehensive set of actions designed to reduce overall carbon emissions in California, improve the environment, reduce the state's dependence on oil, diversify energy sources, save energy, and enhance public health while creating new jobs and enhancing growth in California's economy." (*Ibid*.)

The Scoping Plan does account for existing buildings and identifies emission reduction strategies for these sources. For example, the Scoping Plan notes, "Many older homes can be retrofitted to use far less energy than at present." (Scoping Plan, p. ES-13.) The Scoping Plan further states that appropriate reduction strategies may include the "voluntary and mandatory whole-building retrofits for existing buildings," and the development of "[i]nnovative financing to overcome first-cost and split incentives for energy efficiency, on-site renewables, and high efficiency distributed generation." (*Id.* at p. 42.)

The comment also states that it is much more difficult to improve energy efficiency in existing development than new development, and contends that there is no basis for the Draft EIS/EIR to assume that the per capita emissions in existing and new developments should be the same. The lead agencies acknowledge that various challenges are associated with improving the energy efficiency of the existing building stock. However, contrary to the comment's claim, the Draft EIS/EIR does not "assume that an individual that lives in a project built today should have the same per capita emissions as an individual living in an older development." The comment misconstrues the scope and purpose of the per capita emissions assessment provided in the Draft EIS/EIR, which provides:

> "California-wide GHG emissions in 2004 were 0.480 billion tonnes and 0.427 billion tonnes in 1990. Based on California's 2004 emissions inventory, the state needs to reduce its emissions by 11 percent per capita (*i.e.*, per person) by 2020 to achieve AB 32 goals. Moreover, because the California population is projected to increase by 18 percent by 2020, when compared to 2004 emissions, a per capita decrease of GHG emissions from 13.4 tonnes CO_2e per capita to 10.1 tonnes CO_2e per capita, or 24 percent, would need to be realized to achieve the AB 32 mandated goals."

(Draft EIS/EIR, **Subsection 8.5.2.3.1**, Comparison with AB 32's 2020 Goal, p. 8.0-58.) The above excerpt presented the results of ENVIRON's technical analysis, which found that based on the projected emissions and population growth curves, on average, per capita emissions need to be reduced to 10.1 tonnes per capita by 2020 to reduce emissions to 1990 levels. (*Ibid*.) As the proposed Project's per capita emissions are estimated to be 5.4 tonnes per capita, the analysis found that the proposed Project was not inconsistent with the per capita reductions. (*Ibid.*) The analysis above does not assume that residents of new and existing developments should or will have the same per capita emissions.

Further, the analysis presented in ENVIRON "Climate Change Technical Addendum" does not assume equivalent per capita emission quantities for residents, regardless of the age the development was constructed. Instead, the focus of the analysis is whether each sector's emissions would be 29 percent below CARB's 2020 "no actions are taken" scenario, so as to achieve the reduction mandates of AB 32.

Response 14

The comment states that "[d]etermining significance from purported reductions from BAU is inherently arbitrary and does not legitimately inform a significance determination."

At the outset, neither NEPA nor CEQA mandates a specific methodology be applied in an EIS/EIR, as long as substantial record evidence supports the methodology used. (See *Laurel Heights Improvement Assn. v. Regents of the Univ. of Cal.* (1988) 47 Cal.3d 376, 393 ["A court's task is not to weigh conflicting evidence and determine who has the better argument ... We have neither the resources nor scientific expertise to engage in such analysis . ..."]; *Laguna Greenbelt, Inc. v. U.S. Department of Transportation*, 42 F.3d 517, 526 (9th Cir. 1994) ["NEPA does not require us to decide whether an EIS is based on the best scientific methodology available or to resolve disagreements among various experts."].) Further, since the function of judicial review is limited to determining whether an EIR is supported by substantial evidence, not to determining the "truth" or "correctness" of the conclusions contained in that document, it is not an "abuse of discretion" for a public agency "to give more weight to one set of 'experts' than to another." (*Greenebaum v. City of Los Angeles* (1984) 153 Cal.App.3d 391, 412.) Thus, in considering the adequacy of an EIR, the lead agency is entitled to weigh evidence as to competing technical data and arguments, and to decide whether to accept one expert's view over another. The agency also may accept the determinations and conclusions reached by the expert that prepared the EIR, even though other conclusions might also be reached. (*Laurel Heights*, *supra*, 47 Cal.3d at pp. 407-08.)

The comment's statements regarding the adequacy of business-as-usual analyses can be boiled down to a dispute over methodology, the accuracy of information, and/or the validity of technical opinions. Substantial evidence in the record, particularly in the form of the technical data and analysis prepared to consider the effects of the proposed Project on global climate change, support the conclusions presented in the Draft EIS/EIR. Therefore, the lead agencies can chose to rely on the opinions and conclusions of the experts that prepared the global climate change analysis.

Further, in response to this comment and an evolution in the technical methods used to evaluate whether greenhouse gas emissions are significant, the analysis has been updated to assess Project emissions against the CARB 2020 "no actions are taken" scenario. While on-site GHG emissions would increase, relative to the existing, on-the-ground conditions at the Project site, the analysis considers whether those Project emissions would be significant in light of California's codified GHG emissions reduction target. (See Health & Saf. Code, §38550.) Although the methodology has been modified, the significance conclusion is the same-that is, the proposed Project would result in a less-than-significant impact on climate change. Please see ENVIRON "Climate Change Technical Addendum," which is found in **Appendix F8.0** of the Final EIS/EIR, **Topical Response 13: Global Climate Change Update**, and **Section 8.0** of the Final EIS/EIR for additional information.

Response 15

The comment states that determining the environmental impact of proposed projects based on reductions below business-as-usual would "improperly allow carbon-intensive projects with high emission levels to avoid feasible mitigation." The comment appears to suggest that all future projects should be carbon neutral through the use of on-site and off-site measures; carbon neutrality as utilized in the comment is coextensive with a zero emission threshold.

First, neither NEPA nor CEQA require project applicants to implement mitigation that is not in proportion and related to the project impacts. (See Cal. Code Regs., tit. 14, § 15041, subd. (a) ["A lead agency for a project has authority to require feasible changes in any or all activities involved in the project in order to substantially lessen or avoid significant effects on the environment, consistent with applicable requirements such as the 'nexus' and 'rough proportionality' standards established by case law . . ."].) That is, CEQA requires rough proportionality, such that significant impacts are subjected to feasible mitigation measures following a lead agency's exercise of discretion as to the significance of the impact in the first instance. Here, the lead agencies have determined that a zero emission threshold is not appropriate; therefore, carbon neutrality is not a component of the mitigation hierarchy.

Second, development projects, such as the build-out that would be facilitated by approval of the proposed Project, are in direct response to the demand for additional residential and non-residential development to support California's projected population growth. The comment's suggestion that large developments cannot be allowed to proceed if catastrophic global climate changes are to be avoided is not based on science, rather on political and policy preferences that are better left to the decision makers.

Response 16

The comment generally questions the adequacy of the less-than-significant determination made in the Draft EIS/EIR with respect to the proposed Project's impact on global climate change. However, **Section 8.0** of the Draft and Final EIS/EIRs is based on substantial evidence, including a detailed technical analysis prepared by ENVIRON International Corporation, that complies with the parameters of NEPA and CEQA. Both environmental statutes affirm the discretion afforded to lead agencies when determining the significance of impacts; here, the lead agencies have determined that the proposed Project's consistency with a statewide emissions reduction mandate supports the finding that impacts would be less than significant.

The comment cites a report prepared by the California Air Pollution Control Officers Association (CAPCOA) for the conclusion that a 90 percent reduction from business-as-usual, *effective immediately*, is necessary to meet the emission reduction targets set by Executive Order S-3-05" and that a "28-33 percent business-as-usual emission reduction-as proposed in the EIR-has 'low' emission reduction effectiveness." (See CAPCOA, "CEQA & Climate Change" (January 2008).[14]) The comment further relies on the CAPCOA report to justify the imposition of a zero threshold under CEQA for the emission of greenhouse gas emissions (*i.e.*, the comment suggests that just one unit of a greenhouse gas is significant).

In the referenced report, CAPCOA discusses the three basic options that lead agencies can pursue when contemplating thresholds of significance for greenhouse gases: (i) no significance threshold; (ii) a threshold set at zero; and, (iii) a non-zero threshold. (CAPCOA, pp. 2-3.) CAPCOA observes that each proposed approach has "inherent advantages and disadvantages;" for example, the use of a zero threshold places "*all* discretionary projects under the CEQA microscope." (*Id.* at p. 3, italics added.)

Of note, when exploring non-zero thresholds, CAPCOA discusses two primary approaches: "The first is grounded in statute (AB 32) and executive order (EO S-3-05) . . . The options under this approach are variations of ways to achieve the 2020 goals of AB 32 from new development . . .." (CAPCOA, p. 3.) The analysis presented in **Section 8.0** of the Draft EIS/EIR is consistent with this threshold approach; and, the comment overlooks the fact that CAPCOA has not endorsed one single threshold approach, but, instead, has recognized that several legitimate alternatives are available to lead agencies.

With respect to the comment's characterization that the use of an AB 32 compliance threshold results in "low" emission reduction effectiveness, the comment misinterprets the CAPCOA report. To preface, the comment does not provide a specific page reference in its citation; accordingly, this response is based on what is believed to be the text the comment relies on. With that said, the CAPCOA report defines "low emission reduction effectiveness" as meaning that the threshold "is not expected to capture a relatively large portion of the new development inventory." (CAPCOA, p. 53.) The report further finds, with respect to thresholds grounded in AB 32 and Executive Order No. S-3-05, that because such "thresholds do not establish a quantitative threshold below which projects do not have to mitigate, the market capture for new development is complete." (*Ibid.*)

---

[14] The referenced report is incorporated by reference, and available for public inspection and review as part of the Final EIS/EIR at the Valencia Library, 23743 Valencia Boulevard, Santa Clarita, California 91355.

Finally, as for the overall insistence throughout the comment letter that a zero emission threshold be applied, it bears noting that neither the California Natural Resources Agency/OPR, CARB, SCAQMD nor any other air district in the State of California are pursuing adoption of a zero threshold. Instead, such agencies have acknowledged the discretion afforded to local lead agencies in identifying the appropriate significance criterion and considered the implementation of performance-based thresholds, tiered thresholds, and/or plan-based thresholds. (See, *e.g.*, CARB Preliminary Draft Interim CEQA Thresholds, p. 4 ["[CARB] staff believes that for the project types under consideration [*i.e.*, industrial and commercial/residential], non-zero thresholds can be supported by substantial evidence. [CARB] staff believes that zero thresholds are not mandated in light of the fact that (1) some level of emissions in the near term and at mid-century is still consistent with climate stabilization and (2) current and anticipated regulations and programs apart from CEQA . . . will proliferate and increasingly will reduce the GHG contributions of past, present, and future projects."]. See also State CEQA Guidelines, §15064.4, subd. (b) [recent amendments to the State CEQA Guidelines confirm significance determination is subject to lead agency discretion].)

Please also see **Response 11**, above, for responsive information relating to the purported scientific consensus that emissions must be decreased to "nearly zero" to stabilize the global climate.

The comment will be included as part of the record and made available to the decision makers prior to a final decision on the proposed Project.

Response 17

The comment states that the proposed Project "cannot legitimately be said to be 29 percent below [business-as-usual]" because build-out enabled by Project approval "would do no more than comply with the Title 24 requirements in force when the Project is built." However, as discussed in **Response 6**, above, the Project applicant has revised its Title 24 commitment, such that it will exceed whatever is the applicable version of Title 24 at the time the building permit applications are filed by 15 percent.

As to the statements regarding the mobile and water use-related emission sources, the business-as-usual analysis methodology has been modified by ENVIRON International Corporation, such that the proposed Project is now compared against the "no actions are taken" scenario identified by CARB. More specifically, CARB's AB 32 emission estimates evidence that a reduction of 29 percent below the "no actions are taken" scenario is required to meet the goals of Assembly Bill 32 (AB 32), Global Warming Solutions Act of 2006. (See Scoping Plan, p. ES-1 ["Reducing greenhouse gas emissions to 1990 levels means cutting approximately 30 percent from business-as-usual emission levels projected for 2020."]; see also Health & Saf. Code, §38500 *et seq.*) As the proposed Project's emissions would exceed the 29 percent requirement, the proposed Project would not impede the implementation of AB 32 and is consistent with the overall trajectory the State of California has established for greenhouse gas reductions. (Please see ENVIRON's "Climate Change Technical Addendum" (October 2009), which can be found in **Appendix F8.0** of the Final EIS/EIR, as well as **Topical Response 13: Global Climate Change Update**.)

Response 18

The comment states that business-as-usual is "measured by the requirements in existence today, not a performance average that accounts for all California development subject to historically less stringent standards." (See Draft EIS/EIR, **Subsection 8.5.2.3.1**, Comparison with AB 32's 2020 Goal, pp. 8.0-59-8.0-62.) However, as discussed in ENVIRON's "Climate Change Technical Addendum" (October 2009), which is found in **Appendix F8.0** of the Final EIS/EIR, the proposed Project's emissions inventory is measured against CARB's "no actions are taken" scenario for year 2020. As such, the analytical methodology has been modified and enhanced, such that it no longer relies on the "California average" to assess significance. That said, the refinements to the technical methods utilized to quantify Project-related emissions and compare such emissions with AB 32 are consistent with the lead agencies' obligation to prepare an informational disclosure document that is reflective of existing science and knowledge. The modifications do not change the significance determinations made in **Section 8.0** of the Draft EIS/EIR.

Response 19

The comment states that the Draft EIS/EIR does not rely on business-as-usual for purposes of mobile source emissions, but instead relies on a "smart growth" suburban goal. (See Draft EIS/EIR, **Subsection 8.5.2.3.1**, Comparison with AB 32's 2020 Goal, pp. 8.0-60-8.0-61,) However, as discussed in ENVIRON's "Climate Change Technical Addendum" (October 2009), which is found in **Appendix F8.0** of the Final EIS/EIR, the proposed Project's emissions inventory is measured against CARB's "no actions are taken" scenario for year 2020. As such, the analytical methodology has been modified and enhanced, such that it no longer relies on CARB's "community performance goal" and "smarter growth suburban" goals to assess significance. As noted above, the modifications to the analysis are consistent with the lead agencies' obligation to prepare an informational disclosure document that is reflective of existing science and knowledge; the modifications do not change the significance determinations made in **Section 8.0** of the Draft EIS/EIR.

With that said, it is worth noting that in order to accommodate the projected population increases in the State of California, growth will occur in the state, including those areas that are considered "suburban" by the comment. That is, it is likely that projected population growth would be accommodated, to some degree, by development other than urban infill or redevelopment.

This conclusion is consistent with the approach taken by the Regional Targets Advisory Committee (RTAC), which is assisting in the implementation of Senate Bill 375 through the development of regional emission reduction targets for the automobile and light truck sector. (Gov. Code, § 65080, subd. (b)(2)(A)(i).) In a recently published report, the RTAC recommended setting reduction targets as a percent reduction in per capita greenhouse gas emissions from 2005 levels. These reduction targets will require a greater reduction, on an absolute basis, from suburban areas, but will require reductions from urban areas, as well. (See "Recommendations of the Regional Targets Advisory Committee (RTAC) Pursuant to Senate Bill 375" (RTAC Recommendations; September 29, 2009), available at http://www.arb.ca.gov/cc/ sb375/rtac/report/092909/finalreport.pdf, which is incorporated by reference.) This is consistent with comparing mileage with a smart growth suburban scenario.

The RTAC Recommendations begin by acknowledging that CARB's "Scoping Plan proposes actions for all sectors to reduce emissions, including a section specifically for regional passenger vehicle-related emissions. This section [of the Scoping Plan] points specifically to SB 375 (Steinberg, Chapter 728, Statutes of 2008) as the process for reducing greenhouse gas emissions through more sustainable land use and transportation planning." (RTAC Recommendations, p. 1.) The RTAC further noted that California's approach to reducing mobile source emissions is contingent upon three elements: (i) vehicle technologies;

(ii) low-carbon fuel technologies; and, (iii) reduced vehicle use through changed land use patterns and improved public transportation. (*Id.* at p. 4.)

As to the comment made above, regarding the RTAC's decision not to distinguish more dense regions from less dense regions during the target setting process, the following recommendation is pertinent:

> "The [RTAC] recommends that regional targets be expressed as a percent per-capita greenhouse gas emission reduction from a 2005 base year. [CARB] would use an interactive process with the [metropolitan planning organizations] to set a *single statewide uniform target* that could be adjusted up or down to respond to regional differences."

(*Id*. at p. 6, italics added.) The adjustment referenced in the excerpt above would not be to account for density, but rather the unique sophistication levels of individual metropolitan agencies, and the modeling tools and technologies available to individual regions. (*Id*. at p. 8.) The RTAC found that the identified metric (*i.e.*, percent reduction in per capita emissions from 2005 levels) *directly* addresses growth rate differences between various regions:

> "Addressing growth rate differences between the [metropolitan planning regions] is important given that growth rates are expected to affect the magnitude of change that any given region can achieve with land use and transportation strategies. The relative characteristic of the metric ensures that both fast and slow growth regions take reasonable advantage of any established transit systems and infill opportunity sites to reduce their average regional greenhouse gas emissions."

(*Id*. at p. 24.) Consistent with the determination that flexibility is required to accommodate the varying growth rates of individual regions, the RTAC iterated its belief that "SB 375 is not a 'no growth' bill and should not be implemented in a manner that turns it into one." (*Id*. at p. 30.)

Response 20

The comment references CARB's December 9, 2008 presentation, entitled "Staff Proposal on Greenhouse Gas Thresholds of Significance under CEQA," for the conclusion that a project must not result in more than 14,000 vehicle miles traveled per household per year in order for impacts to be less than significant. (For a copy of the referenced presentation, please see http://www.arb.ca.gov/cc/localgov/ceqa/meetings/120908/wkshpslides120908.pdf, which is incorporated by reference.)

First, CARB has discontinued the process for developing CEQA significance criteria for CEQA purposes; and, therefore, the referenced interim draft work product from this effort is not determinative. Second, during CARB's consideration of potential significance criteria, serious questions were raised regarding the referenced 14,000 vehicle miles traveled per household per year standard. (See, *e.g.*, Letter from Shari Libicki, on behalf of the Green Developers' Coalition, dated January 16, 2009, pp. 5-10, available at http://www.arb.ca.gov/lists/ceqa-general-ws/51-gdc_comments_final_20090116.pdf, which is incorporated by reference.) For these reasons, CARB's 2008 staff proposal is not used for the global climate change analysis provided in **Section 8.0** of this EIS/EIR.

Response 21

The comment states that the Draft EIS/EIR's discussion of the proposed Project's consistency with greenhouse gas emission reduction strategies recommended by the California Attorney General's Office and Climate Action Team is irrelevant to the significance determination. (See Draft EIS/EIR, **Subsection 8.6.4**, Consistency With Recommended Mitigation Programs, p. 8.0-111-8.0-126.) The referenced discussion and comparative tables are not intended to serve as the basis for the significance determinations; instead, the tables, which appear under the discussion of mitigation measures, provide a side-by-side, tabular presentation of the proposed Project's "green" design features and their compatibility with strategies recommended by the California Attorney General's Office and the Climate Action Team. (Compare Draft EIS/EIR, **Subsection 8.5**, Impacts of the Proposed Project and Alternatives, pp. 8.0-30-8.0-109 with **Subsection 8.6**, Mitigation Measures, pp. 8.0-109-8.0-126.) As demonstrated in the comparative tables, the proposed Project would facilitate development with a number of features that improve overall energy efficiency, reduce water demand, and incorporate public transit and smart community planning strategies into the overall site design. The significance determination is based upon the finding that the proposed Project would not impede achievement of AB 32's 2020 reduction mandate, and specifically has reduced its emissions 32 percent below the levels projected by CARB for year 2020 under a "no actions are taken" scenario. (Please see ENVIRON's "Climate Change Technical Addendum" (October 2009), which can be found in **Appendix F8.0** of the Final EIS/EIR, **Topical Response 13: Global Climate Change Update**, and **Section 8.0** of the Final EIS/EIR for additional information regarding the significance assessment.)

Response 22

The comment states that "[b]ecause the EIR fails to acknowledge the significance of project impacts, it cannot rely on a handful of mitigation measures to claim all feasible mitigation measures and alternatives have been adopted." To preface, this comment is not a stand-alone comment but depends upon the accuracy of the previous comments regarding the adequacy of the Draft EIS/EIR's analysis. As evidenced by the previous responses, substantial evidence supports the finding that the proposed Project's impact to global climate change is less than significant because it would not impair achievement of AB 32's emission reduction mandate for year 2020. The Draft EIS/EIR also included information, supported by substantial evidence, to facilitate meaningful review by the public and agencies, and informed decision making. Because impacts would be less than significant, lead agencies are not required to consider feasible mitigation measures. (Cal. Code Regs., tit. 15126.4, subd. (a)(3) ["Mitigation measures are not required for effects which are not found to be significant."].) Nonetheless, the Project applicant's design commitments are recommended for adoption as mitigation measures in order to provide assurances that the build-out enabled by approval of the proposed Project and EIS/EIR would be energy efficient and environmentally conscious.

Response 23

The comment states generally that the mitigation measures are largely illusory, deferred and ineffective. The comment also states that the mitigation measures requiring the proposed Project to exceed the 2005 Title 24 standards are misleading because the 2008 Title 24 standards will be effective on January 1, 2010. First, the mitigation measures are design features to be implemented during Project build-out. Second, the mitigation will be included, for purposes of state law, in a mitigation monitoring and reporting program that CDFG is required to adopt in the event and at the time of Project approval. (Pub.

Resources Code, § 21081.6.) Third, please see **Response 6**, above, for responsive information. Specifically, please refer to the Project applicant's commitment to exceed, by 15 percent, whatever is the current version of Title 24 that is applicable at the time building permit applications are filed (*i.e.*, revised Mitigation Measures GCC-1 and GCC-2). . The comment will be included as part of the record and made available to the decision makers prior to a final decision on the proposed Project.

Response 24

The comment questions the effectiveness of Mitigation Measures GCC-3 and GCC-4, and cites a draft document published by SCAQMD to demonstrate the regional agency's preference for on-site mitigation. (See Draft EIS/EIR, **Subsection 8.6.2**, Additional Project-Specific Mitigation Measures Proposed by this EIS/EIR, p. 8.0-110.) The referenced mitigation measures provide that the Project applicant or designee, with respect to single-family detached residential units and non-residential roof area, *either* shall produce or purchase renewable electricity (equivalent to the installation of photovoltaic power systems), *or* shall secure offsets or credits from a qualified carbon exchange/reserve, *or* shall pay the SCAQMD the equivalent amount of funds that would be due to buy credits from a qualified carbon exchange/reserve.

First, under CEQA, mitigation measures must be fully enforceable, consistent with the public agency's regulatory authority. (Cal. Code Regs., tit. 14, § 15126.4, subd. (a)(2); see also Pub. Resources Code, §§ 21004, 21081.6.) This requirement will be met in terms of mitigation measures GCC-3 and GCC-4, among other reasons, by their adoption and incorporation into the CEQA-required mitigation monitoring and reporting program. (See, *e.g.*, Cal. Code Regs., tit. 14, § 15097.)

Second, in the California Natural Resources Agency's adopted amendments to the State CEQA Guidelines, the Agency recognized that off-site mitigation measures may be warranted. Specifically, State CEQA Guidelines section 15126.4 (Consideration and Discussion of Mitigation Measures Proposed to Minimize Significant Effects), provides as follows:

> "**(c) Mitigation Measures Related to Greenhouse Gas Emissions.**
>
> Consistent with section 15126.4(a), lead agencies shall consider feasible means, supported by substantial evidence and subject to monitoring or reporting, of mitigating the significant effects of greenhouse gas emissions. Measures to mitigate the significant effects of greenhouse gas emissions may include, among others:
>
> (1) Measures in an existing plan or mitigation program for the reduction of emissions that are required as part of the lead agency's decision;
>
> (2) Reductions in emissions resulting from a project through implementation of project features, project design, or other measures, such as those described in Appendix F;
>
> (3) *Off-site measures, including offsets that are not otherwise required, to mitigate a project's emissions*;
>
> (4) Measures that sequester greenhouse gases; and
>
> (5) In the case of the adoption of a plan, such as a general plan, long range development plan or plans for the reduction of greenhouse gas emissions, mitigation may include the identification of specific measures that may be implemented on a project-by-project basis. Mitigation may also include the

> incorporation of specific measures or policies found in an adopted ordinance or regulation that reduces the cumulative effect of emissions."

(Italics added.)

Third, Mitigation Measure GCC-5 affirms the Project applicant's commitment to proceed with build-out of any development facilitated by approval of the proposed Project and in accordance with the Governor's Million Solar Roofs Plan, such that first-time purchasers of single-family residences would be provided with a solar energy system option. Therefore, to the extent that there is demand for solar energy systems in the single-family residential market, the subject build-out would result in the installation of on-site solar systems.

Response 25

Citing the *Protect the Historic Amador Waterways v. Amador Water Agency* (2004) 116 Cal.App.4th 1099 decision, the comment states that CEQA requires a lead agency to consider "any fair argument" that a certain environmental impact may be significant, even when the project complies with a regulatory threshold. The comment further states that "because there is a fair argument that application of a threshold with limited effectiveness at reducing emissions would still result in environmental effects," reliance on such a threshold is ineffective and leaves projects open to legal challenge under the fair argument standard.

The fair argument standard is not applicable to decisions challenging an EIR. By way of background, a strong presumption in favor of requiring preparation of an EIR is built into CEQA. (See Cal. Code Regs., tit. 14, § 15063, subd. (b).) This presumption is reflected in the "fair argument" standard, under which an agency must prepare an EIR whenever substantial evidence in the record supports a fair argument that a project may have a significant effect on the environment. (See *No Oil, Inc. v. City of Los Angeles* (1974) 13 Cal.3d 75, 82.) Lead agencies apply the fair argument standard as a substantive standard in deciding whether an EIR or a negative declaration is required, and courts apply the fair argument standard as a standard of judicial review for agency decisions to adopt a negative declaration. (See *Communities for a Better Environment v. California Resources Agency* (2002) 103 Cal.App.4th 98, 106-107 ["With certain exceptions, CEQA requires public agencies to prepare an EIR for any project they intend to carry out or approve whenever it can be fairly argued on the basis of substantial evidence that the project may have a significant environmental effect; under this "fair argument" standard, an EIR must be prepared even if other substantial evidence shows no significant environmental effect."].) However, once an EIR is prepared and certified, the court does not ask whether record evidence supports a fair argument that impacts may be significant; instead, the court asks whether substantial record evidence supports the determination rendered by the lead agency. Accordingly, the comment's suggestion that the significance determinations rendered in the Draft EIS/EIR are open to a "fair argument" challenge is legally incorrect. See also **Response 9**, above, which discusses and distinguishes the *Protect the Historic Amador Waterways* decision. The comment will be included as part of the record and made available to the decision makers prior to a final decision on the proposed Project.

Response 26

Citing CAPCOA's January 2008 report, the comment states that the only two thresholds that are "highly effective" at reducing greenhouse gas emissions are zero thresholds and thresholds designed to capture 90 percent or more of likely future discretionary projects (*i.e.*, a 900-ton CO_2e threshold). However, the comment misconstrues the CAPCOA report. In fact, the report states:

> "With an established cumulative context that demonstrates overall net reductions, *all* threshold approaches could be effective in ensuring growth and development that significantly mitigates GHG emission growth in a manner that will allow the CARB to achieve the emission reduction targets necessary to meet AB 32 targets. In that respect, *all* of these thresholds are supported by substantial evidence."

(CAPCOA, p. 53.) As discussed in **Response 16**, above, the significance criterion utilized in the Draft EIS/EIR is consistent with one of the approaches identified by CAPCOA. In addition, the report noted that "[t]hresholds that require reductions compared to business-as-usual for all projects or for a large portion of new development would be consistent with regulatory mandates." (*Id.* at p. 54.)

Response 27

The comment is critical of the Corps' alleged failure to render a significance determination, under NEPA, with respect to global climate change. However, the comment is not correct for several reasons.

First, the Draft EIS/EIR for the proposed Project provided as follows with respect to the Corps' assessment of climate change impacts:

> "The Corps' position under NEPA is that there are no science-based GHG significance thresholds, nor has the federal government or the state adopted any by regulation. In the absence of an adopted or science-based GHG significance standard, the Corps will not utilize the CEQA significance criterion being used by CDFG, propose a new GHG significance standard, or make a NEPA impact determination for GHG emissions anticipated to result from the proposed Project or any of the alternatives. Rather, in compliance with NEPA implementing regulations, the anticipated GHG emissions will be disclosed for the proposed Project and each alternative without the Corps expressing judgment as to the significance of such emissions."

(Draft EIS/EIR, **Subsection 8.4**, Impact Significance Criteria, p. 8.0-29.)

One of the primary differences between NEPA and CEQA is the way in which significance is determined. Under NEPA, significance is used to determine whether an environmental impact statement (EIS) or some less extensive level of document will be required. (40 C.F.R. § 1502.4.) NEPA requires that an EIS be prepared when the proposed federal action (*i.e.*, the proposed Project), as a whole, has the potential to significantly affect the quality of the human environment. (See, *e.g.*, 40 C.F.R. § 1502.4.) The determination of significance is based on context and intensity. (40 C.F.R. § 1508.27.) Under NEPA, once a decision is made regarding the need for an EIS, it is the magnitude of the impact that is evaluated and no judgment of its individual significance is deemed important for the text. CEQA, on the other hand, requires a lead agency to identify each "significant effect on the environment" in the environmental impact report. (See, *e.g.*, Cal. Code Regs., tit. 14, § 15126.2 (Consideration and Discussion of Significant Environmental Impacts), § 15091 (Findings).) In summary, the Corps is not required under NEPA to render a significance determination in an EIS.

In further response, the Corps concurs in the determination that the proposed Project would have a less-than-significant impact with respect to impacts to global climate change for all of the reasons expressed in **Section 8.0** and ENVIRON's "Climate Change Technical Report" (see **Appendix 8.0** of the Draft EIS/EIR) and "Climate Change Technical Addendum" (see **Appendix F8.0** of the Final EIS/EIR).

This approach is consistent with the Council for Environmental Quality (CEQ) recently issued "Draft NEPA Guidance on Considerations of the Effects of Climate Change and Greenhouse Gas Emissions" (February 18, 2010). On page 1 of the Draft NEPA Guidance, CEQ "affirms the requirements of the statute [i.e., NEPA] and regulations and their applicability to GHGs and climate change impacts." CEQ also underscores the practical limits on the analysis of global climate change. For example, CEQ provides that "agencies should recognize the scientific limits of their ability to accurately predict climate change effects, especially of a short-term nature, and not devote effort to analyzing wholly speculative effects." (Draft NEPA Guidance, p. 2.) For more information on CEQ's Draft NEPA Guidance, please see **Topical Response 13: Global Climate Change Update**, and **Section 8.0** of the Final EIS/EIR.

In support of its conclusion, the comment cites the Ninth Circuit Court of Appeals' decision in *Center for Biological Diversity v. National Highway Traffic Safety Administration*, 508 F.3d 508 (9th Cir. 2007) (*CBD* decision). Preliminarily, please note that the cited opinion was vacated and superseded upon denial of rehearing, such that the operative opinion is now set forth at 538 F.3d 1172 (9th Cir. 2008).[15] All subsequent references to the *CBD* decision are to the superseded opinion filed on August 18, 2008.

The *CBD* decision addresses the National Highway Traffic Safety Administration's (NHTSA) corporate average fuel economy (CAFE) standards for light trucks for model years 2008-2011. (*Center for Biological Diversity*, *supra*, 538 F.3d at p. 1181.) Specifically at issue was NHTSA's decision to prepare an environmental assessment (EA) in lieu of an EIS. The Ninth Circuit held that while the EA quantified the greenhouse gas emissions that would result from implementation of the CAFE standards, the EA failed to "discuss the *actual* environmental effects resulting from those emissions or place those emissions in context of other CAFE rulemakings." (*Id*. at p. 1216, italics original.) The *CBD* decision is distinguishable from the present circumstances, in which the Corps has proceeded with the preparation and circulation of an EIS (as opposed to an EA), and has analyzed the actual implications of the greenhouse gas emissions by assessing whether the proposed Project's emissions inventory would impair attainment of California's mandatory emissions reduction mandate (*i.e.*, AB 32) for year 2020.

[15] One of the primary modifications to the initial opinion related to the Ninth Circuit's recognition that, on remand, the federal agency should not conclusively be required to prepare an environmental impact statement; instead, whether preparation of an environmental assessment or environmental impact statement is necessary was left to the agency's discretion. (*Center for Biological Diversity*, *supra*, 538 F.3d at pp. 1178-1180.)