NPR's Planet Money – Episode 616, How Solar Got Cheap

http://www.npr.org/templates/transcript/transcript.php?storyId=398811199

Thanks Christina!

Price drop in residential solar due to:

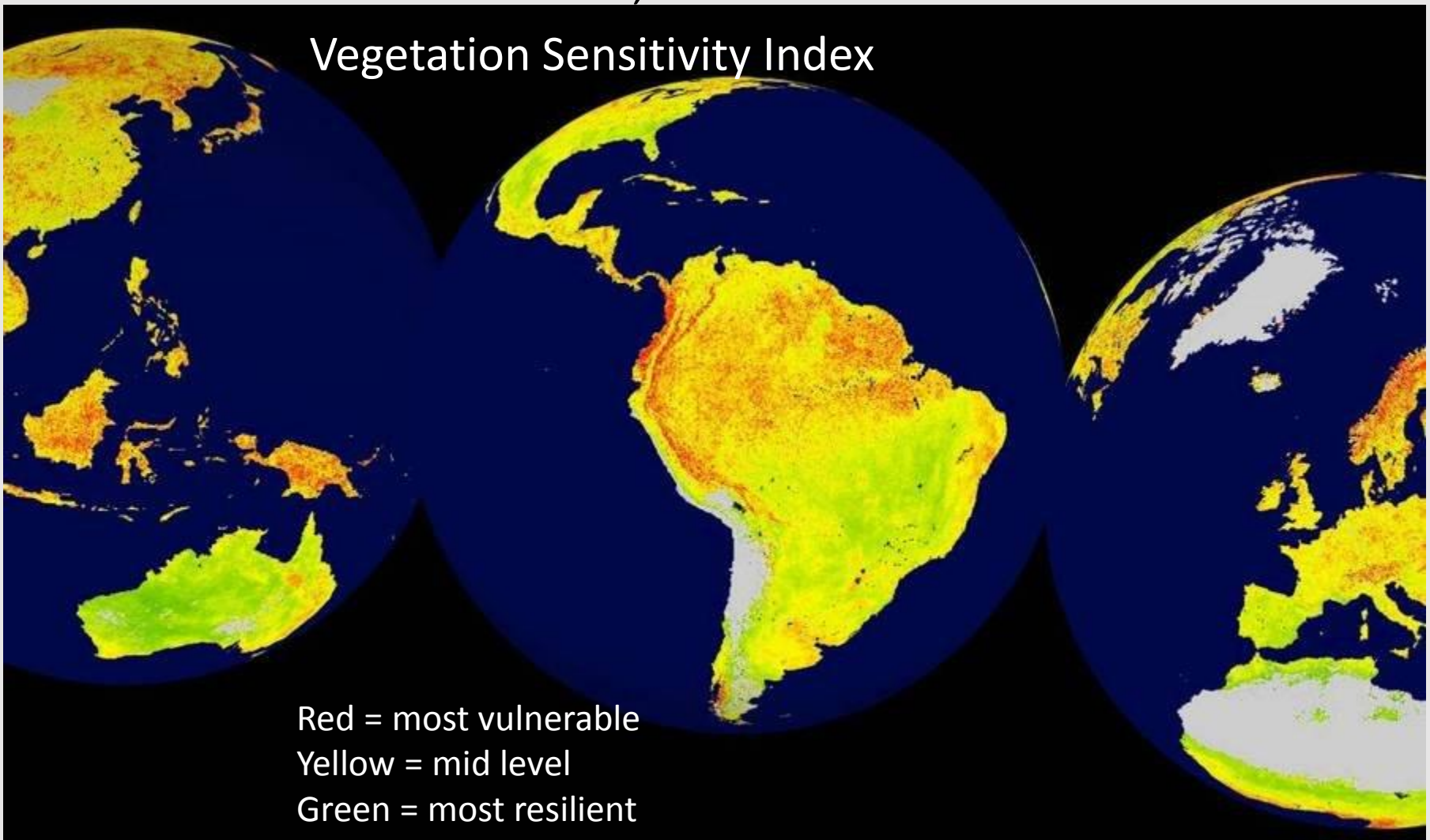
1) drop in the price of panels themselves, mainly because Chinese manufacturers flooded the market and forced prices down (more supply means lower prices = more demand).
2) invention of a special tool which cuts installation costs and time significantly, from a couple days to a couple hours

3) leasing programs instead of paying large upfront costs for the panels and installation.

Where Will Climate Change Hit the Hardest?

http://news.yahoo.com/map-shows-where-climate-change-160100393.html

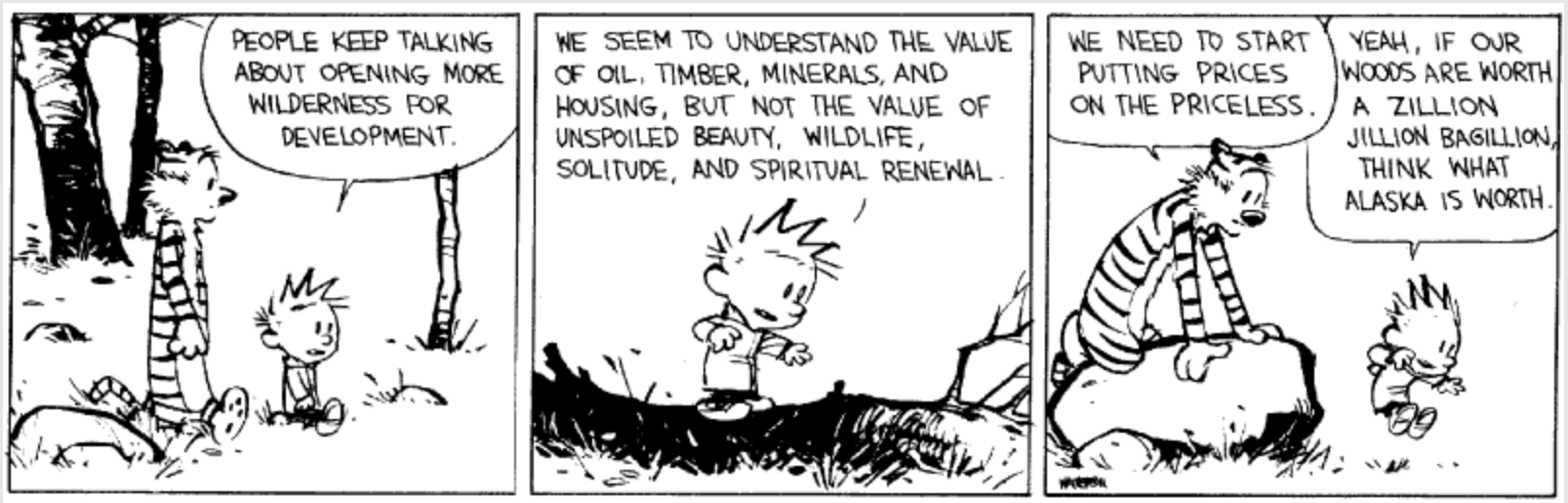
Thanks Melanie, CDFW!



Last Time…

Economics of Climate Change

- Can we apply economic concepts to natural resources like Earth's atmosphere?
- Can we use cost-benefit analysis to select mitigation strategies?
- How do we evaluate things like human welfare and peace of mind?



Supply and Demand

- **Demand** refers to how much (quantity) of a product/service is desired by buyers
- **Supply** represents how much producer can offer

- **Price** is a reflection of supply and demand

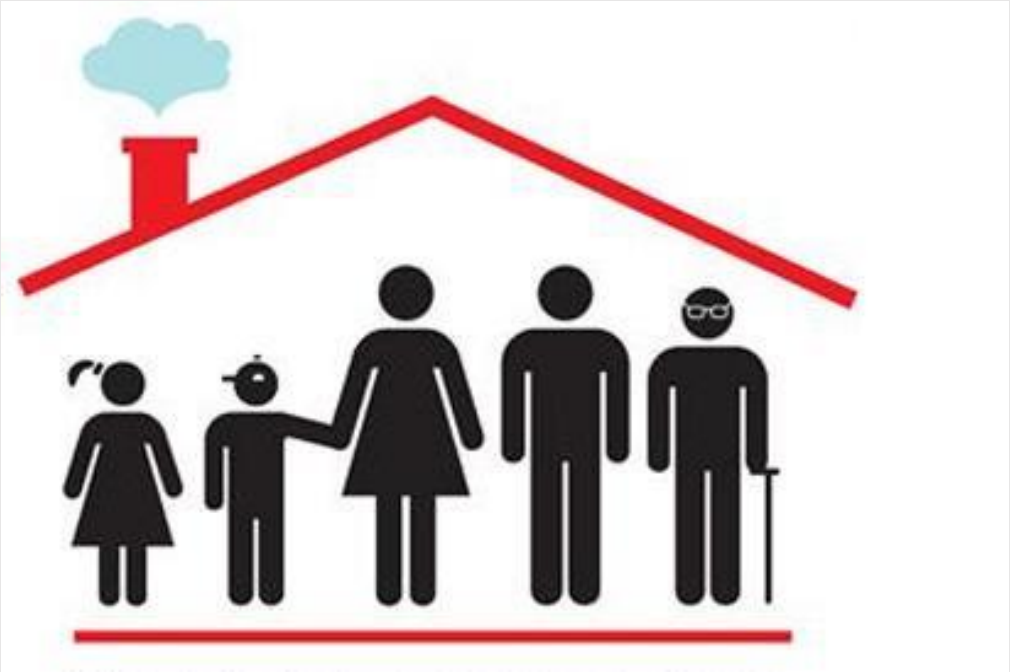
Global Climate Change ≠ Market Economy

Global Climate Change ≠ Market Economy

- Divergent national interests distort global markets for goods or services
- Monopolies or cartels control the supply of some goods or services
- Other relevant goods or services are free and invite indiscriminate use
- Crucial information about many goods or service is sparse, uncertain, or not publicly available
- Processes span several generations of human beings

Multigenerational time scale

- Long delays between cause and effect, action and reaction
- Even if emissions abate today, temperatures will continue to rise through the next century



Intergenerational Equity

Each generation has the right to inherit the same diversity in natural and cultural resources enjoyed by previous generations and to equitable access to the use and benefits of these resources

Multigenerational time scale

Will future generations be better equipped to deal with climate change?

- They will be smarter
- They will be richer
- They will have better technology

People in California are twice as rich as they were 50 years ago. Are we better able to deal with life's problems because we are richer?

- Schools?
- Transportation?
- Water?
- War and Peace?
- Family?
- Freedom?
- Food Quality?
- Better TV Programs?

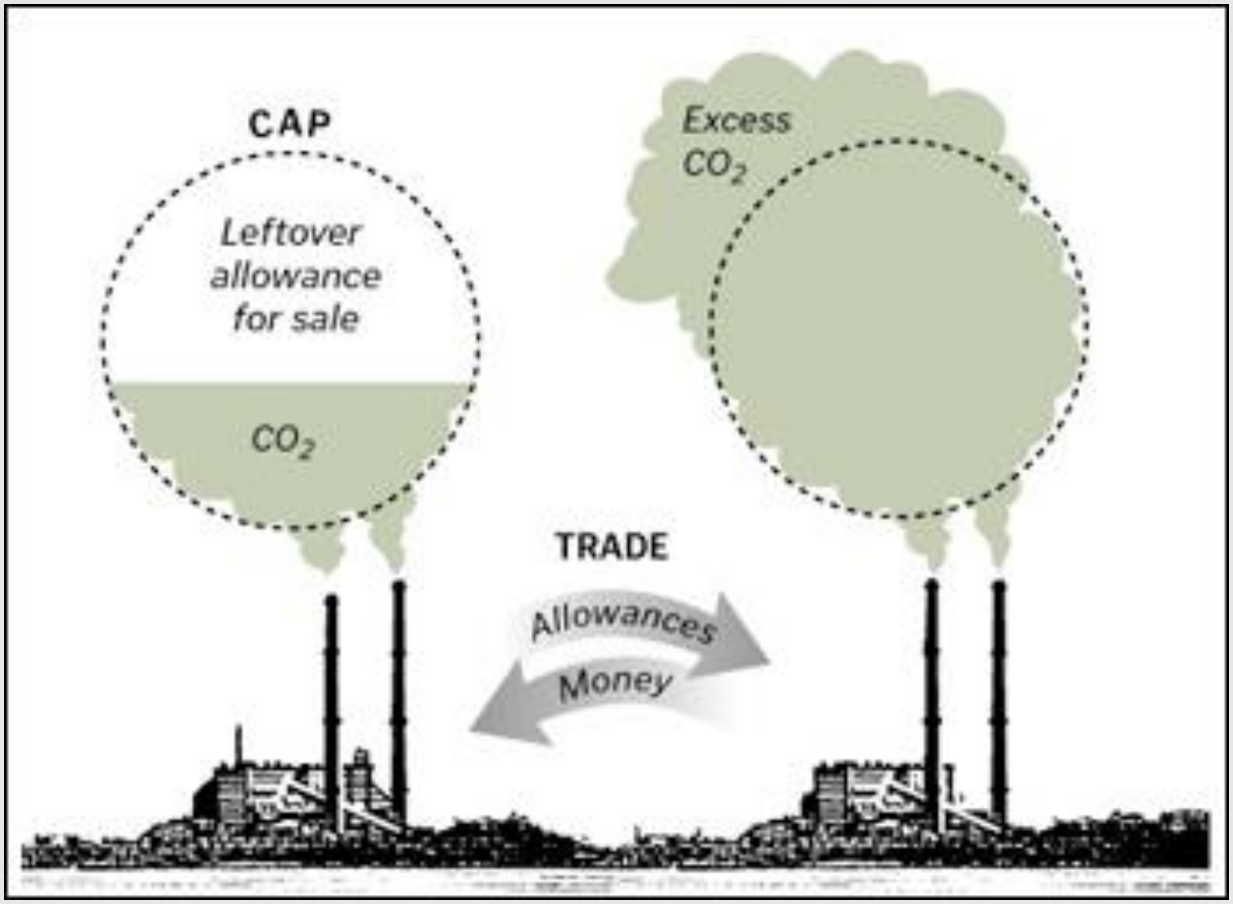
Free market forces and climate change

- Most economists believe market forces alone can not achieve significant reductions in GHG emissions
- Governments must take corrective measures
- What are those measures?

Solutions: government intervention

- Tax and dividend: taxes collected from buyers of "gas guzzling" vehicles pay for rebates to buyers of gas-electric hybrids
- Permit system: government issues permits (carbon credits) that limit how much GHG emissions a company may produce
  - Carbon Cap-and-Trade: A company that does not use all of its carbon credits may sell the leftovers to a company that has produced more emissions than were permitted

Carbon Cap and Trade



How do we decide which solutions are best?

Cost Benefit Analysis

Cost Benefit Analysis

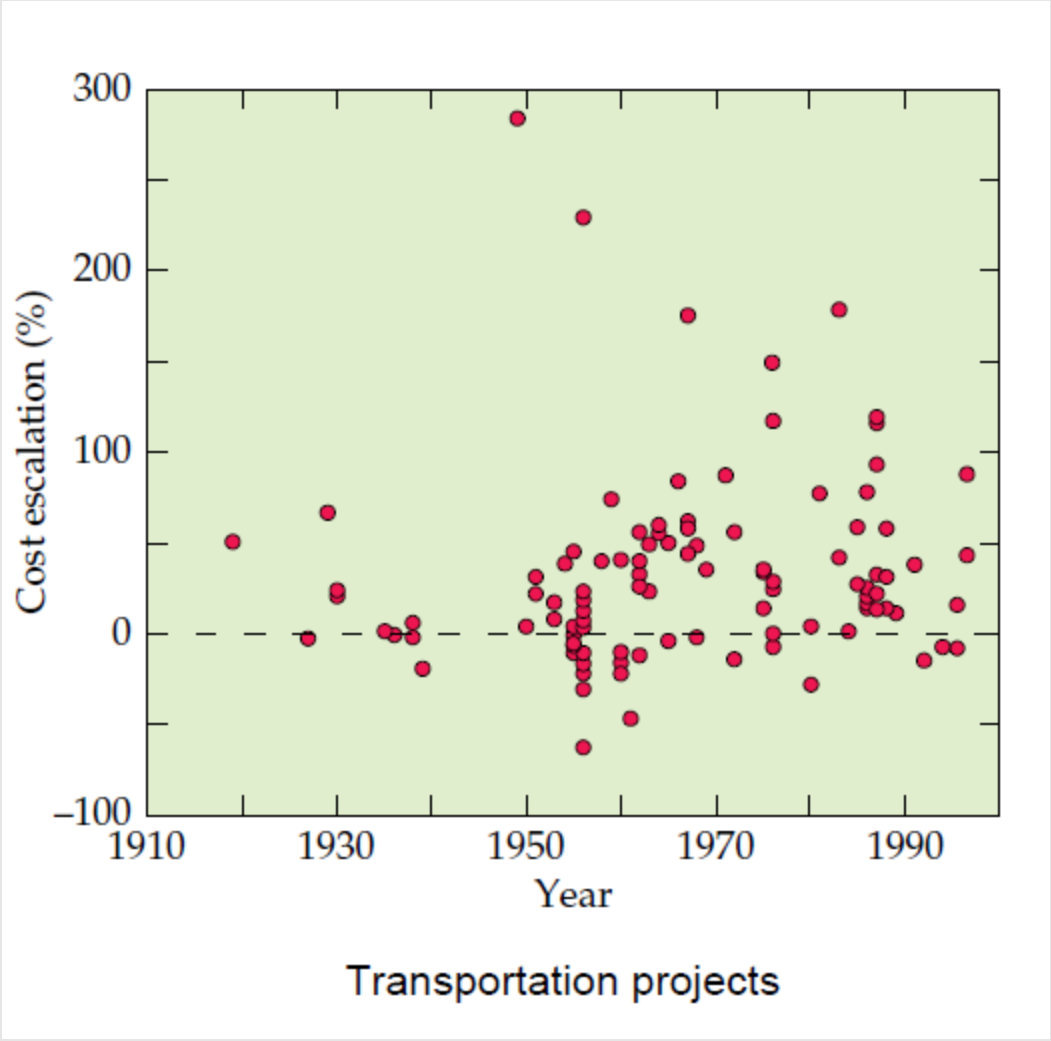
Choosing the course of action that has the highest benefits at the lowest cost

Difficulty in analyzing cost/benefits of large scale projects

- Estimates based on past projects that seem similar, but might be distinct
- How do we assess aesthetics, human welfare, peace of mind, etc?
- Pressure from special interest groups to include or exclude various costs/benefits
- Personal stakes in whether a project gets funded
- Few penalties for mistakes
- Usually over optimistic. Unforeseen mishaps not included

Underestimation of Costs

Cost estimate $7 million
True cost $107 million



Transportation projects

Cost/Benefit Analysis

- We could dam the Colorado River, flowing through the grand canyon
- Benefit: hydroelectricity
- Cost: loss of national landmark and natural wonder

How do we assign value to intangible benefits?
Aesthetics, cultural values, human welfare, risk avoidance

Energy Institute: Economics of Electric Cars

https://energyathaas.wordpress.com/2015/12/14/economists-are-from-mars-electric-cars-are-from-venus/

Thanks Corey!

- Economists pointing to **programs with an implied cost per ton of CO2 reductions in the range of hundreds of dollars per ton**. One reaction to such findings is to point out that **we need to do this expensive stuff *and* the cheap stuff or else we just aren't going to have enough emissions reductions**. Since we need to do all of it, it's no great tragedy to do the expensive stuff now.
- The underlying implication is that we have to do all the policies necessary to reach the mitigation target, or we are completely screwed. So **we need to identify the ways (wedges) that reduce emissions and get them done, no matter what the costs may be**.

- Many environmental economists think of the problem in a different way. **Each policy that reduces emissions has a cost, and those reductions create an incremental benefit**. The question is then **"are the benefits greater than the costs"?** From this framing of the problem, a statement like "we have to stick to the carbon budget X, *no matter what the costs*" doesn't make sense. Any statement that ignores the costs doesn't make sense.
- **Quantity targets we are picking**, like limiting warming to 2 degree Celsius increase and/or reducing emissions by 80% by 2050, **are somewhat arbitrary targets** themselves.
- Economists argue **we should keep pushing on abatement as much as we can, and see if the costs turn out to be less than the benefits.** If not, **we adjust our targets in response to what we learn about abatement costs (in addition to climate impacts).**

Discount Rate

How much is it worth to us today to avoid climate disruption later this century?

Preference for Present Benefits Over Future Benefits

- I'll give you $100 today or $100 in 10 years
- $70 today or $100 in 10 years?
- $50 today or $100 in 10 years?

- If you choose $50 today, you're saying you value dollars today twice as much as you value dollars 10 years from now

Opportunity Costs

- What would you pay to avoid $100 in damage to your car a year from now?
- What else could you do with the money in the meantime?
  - Invest it, get 3% interest. In a year you'd have $103
  - It's worth $97 to you today to avoid $100 in damage a year from now
  - If the damage was 10 years from now, it would be worth $67

Discount Rate

- The amount a benefit declines in value each year into the future you extend

Present Value

The present value of a something ($100) is the future value (next year's value of $103) discounted to today, taking into account the discount rate.

The present value of a $100 in 2017, given a discount rate of 3% is $97

Discount Rate

- All economic analyses are done in terms of present values
- All values are compared on how they would look if they were in today's terms. This process uses discount rates.

Discount Rate

- Over time goods are discounted, since they are not as valuable in the future. Think of an iPod in 100 years. Is it worth the same as today?
- The same concept is applied to the environment

DOES THIS MAKE SENSE?

Social Discount Rate

Imagine climate change will cause $5 trillion in damages by 2100. A discount rate of 3% means it would only be worth $382 billion to avoid it (1/2 the annual US military budget)

Discount Rate

- If the discount rate is 5%, avoiding $5 trillion in damages in 2100 is only worth $72 billion today

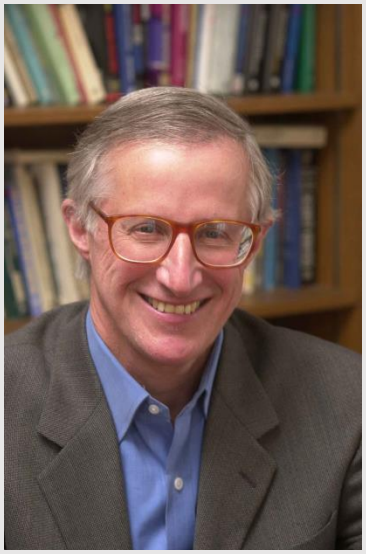
- The higher the discount rate, the less the current value

Social Discount Rate

- If we lower the discount rate the value is higher but it is still a problem
- At some point in the future the present value goes to 0 for as long as you have a positive discount rate
- Does this make sense?
- How fast do we get to 0?

Nordhaus versus Stern

- William Nordhaus (USA) published an economic analysis of climate change in 1999
- Nicholas Stern commissioned by the British government in 2006 to review the same issue.



Nordhaus

Stern

Nordhaus

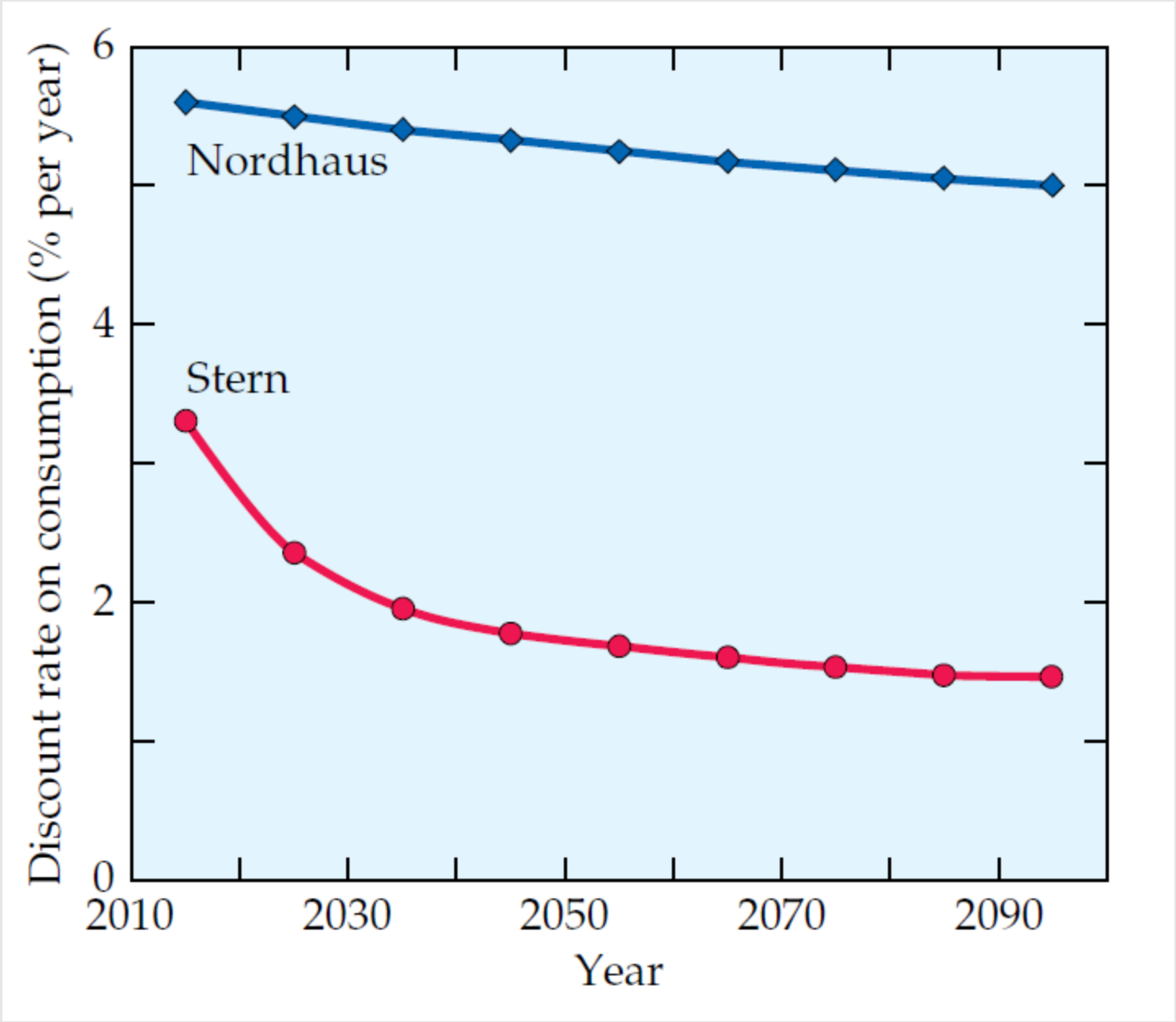
- Costs of mitigation strategies would exceed benefits by $1.1 trillion -$2.2 trillion
- Mitigation would reduce global GDP by 6%

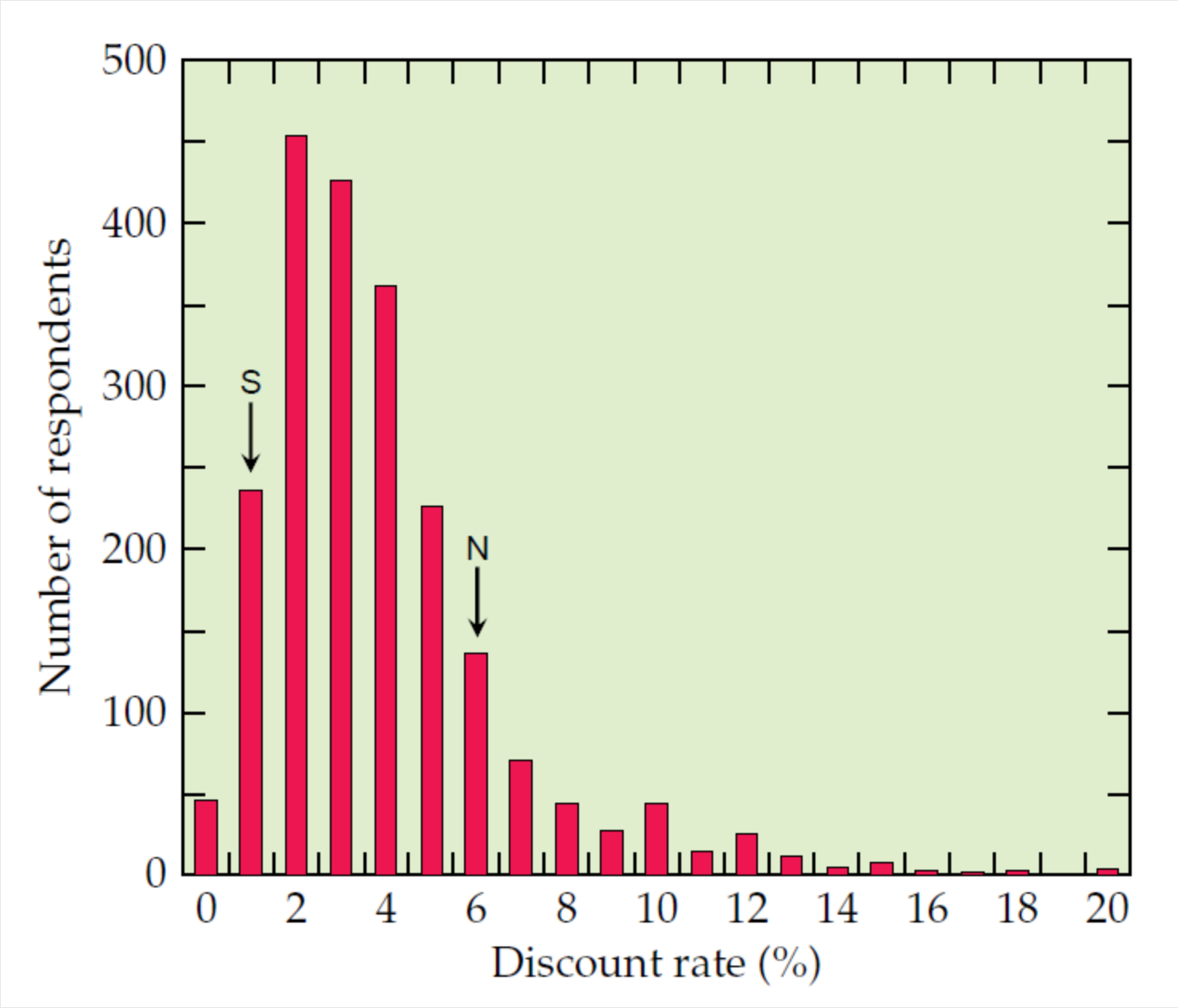
Stern

- Benefits of mitigation strategies would exceed costs by $2.5 trillion
- Mitigation would reduce global GDP by 1%
- Without mitigation, the GDP would decrees by at least 4%

Nordhaus vs Stern

- They used similar economic models to reach these conclusions
- They used different discount rates
  - Nordhaus: rate of social time preference starting at 6% per year and declining slowly to about 1% per year in 300 years
  - Stern: starting at 3% but lowered exponentially to 1.4% in 100 years
  - Most economists believe the discount rate should be around 2%


Discount rate on consumption (% per year)
6
4
2
0
Nordhaus
Stern
2010
2030
2050
2070
2090
Year


500
400
300
200
100
0
Number of respondents
S
N
0
2
4
6
8
10
12
14
16
18
20
Discount rate (%)

Nordhaus vs Stern

- Nordhaus: The future will be richer and can therefore deal with global climate change better that we can and this is a reason to delay
- Stern: Intergenerational equity should be exactly even. Even though people in the future will be “richer” they will not be better able to deal with problems

What should we do?

Stern says do something now

Nordhaus says wait

What should we do?

- US Government Accountability Office survey of 18 US economists, including Nordhaus
- All agreed that market-based mechanisms should be used to put a price on GHG emissions
  - 8 preferred cap-and-trade system with a safety valve: government can issue additional permits if price of permits exceeds a certain level
  - 3 preferred cap-and-trade without safety valve
  - 7 preferred a tax on emissions

What should we do?

- The majority believed the prices of emissions should gradually increase over time
- All suggested the US government should regulate emissions by 2015 regardless of the actions of other nations
- All agreed that emission prices should apply to all sectors of the economy
- 14 of the 18 were “moderately certain” the benefits would outweigh the costs (4 did not respond to the question)

The vast majority of economists now advocate that governmental economic policies to address global climate change are not only feasible but also desirable

http://grist.org/article/discount-rates-a-boring-thing-you-should-know-about-with-otters/

Bill Gates: The Math Formula That Will Solve Climate Change

http://www.forbes.com/sites/randalllane/2016/02/23/bill-gates-just-released-the-math-formula-that-will-solve-climate-change/#49226d415ab8

Thanks Yumi!

P x S x E x C = CO_2 (carbon dioxide output)

P=population

S=services used by people

E=the energy needed to power those services

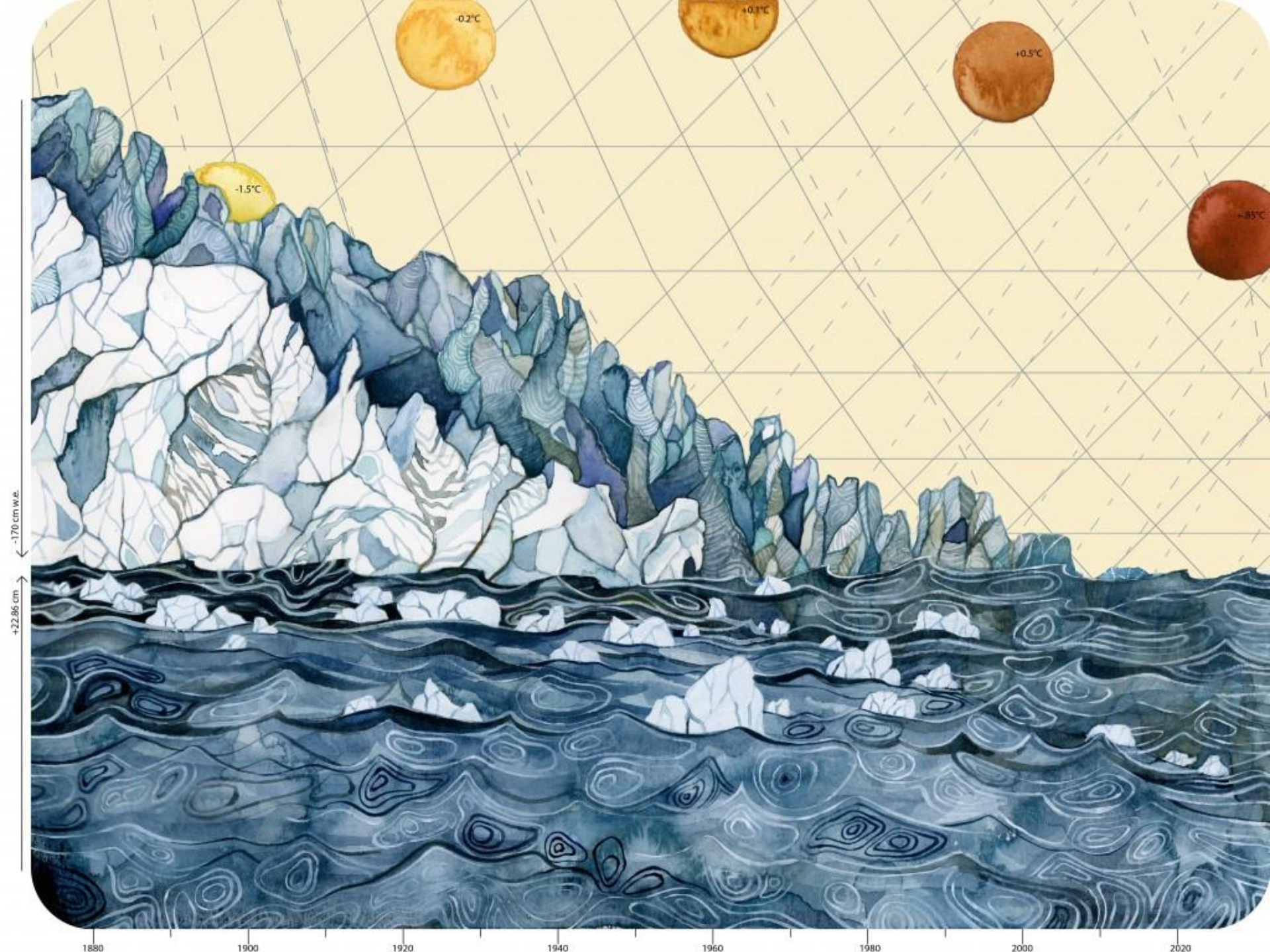
C=the carbon dioxide created by that energy

Eliminating C is the most desirable

Painter captures the data of climate change in watercolors

http://www.pbs.org/newshour/art/artist-captures-climate-change-in-7-stunning-watercolors/

Thanks Nicole!


-0.2°C
+0.1°C
+0.5°C
-1.5°C
+.85°C
-170 cm w.e.
+22.86 cm
1880
1900
1920
1940
1960
1980
2000
2020