Renewable Fuels for the Diesel Market

9th ISCC Global Sustainability Conference
February 14, 2019

Safe Harbor Statement

This presentation contains certain forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995 as amended, including statements regarding the possible retroactive reinstatement of the BTC for 2018, the estimated benefits to 2018 Adjusted net income and Adjusted EBITDA if the BTC is retroactively reinstated, our expectations regarding fourth quarter results and the possible joint development of a renewable diesel plant with Phillips 66. These forward-looking statements are based on current expectations, estimates, assumptions and projections that are subject to change, and actual results may differ materially from the forward-looking statements. Factors that could cause actual results to differ materially include, but are not limited to, potential changes in governmental programs and policies requiring or encouraging the use of biofuels, including RFS2; availability of federal and state governmental tax incentives and incentives for biomass-based diesel production, including that the BTC may not be retroactively reinstated for 2018 or that it may be reinstated on less favorable terms; changes in the spread between biomass-based diesel prices and feedstock costs; the future price and volatility of feedstocks; the future price and volatility of petroleum and products derived from petroleum; risks associated with fire, explosions, leaks and other natural disasters at our facilities; the effect of excess capacity in the biomass- based diesel industry; unanticipated changes in the biomass-based diesel market from which we generate almost all of our revenues; seasonal fluctuations in our operating results; competition in the markets in which we operate; our dependence on sales to a single customer; technological advances or new methods of biomass-based diesel production or the development of energy alternatives to biomass-based diesel; our ability to successfully implement our acquisition strategy; our ability to generate revenue from the sale of renewable chemicals, fuels and other products on a commercial scale and at a competitive cost, and customer acceptance of the products produced; whether our Geismar biorefinery will be able to produce renewable diesel consistently or profitably; and other risks and uncertainties described in REG's annual report on Form 10-K for the year ended December 31, 2017.

All forward-looking statements are made as of the date of this presentation and REG does not undertake to update any forward-looking statements based on new developments or changes in our expectations.


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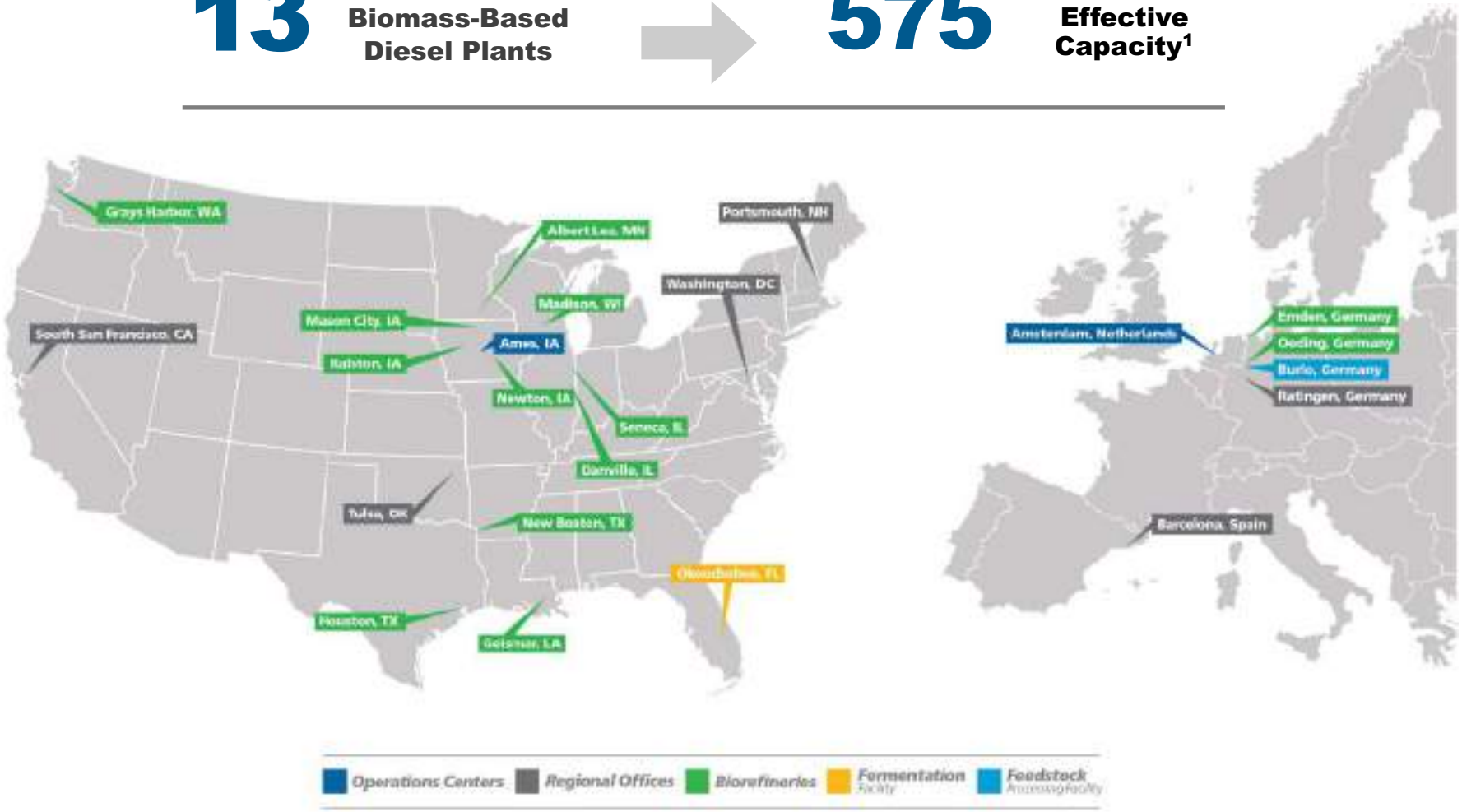
SUSTAINABLE ADVANCED BIOFUELS

REG converts waste oils, fats, and greases into high quality renewable fuels and chemicals to meet growing global demand for cleaner products

Nr. 1 in biomass-based diesel in North-America & leader in waste biodiesel in Continental Europe

13 Biomass-Based Diesel Plants → **575** MMGY Effective Capacity[1]



Note: 1. Effective capacity for 2017 - Represents the maximum average throughput that satisfies certain defined technical constraints

Source: REG Analysis

Production Network

13
Biomass-Based Diesel Plants

575
MMGY
EFFECTIVE CAPACITY

Crude Feedstock Capable


Albert Lea, MN


Danville, IL


Emden, Germany


Geismar, LA


Madison, WI


Mason City, IA


New Boston, TX


Newton, IA


Oeding, Germany


Seneca, IL

Refined Feedstock


Grays Harbor, WA


Houston, TX


Ralston, IA

Fermentation Facility

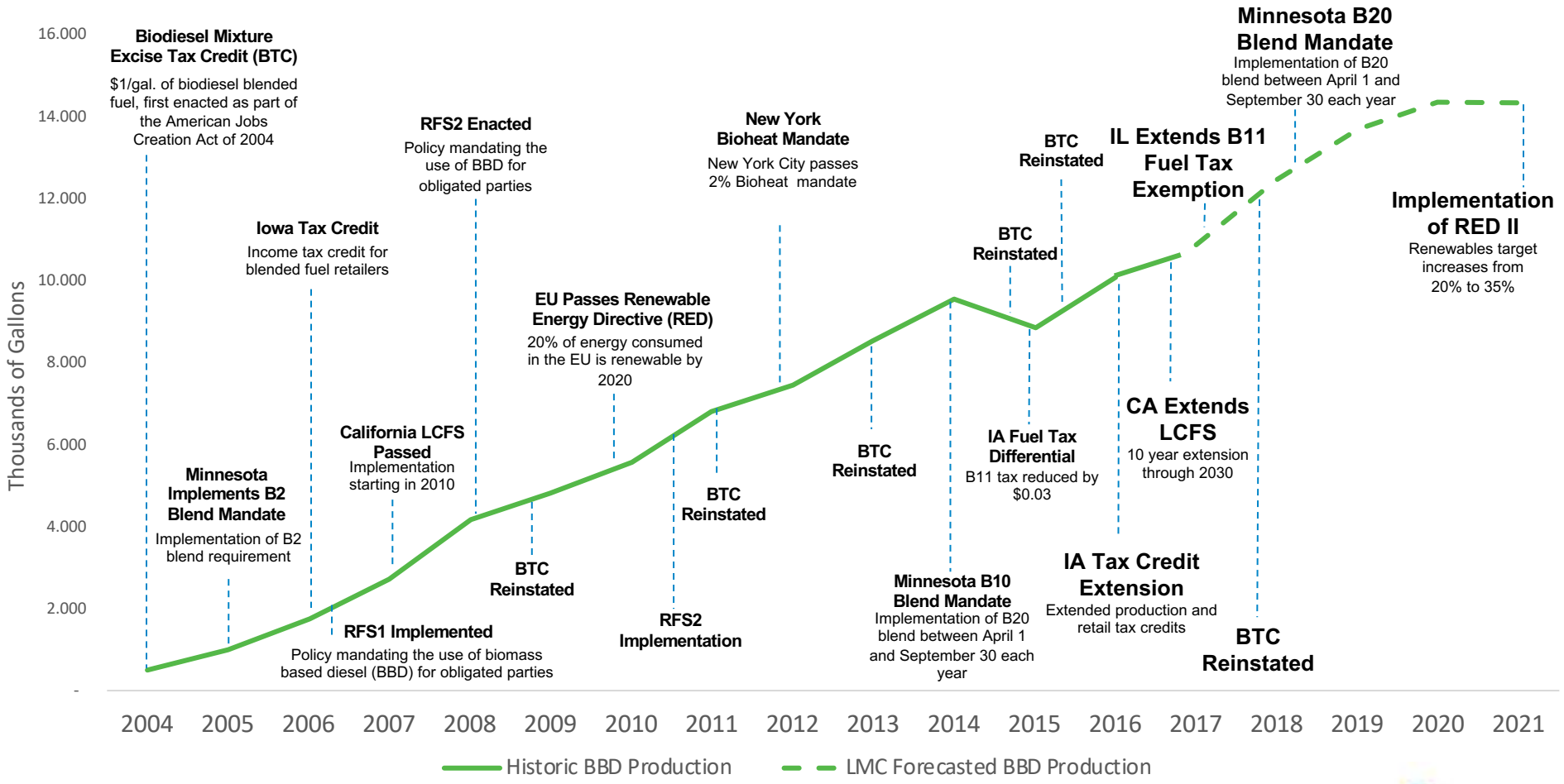

Okeechobee, FL

Feedstock Proc. Facility


Burlo, Germany

World Demands Cleaner Fuel Solutions

Historic and Forecasted Global BBD Production

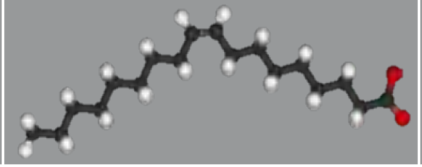
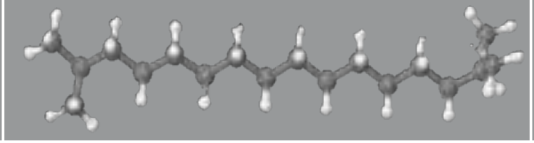
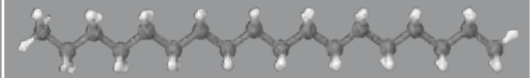


Source: LMC International, National Biodiesel Board

Biomass-based diesel basics

- Biodiesel: Fatty acid methyl esters, produced from reacting fats and oils with methanol
- Renewable Diesel (HVO): Hydrocarbon-only diesel fuel made by processing fats & oils through hydrotreating and isomerization
- Co-Processed Renewable Diesel: Is a partially renewable diesel fuel created when fats, oils, or other renewable biomass is processed together with petroleum in the same process unit or refinery.

Comparison of Critical Properties

	Biodiesel	Stand-Alone HVO	Co-Processed HVO
			
Cloud Point of neat fuel	1 – 8 °C	-10 – -14 °C	25 – 30 °C
GHG Reduction compared to petro diesel	88%	87%	?

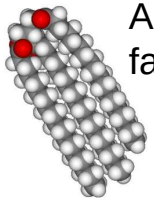
- Biodiesel has higher GHG savings & is cheaper
- HVO has better winter performance & allows higher blends

Biomass-based Diesel Overview

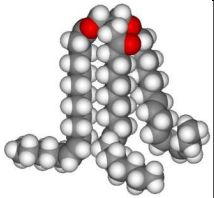
Renewable Diesel and Biodiesel

Feedstock	Process	Product	Specification

Both processes can utilize any fat or oil.



Animal fat



Vegetable Oil

Renewable Diesel

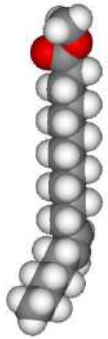
- React with hydrogen (hydrotreat & isomerize)
- Convert 3-carbon backbone to renewable propane
- Convert oxygen to H_2O

Paraffin

- **Meets the diesel spec, EN 590**
- Molecules are familiar constituents of ULSD (petroleum diesel)
- Paraffinic fuel

Biodiesel

- React with methanol (transesterification)
- Convert 3-carbon backbone to glycerol
- Oxygen remains in fuel molecule



FAME

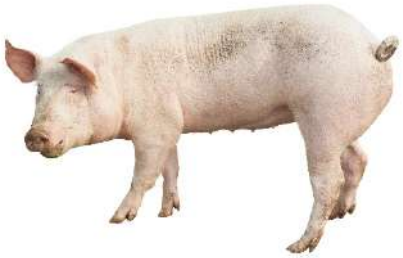
- **Meets the biodiesel spec, EN 14214**
- Different molecules than those in petroleum diesel
- Oxygenated fuel

Biomass-based diesel feedstocks

Soybean Oil

Distillers Corn Oil

Beef Tallow



Choice White Grease

Used Cooking Oil

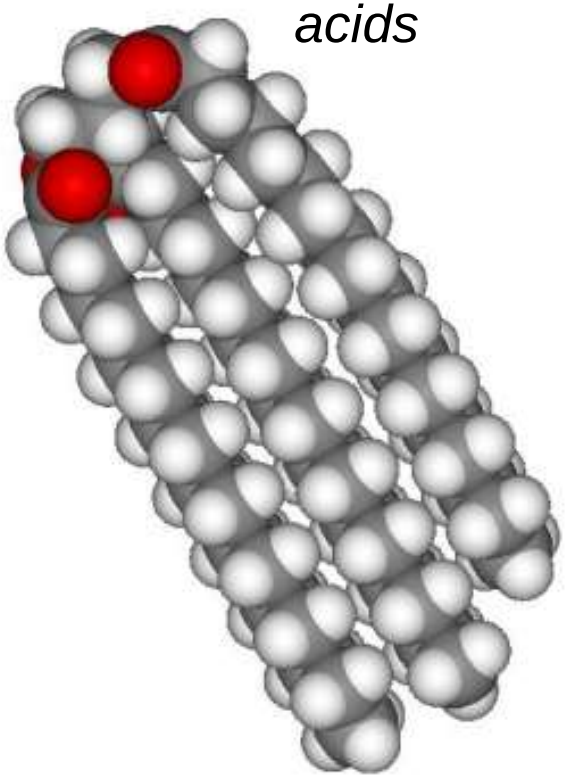
Algae Oil

Rapeseed Oil

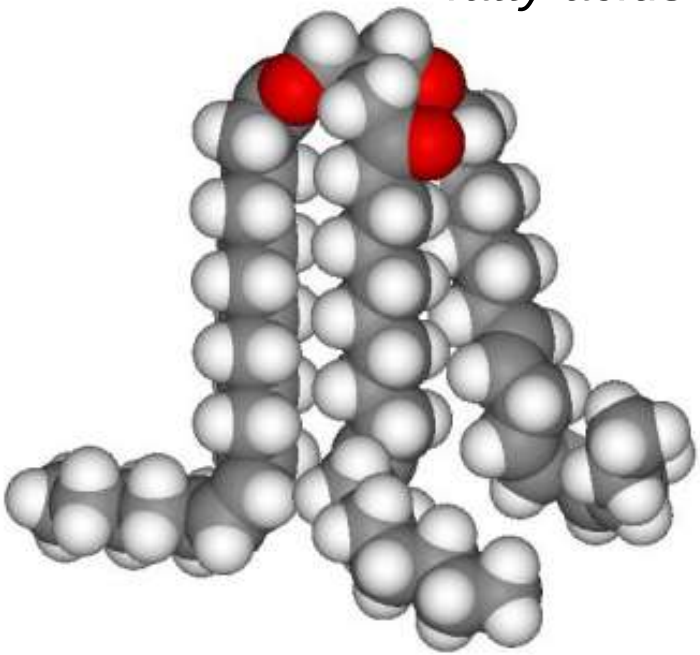
Carinata Oil

Biomass-based diesel feedstocks

Triglyceride with 3 saturated fatty acids

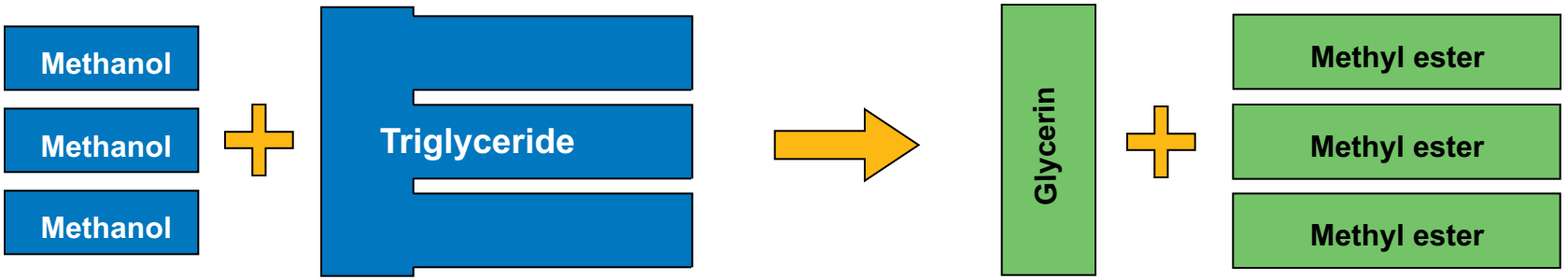


Triglyceride with 3 unsaturated fatty acids



What is Biodiesel?

- Biodiesel is methyl esters made from biological oils and fats (triglycerides) by transesterification

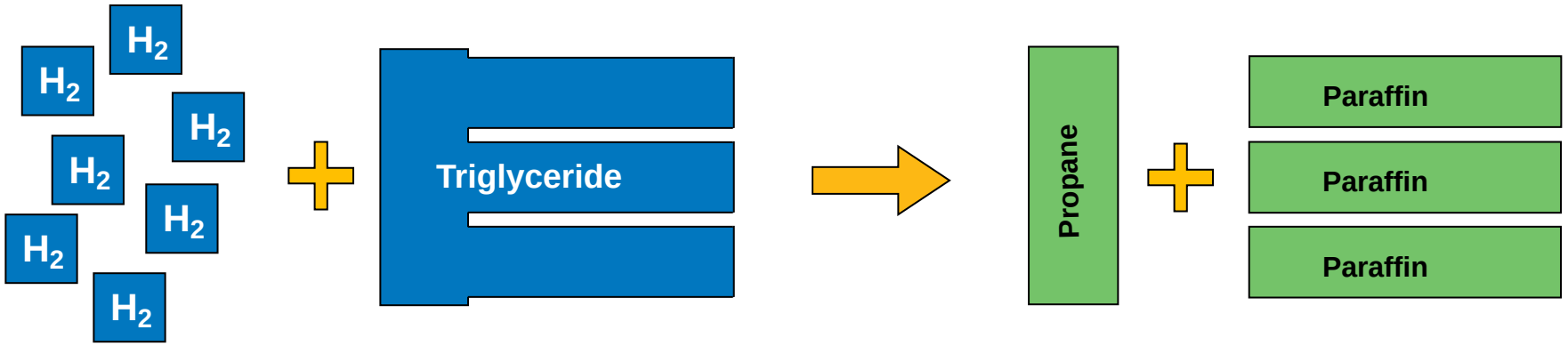


Raw materials *Products*

Transesterification reaction

What is Renewable Diesel?

- Renewable Diesel is hydrocarbons made from biological oils and fats (triglycerides) by hydrotreating

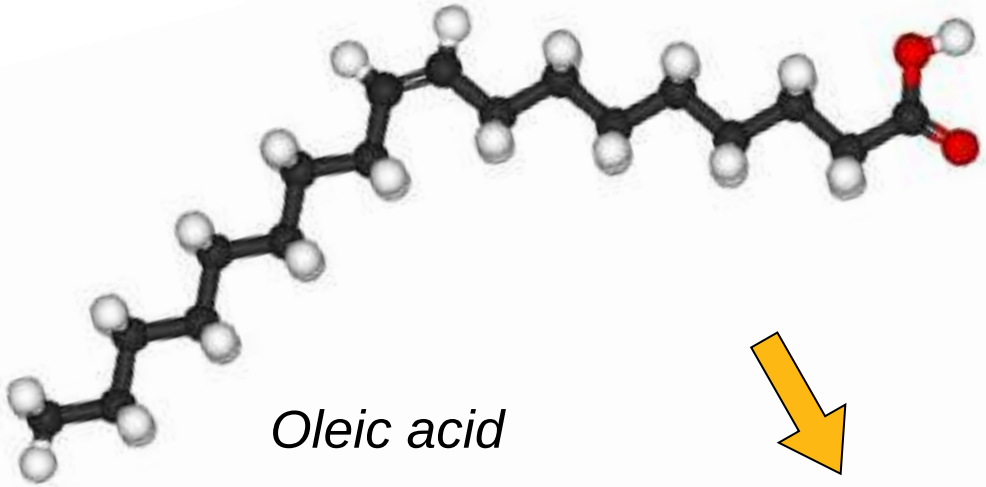


Raw materials *Products*

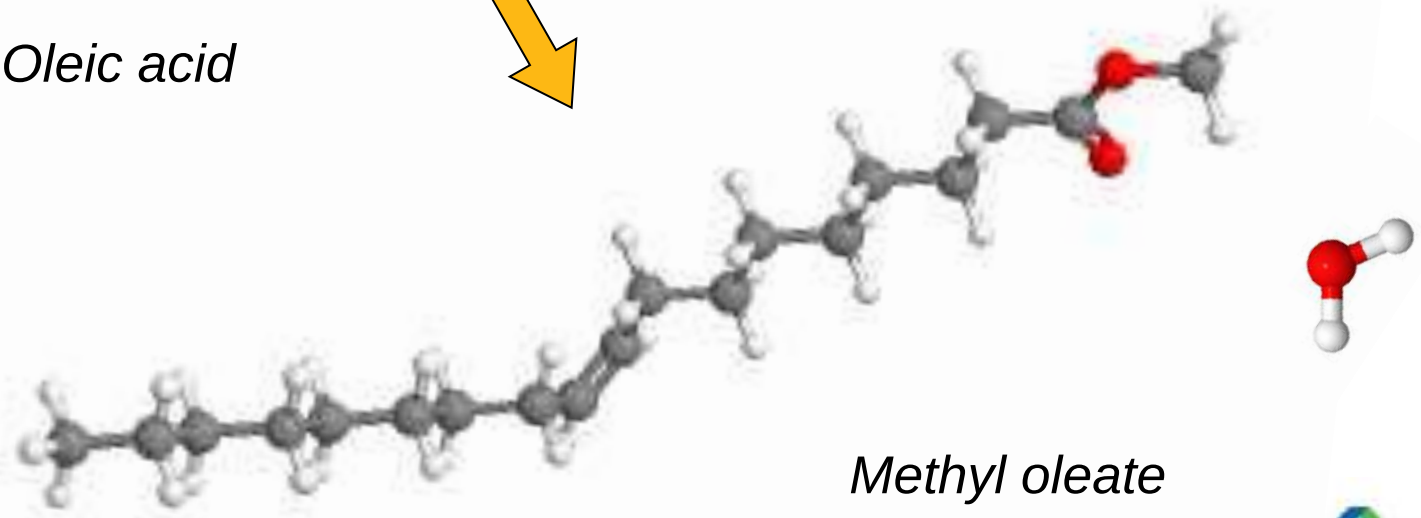
Hydrotreating reaction

Biodiesel example

Oleic acid to methyl oleate



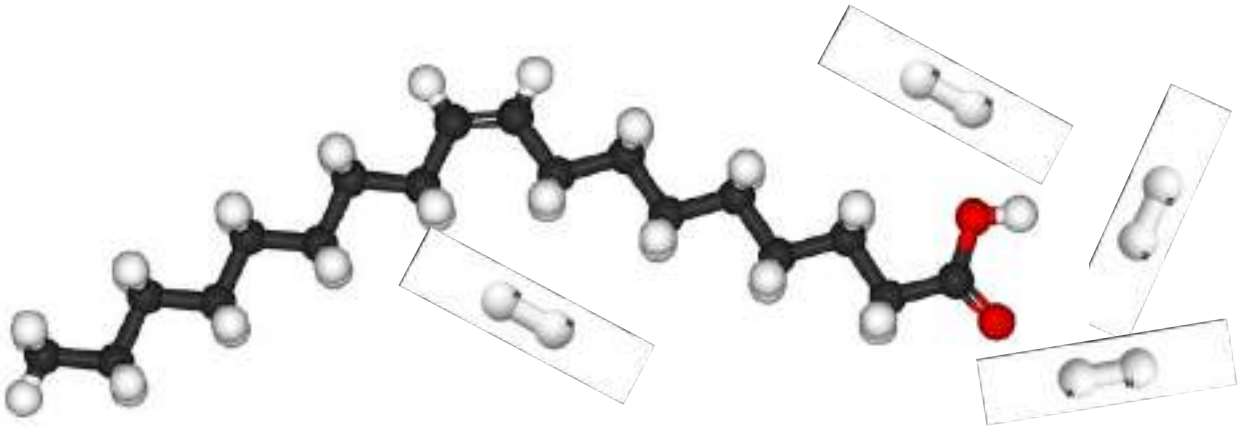
Oleic acid



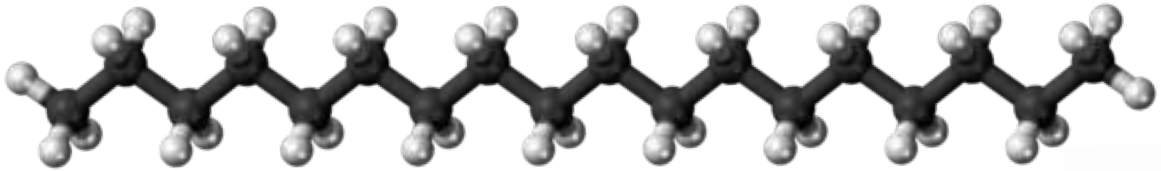
Methyl oleate

Hydrotreating example

Oleic acid to C18 n-paraffin



Oleic acid

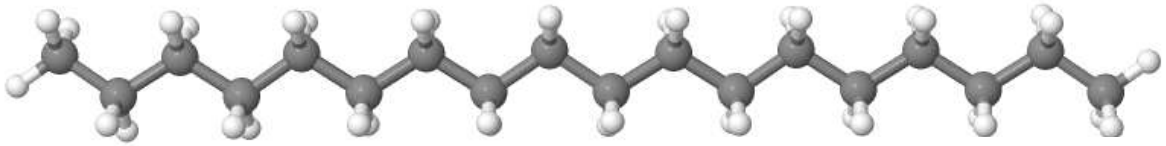


C18 n-paraffin

Isomerization example

Isomerization dramatically reduces melting point

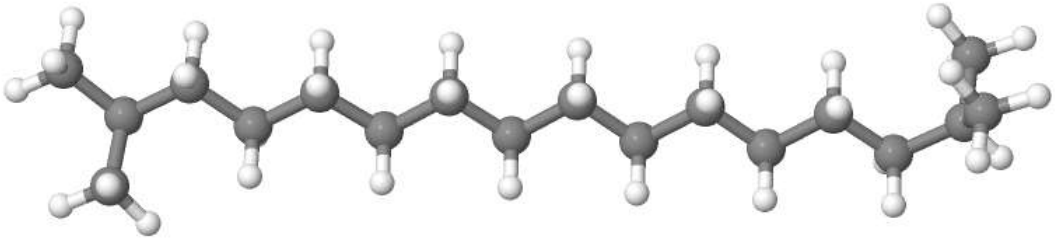
C18 n-paraffin ($C_{18}H_{38}$)



Melting point > 28 °C

C18 isoparaffin ($C_{18}H_{38}$)

Melting point < -7 °C



HVO production samples

- Left: Crude Feedstock
  - Middle: Hydrocarbons after hydrotreating
    - Right: Finished (isomerized) HVO

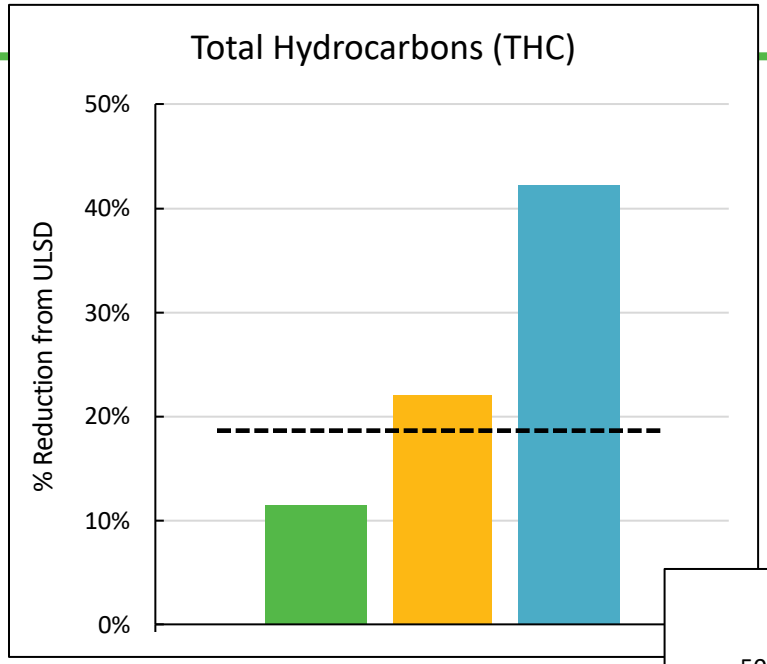
Benefits of HVO (Renewable Diesel)

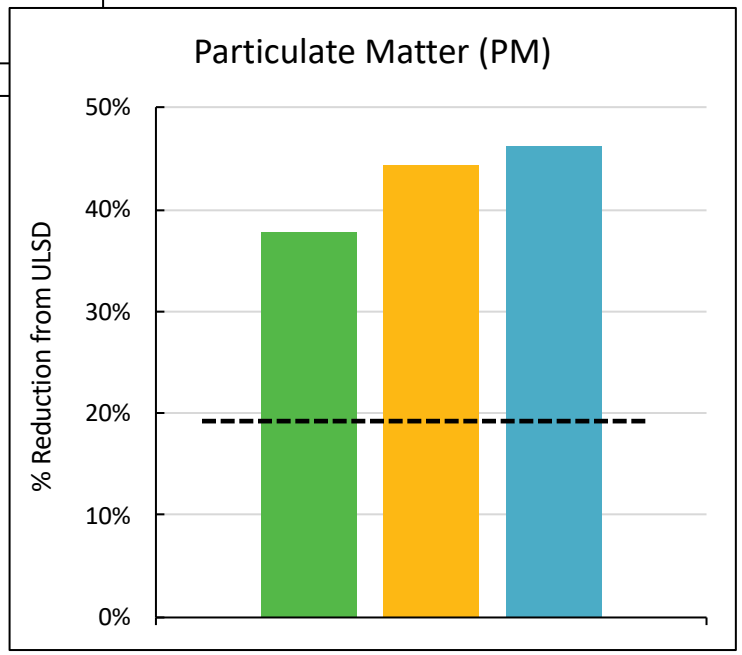
- Paraffinic fuel, which means:
  - Exceptional Cetane number
    - Greater than 65 (EU diesel specification requirement is 51)
    - Cetane number is an indicator of combustion quality
  - Reduced tailpipe emissions
    - In particular, NOx and carbon monoxide
    - Also particulate matter and total hydrocarbons
    - Virtually no sulfur
- Desirable Cloud Point
  - Cloud Point ranges from -10 °C to -20 °C
  - Winter pipeline specs for diesel are around -10 °C
- Can be blended at any level with diesel and biodiesel
  - Some users consider a 50% maximum (elastomer compatibility)

Benefits of Biodiesel

- Oxygenated fuel, which means:
  - Reduced tailpipe emissions
    - Sulfur, carbon monoxide, hydrocarbons and particulates
    - Burn fuel instead of losing it out the exhaust
  - Enhanced lubricity
    - Excellent for ULSD and HVO (Renewable Diesel)
    - No lubricity additives needed with B2 or higher blends
- Comparable to vegetable oil for transport & handling requirements
- Can be blended at high level with diesel and HVO (Renewable Diesel)
  - 20% is a common maximum for general purpose use
  - Higher quality biodiesel performs better with HVO (Renewable Diesel) (CSFBT test)

Biomass-based diesel emissions





R100 (HVO)

B20/R80

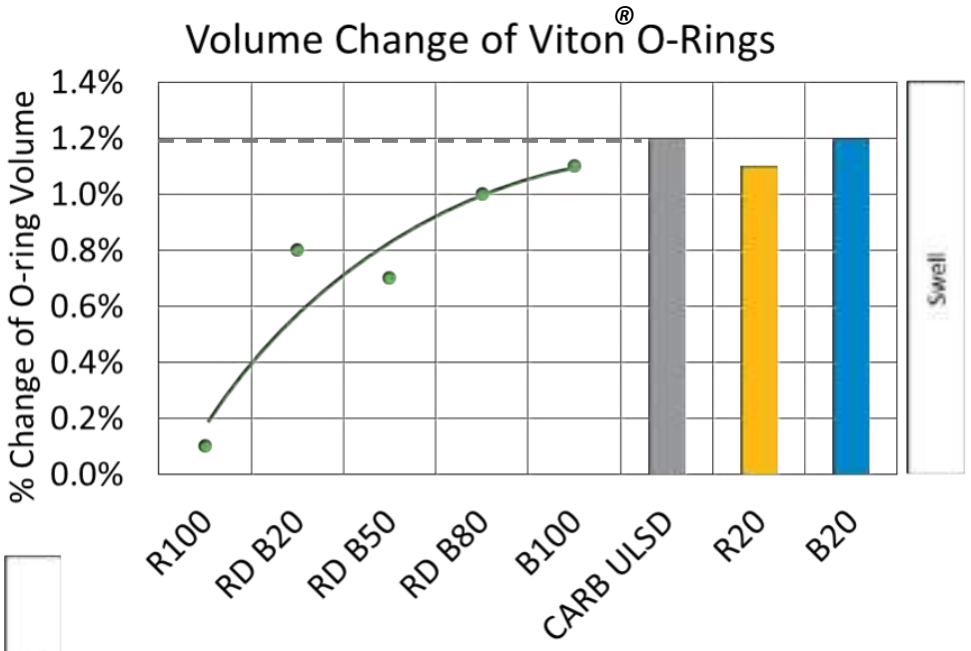
B50/R50

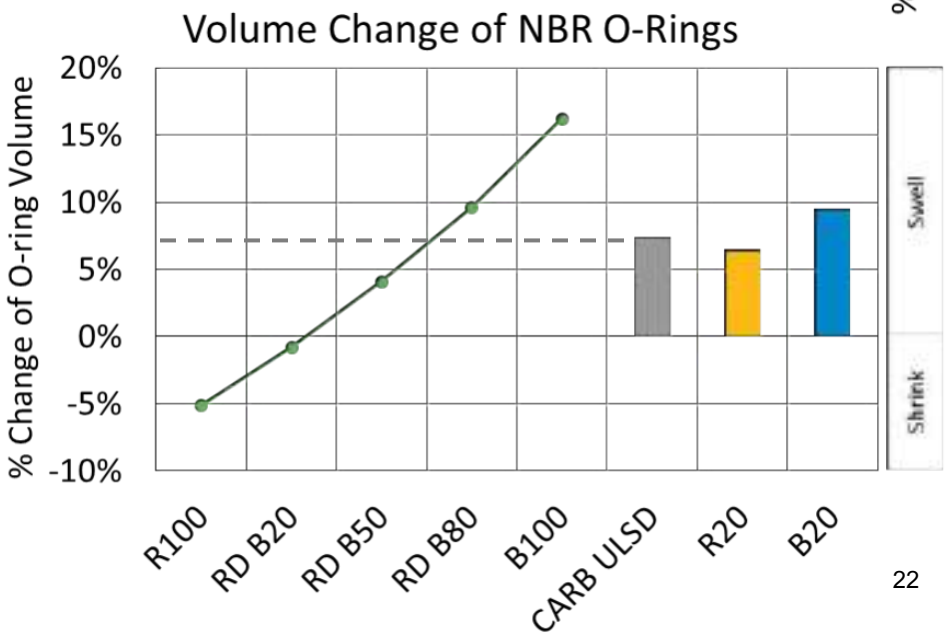
B20/R20 (60% ULSD)

Note: *Emissions estimates are derived from data for a 2006 Cummins ISM 370 on Federal Test Procedure driving cycle, as reported in Durbin, Thomas D., et al. "CARB Assessment of the Emissions from the Use of Biodiesel as a Motor Vehicle Fuel in California "Biodiesel Characterization and NOx Mitigation Study"." California Air Resources Board: Sacramento, CA (2011). Comparisons with Federal ULSD were conducted based on a linear comparison with CARB ULSD data. All biodiesel data shown are taken as an average of the means of high and low cetane biodiesel emissions results, where available.*

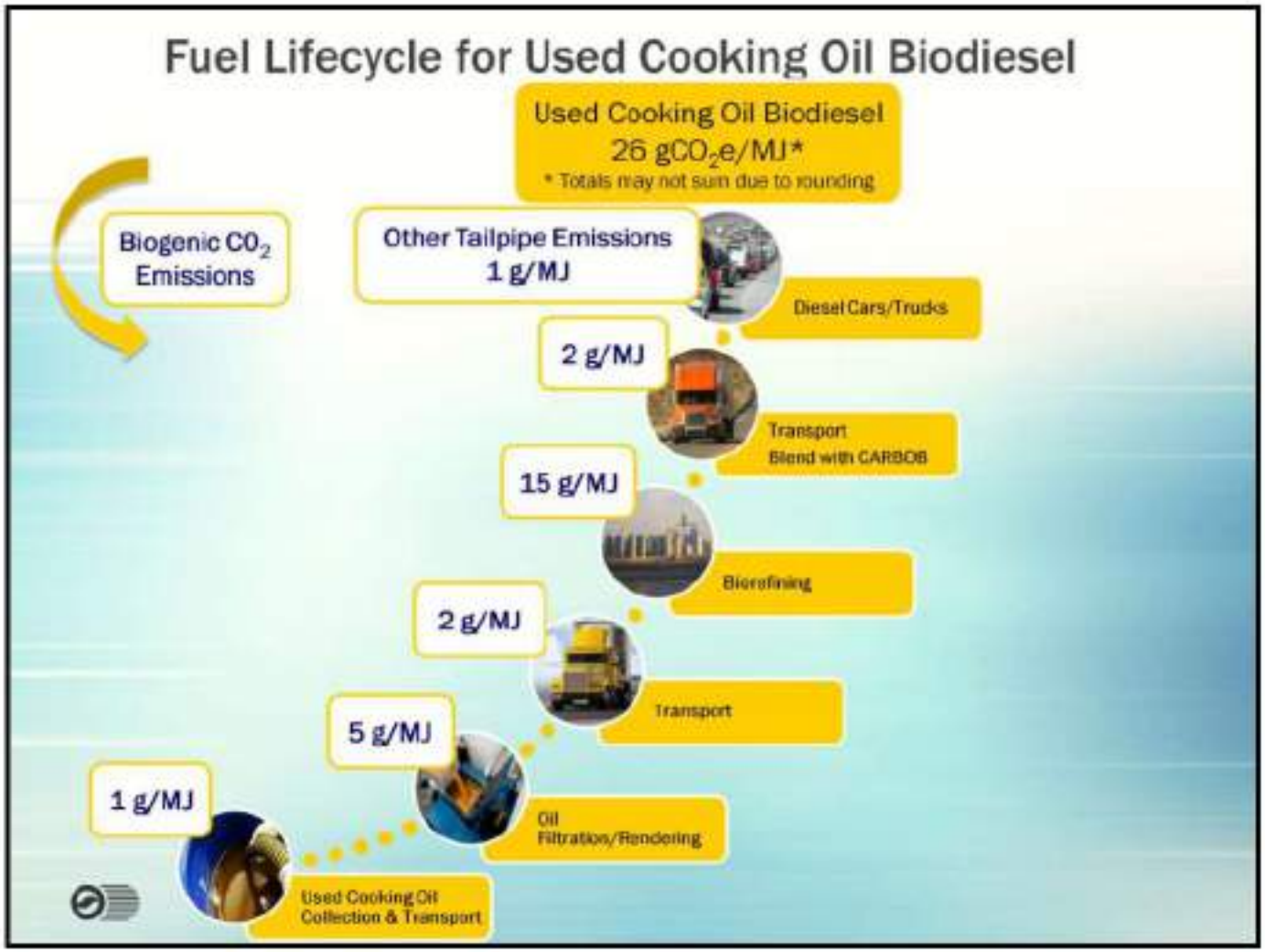
Elastomer impact of diesel fuel options

- Volume change results indicate the extent of swell that occurs when an elastomer seal is exposed to fuel
- Volume change is a critical property for predicting seal performance in an engine
- Viton® seals (or equivalent) are typical for modern engines, while older engines often have NBR (nitrile rubber) seals





California Lifecycle Analysis Example



Notes: Numbers are for illustrative purposes only
Source: California Air Resources Board

GHG Values in Annex V

waste ⇨ cooking ⇦ ~~vegetable or animal~~* oil biodiesel	~~88~~ ⇨ 83 ⇦ %	~~83~~ ⇨ 77 ⇦ %
⇨ animal fats from rendering biodiesel ⇦	⇨ 79% ⇦	⇨ 72 % ⇦

- **Final values**:
  - **Waste cooking oil: 88% / 84%**
  - **Animal fats: 84% / 78%**
- 1% above UCO and Animal fats based HVO (even higher in real world)

➔ **WASTE BIODIESEL**
- SAVES MORE GHG
- IS CHEAPER