

Introduction to Renewable Diesel and Biodiesel

Joe Korpi



Cautionary Statement

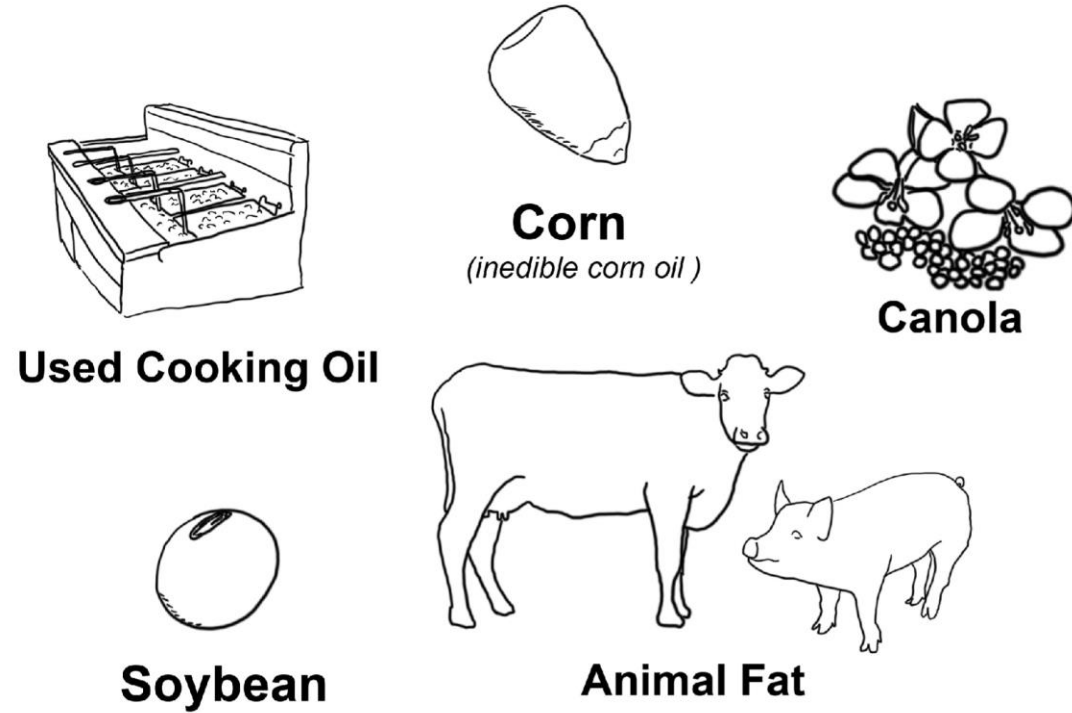
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Where Does Biodiesel & Renewable Diesel Come From?

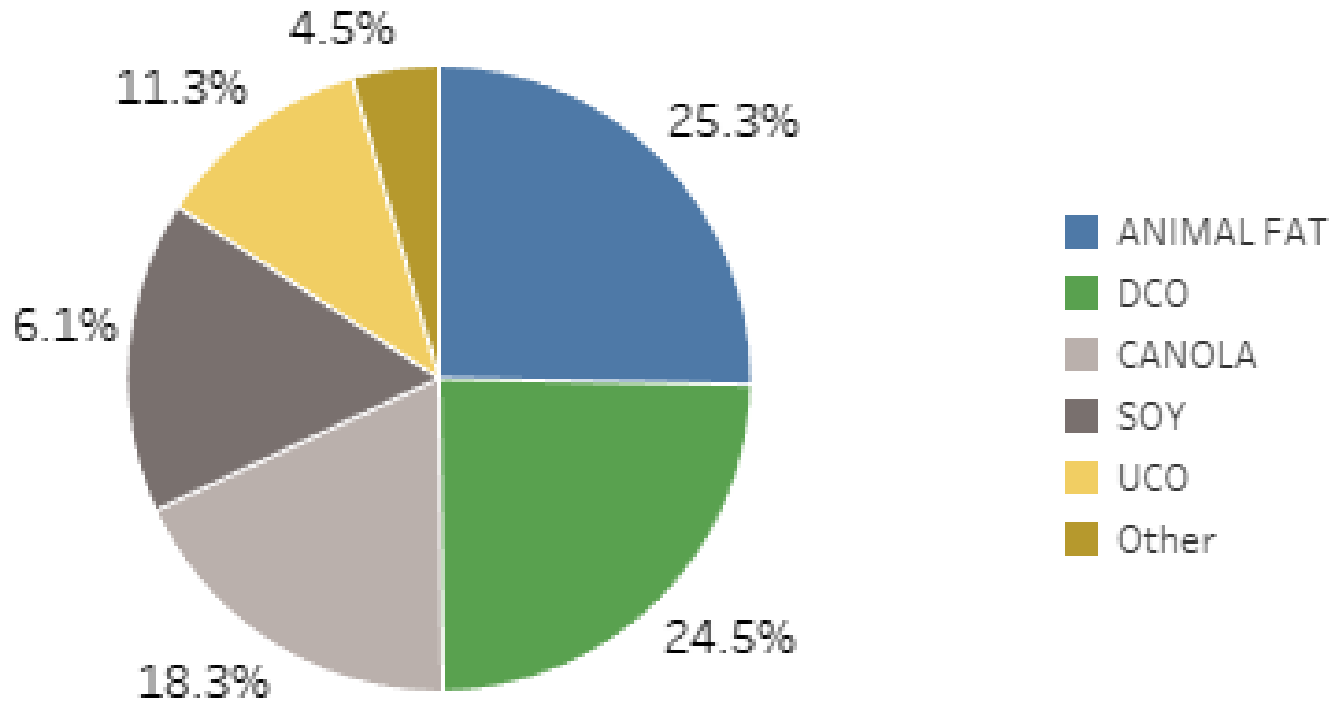


Biological Fats, Oils and Greases

We have learned how to be flexible and remain profitable as feedstock and product markets fluctuate

Feedstock Sources In 2022

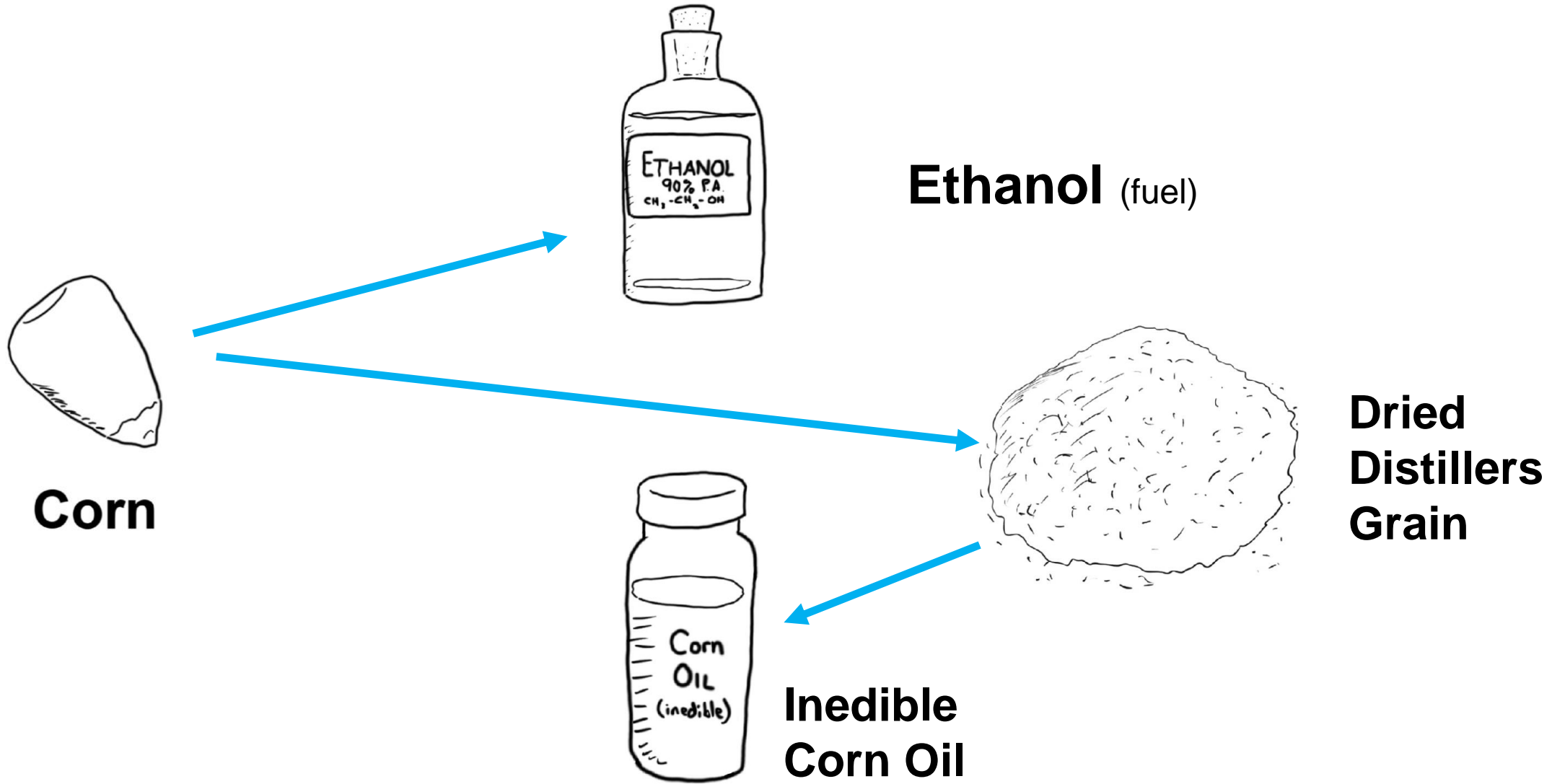
YTD Feedstock Mix for North American Facilities



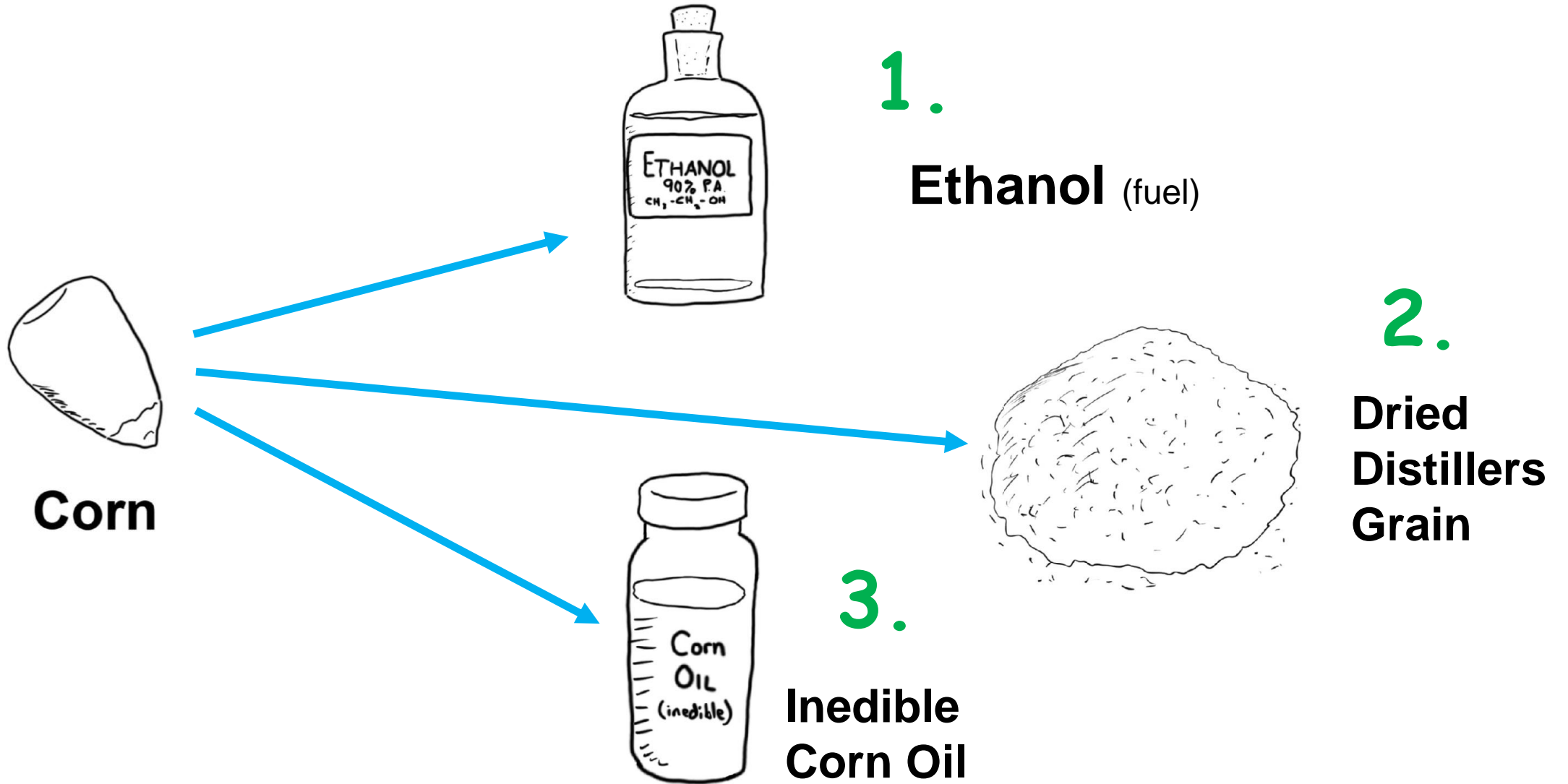
Network feedstock flexibility allows Chevron Renewable Energy Group to utilize optimal feedstocks based on overall economics, production technology and final product destination



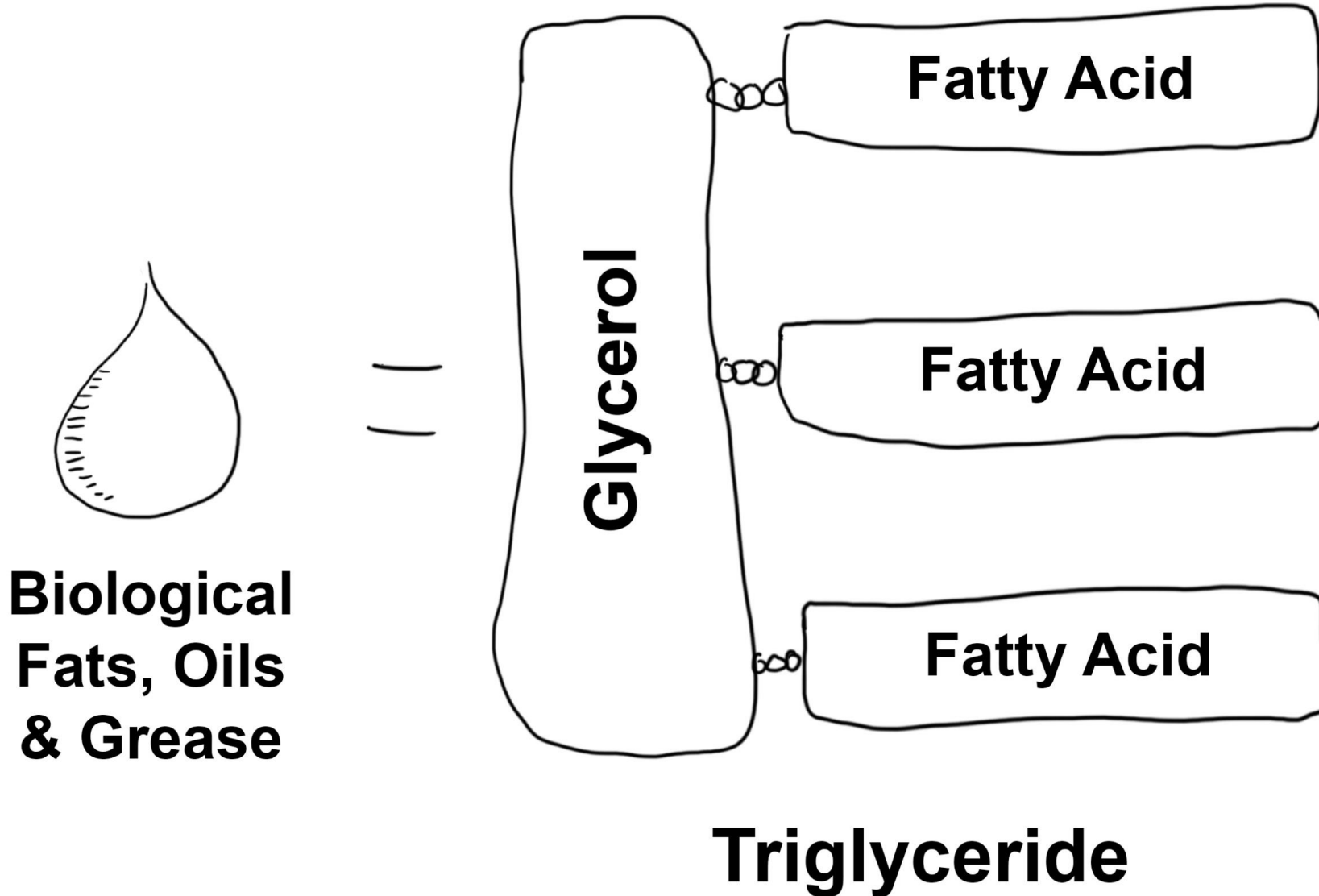
Consider One Feedstock: Inedible Corn Oil



One Feedstock: THREE Products!



All Biological Fats, Oils and Greases = Triglycerides



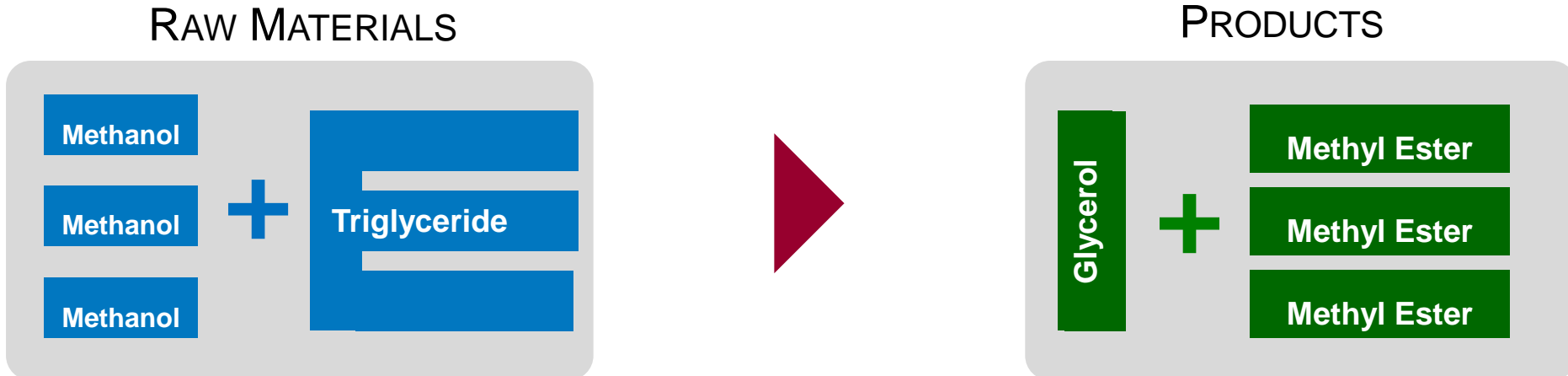
How Is It Made?

What Is Bio-Based Diesel Today?

Option 1: Biodiesel

Renewable fuel composed of esters made from biological oils and fats through transesterification or esterification.

Sometimes referred to as FAME

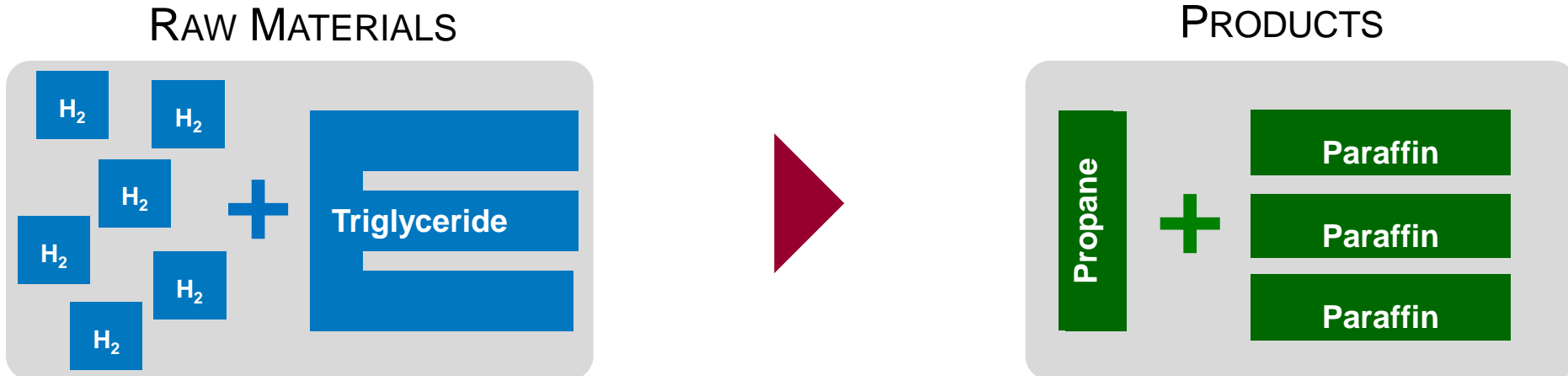


What Is Bio-Based Diesel Today?

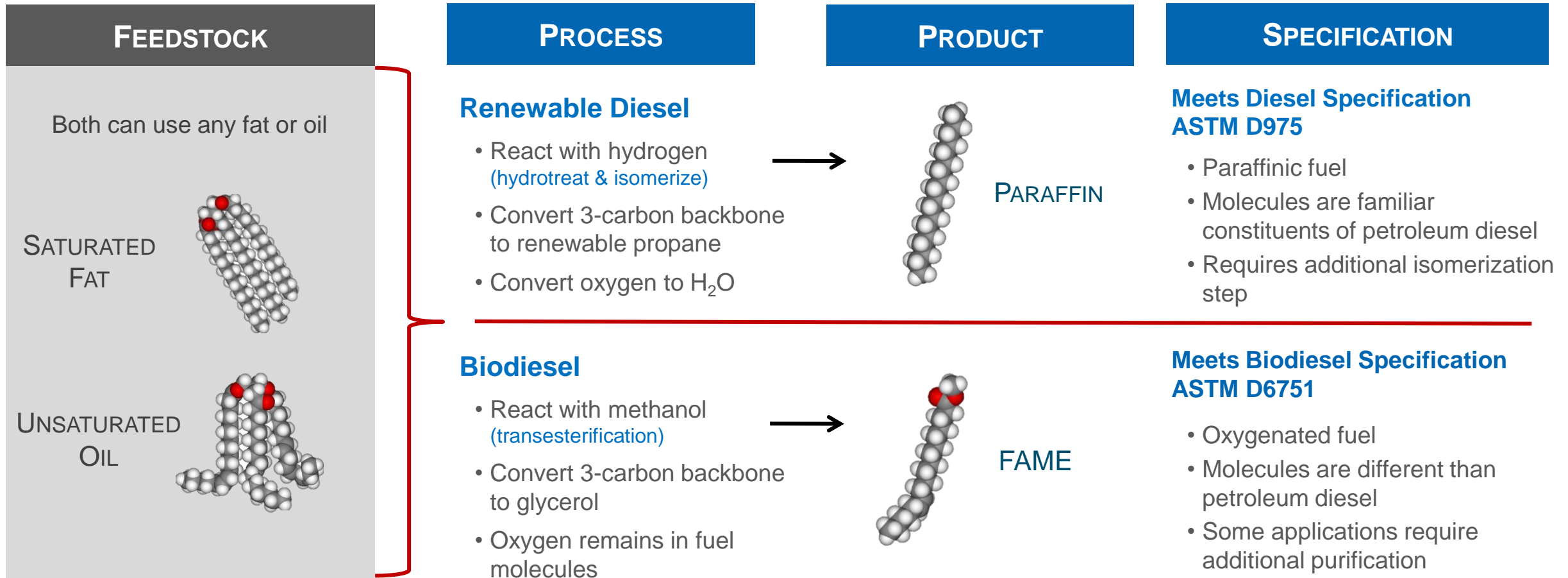
Option 2: Renewable Diesel

Renewable fuel composed of hydrocarbons made from biological oils and fats through hydrotreating.

Sometimes referred to as HVO



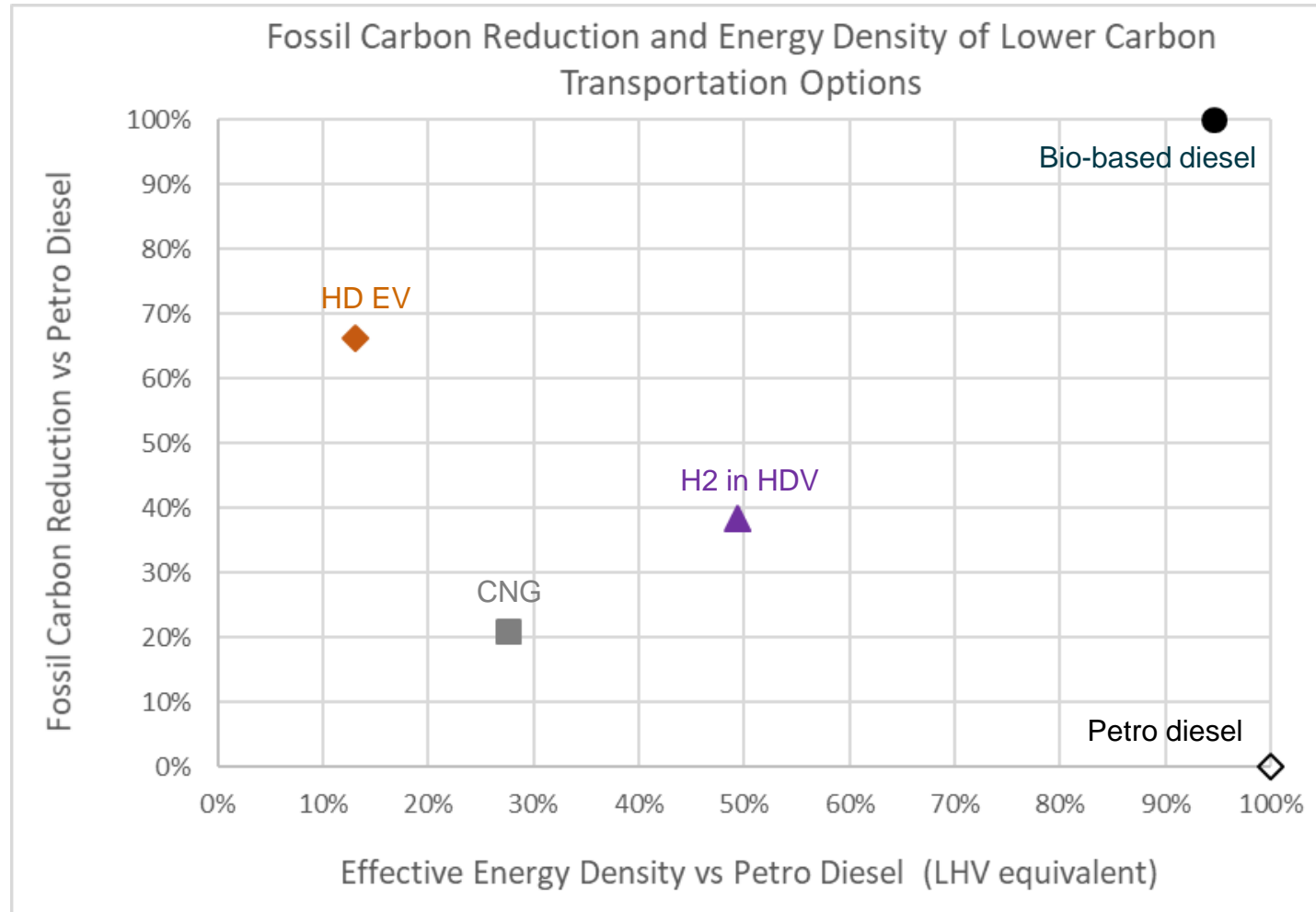
Renewable Diesel And Biodiesel Overview





BIO-BASED DIESEL PROPERTIES

Heavy Duty Truck Alternative Energy Source Comparison



KEY ASSUMPTIONS

1. All estimates based on properties in the Greenhouse Gas Protocol's Scope 1 emissions calculator and in CA-GREET version 3.0.
2. Hydrogen is derived from natural gas via SMR, pressurized to 5,000 psi (35 MPa), and consumed via fuel cell (not combustion). Includes fossil CO₂ production for steam methane reforming (SMR) process.
3. CNG is conventional gas pressurized to 3,600 psi.
4. Heavy-duty EV assumes electricity with the 2019 U.S. grid average CI, an EER of 5.0, and battery volume (physical size) of 1 gallon per kWh capacity.

Lower carbon liquid fuels offer significant advantages over other lower carbon transportation energy options

Maximizing Customer GHG Reductions



Successful lower carbon fuel programs allow customers to choose from multiple options, optimizing against their individual value drivers

Basic Properties

Biodiesel (B100)

- Flashpoint $>230^{\circ}\text{F}$
 - Can be ignited under pressure or after heating
 - NOT “Flammable” (*by any definition – OSHA, DOT, etc.*)
- Non-toxic & **NOT** a hydrocarbon
- No “BTEX” is produced in this process.
 - BTEX is defined as:
 - Benzene
 - Toluene
 - Ethylbenzene
 - Xylene

Renewable Diesel (R100)

- Flashpoint $>125^{\circ}\text{F}$ or $>140^{\circ}\text{F}$ (*depending on specification*)
 - Depending on specifications, it will either be classified by DOT as a Flammable liquid or a Combustible liquid
- Straight “drop-in” diesel fuel
 - IS a hydrocarbon, like petroleum diesel
- No “BTEX” is produced in this process
 - Benzene
 - Toluene
 - Ethylbenzene
 - Xylene

Environmental Properties

Spills to land:

- Biodegradable – readily decomposes in soil
 - Typically, greater than 80% degradation in 28 days*

Water:

- Biodegradable – readily decomposes in water at a similar rate to soil*
- Rapid biodegradation induces anaerobic conditions
 - Aquatic life may be harmed as micro-organism rapidly reproduce, reducing available Oxygen



*Source: [NBB Study](#) and [ASABE](#)

Environmental Properties

Additional hazards/concerns:

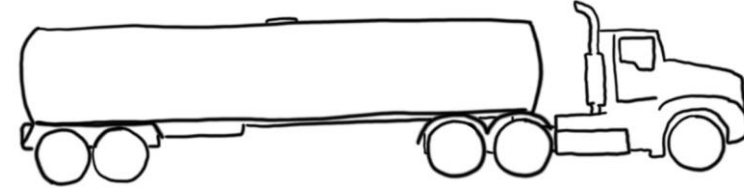
- **Spontaneous combustion** *(specific to saturated materials, like oily rags, oil dry, etc.)*
 - Saturated materials may be prone to autoignition under certain conditions
 - Caused by thermal decomposition of the oily material in the presence of oxygen
- **Preventative measures**
 - Reduce oxygen exposure
 - Prevent heat build-up
 - Apply water mist / fog - IF elevated temperature is detected



How Is It Transported?

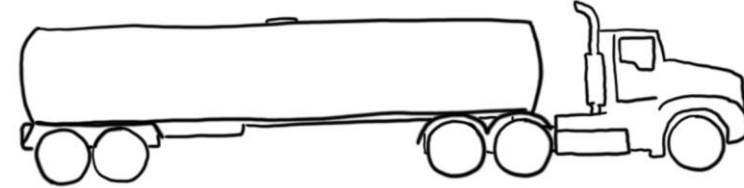
Three Primary Pathways

- Truck (*tanker, intermodal container, etc.*)

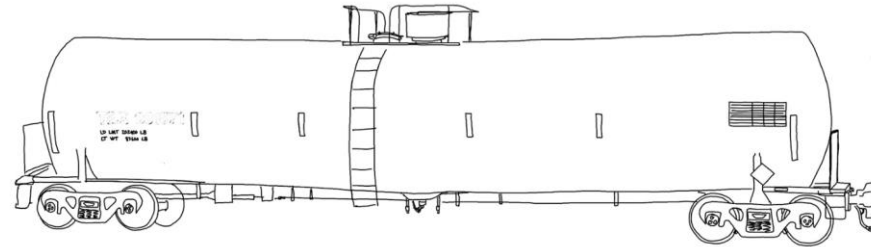


Three Primary Pathways

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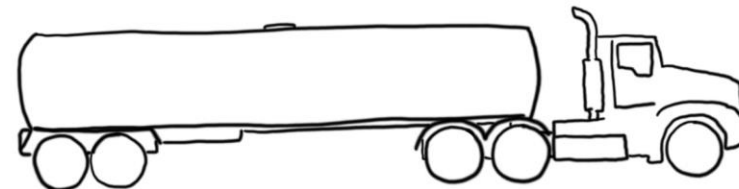


- Rail tank car

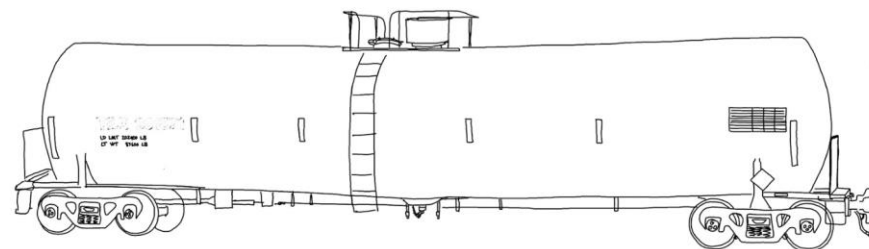


Three Primary Pathways

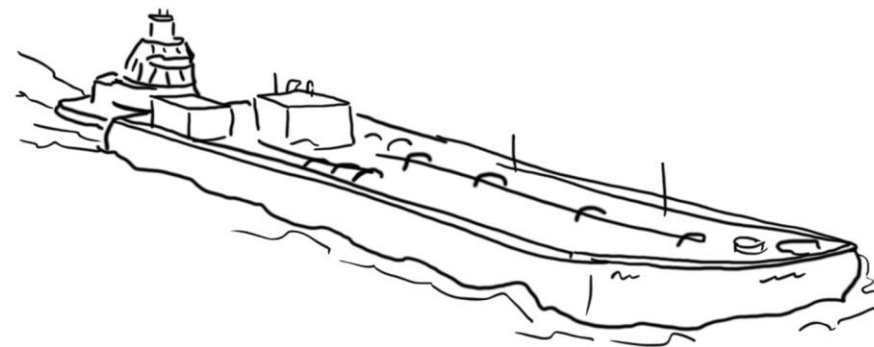
- Truck (*tanker, intermodal container, etc.*)



- Rail tank car



- Barge / Deepwater vessel



Thank You!

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