

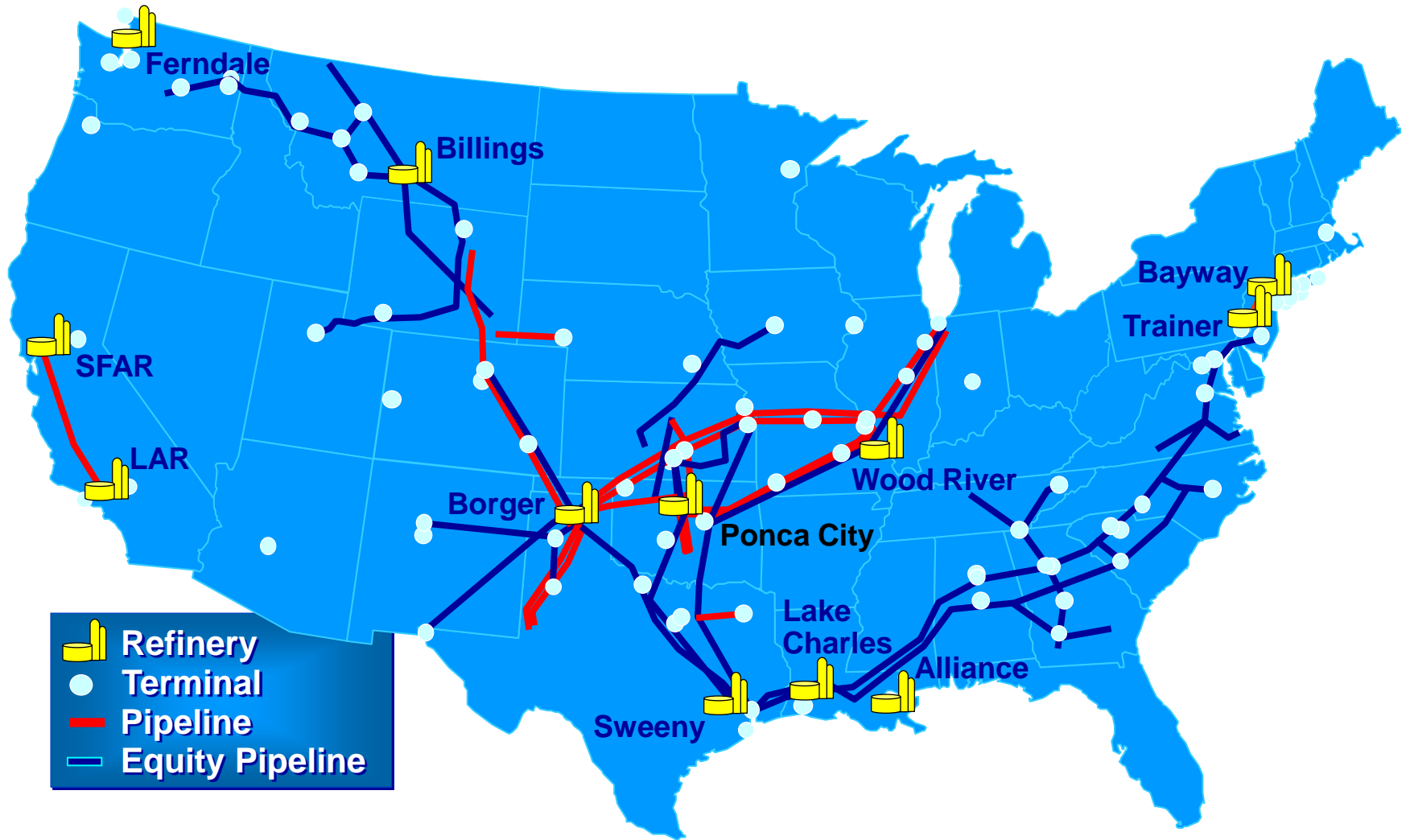
Evolution of Fuels to Biofuels

April, 2010

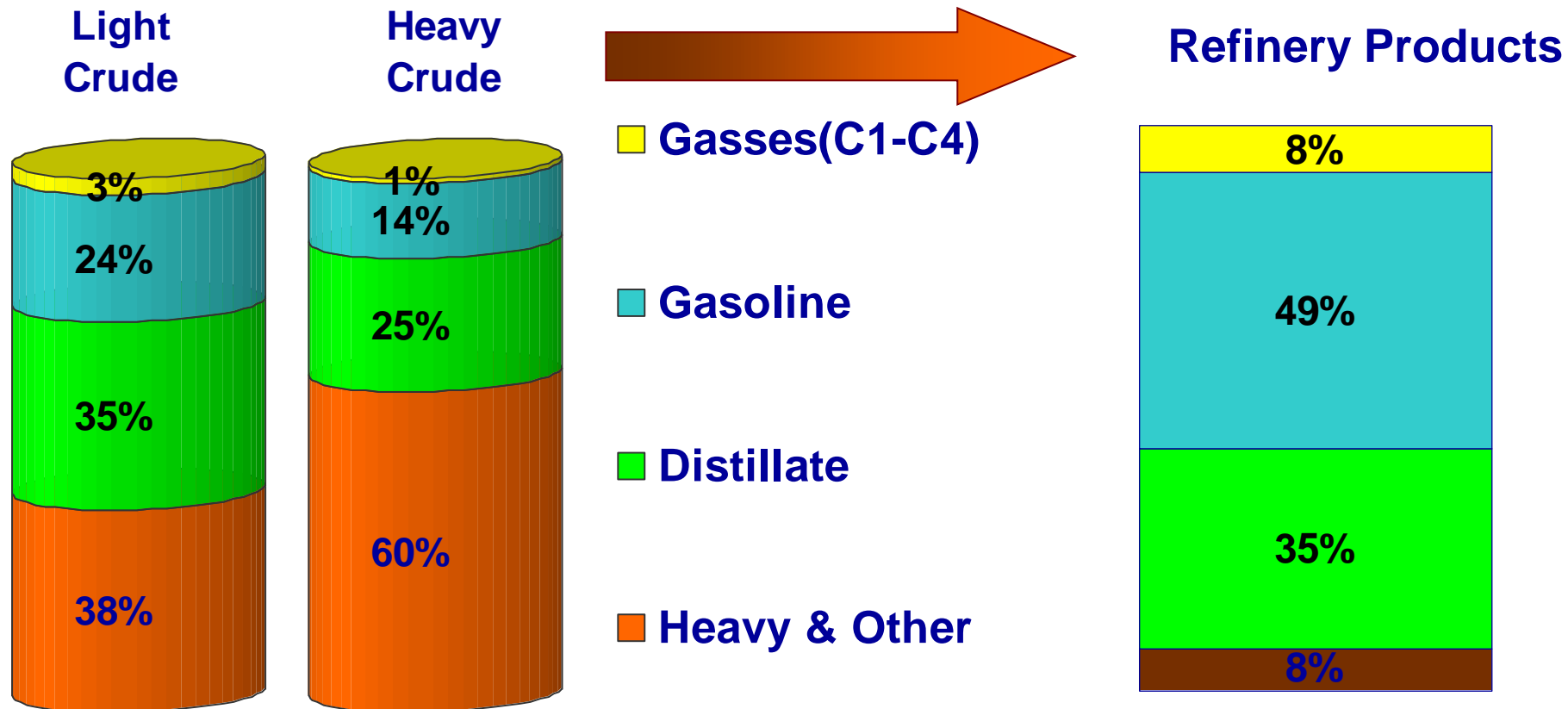
ConocoPhillips



Size: Huge (US >250 billion gallons per year)



Technology: Mature and Viable



Source: EIA (2004 U.S. Yields)

Fuel Specifications

■ Combustion

- Octane

■ Volatility

- Boiling Points Curves

■ Emissions

■ Storage

- Oxidation Stability
- Corrosion

Today

	<u>Current</u>	<u>Biofuels</u>
Size	Huge	Small
Technology	Mature, Viable	New
Product	Fungible	?????

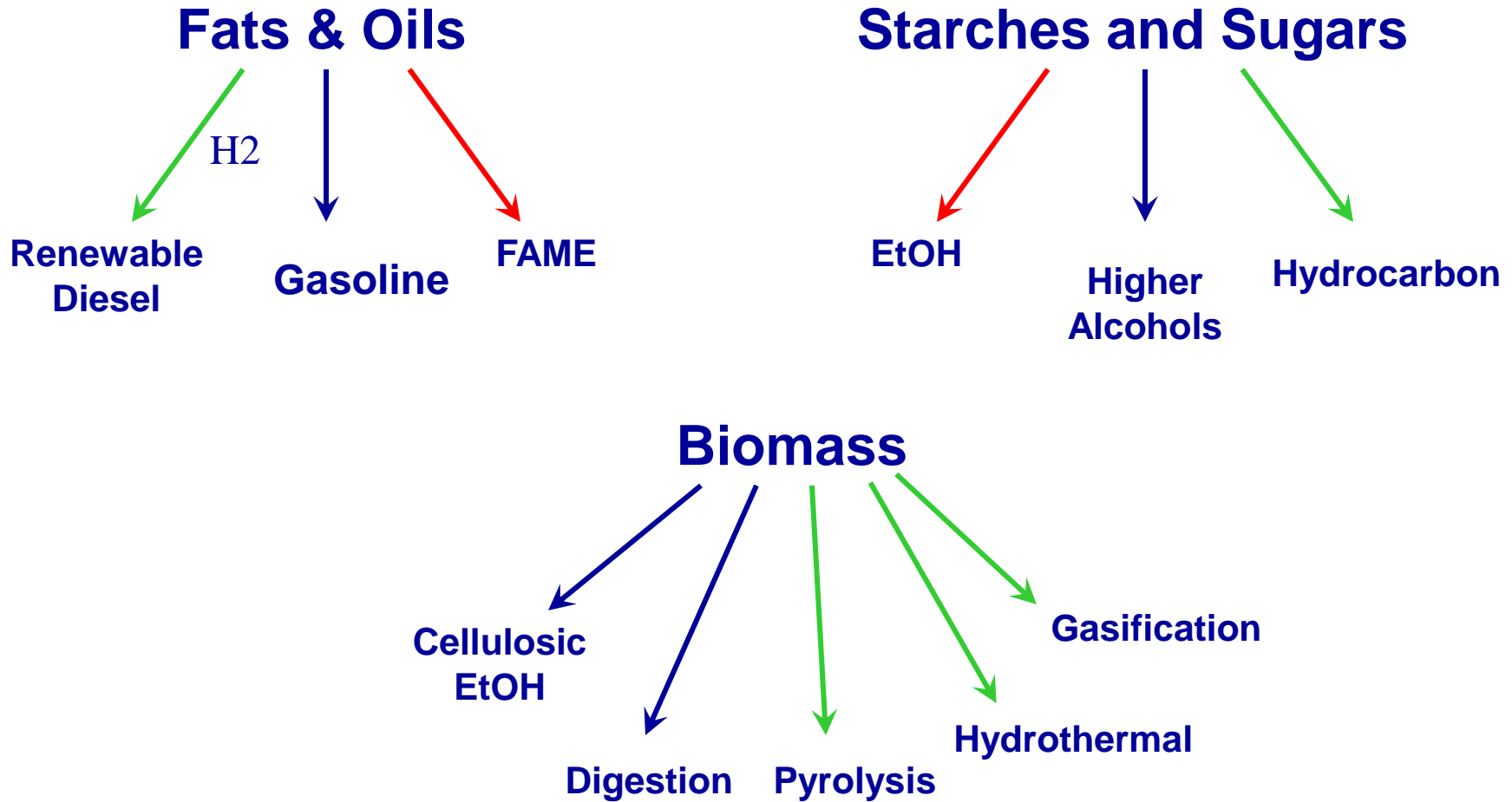
Change will be slow

Evolutionary

not revolutionary

Size: Small to Huge

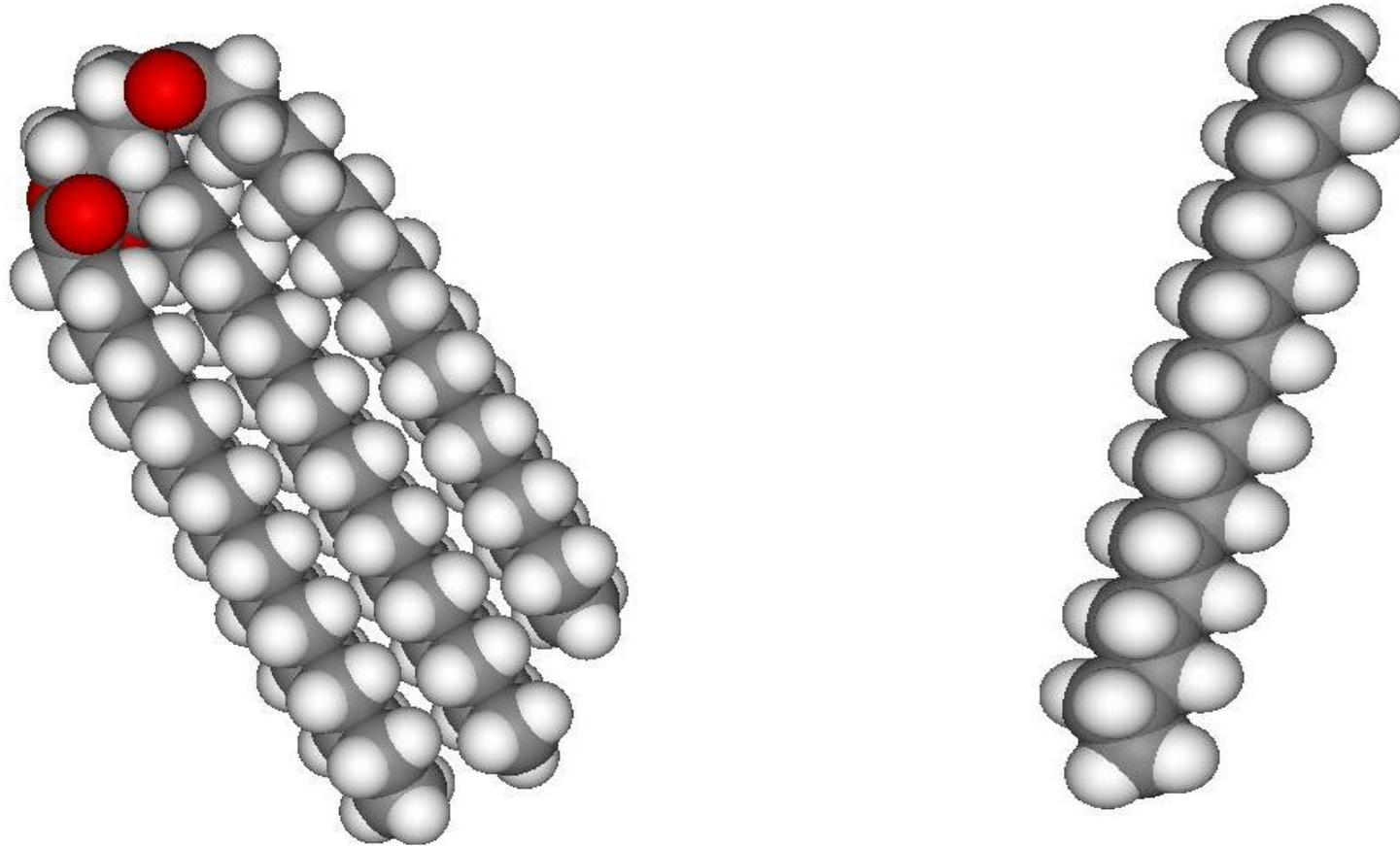
Biofuel Pathways



How much biofuel can be made?

Technology: New to Viable

Renewable Diesel

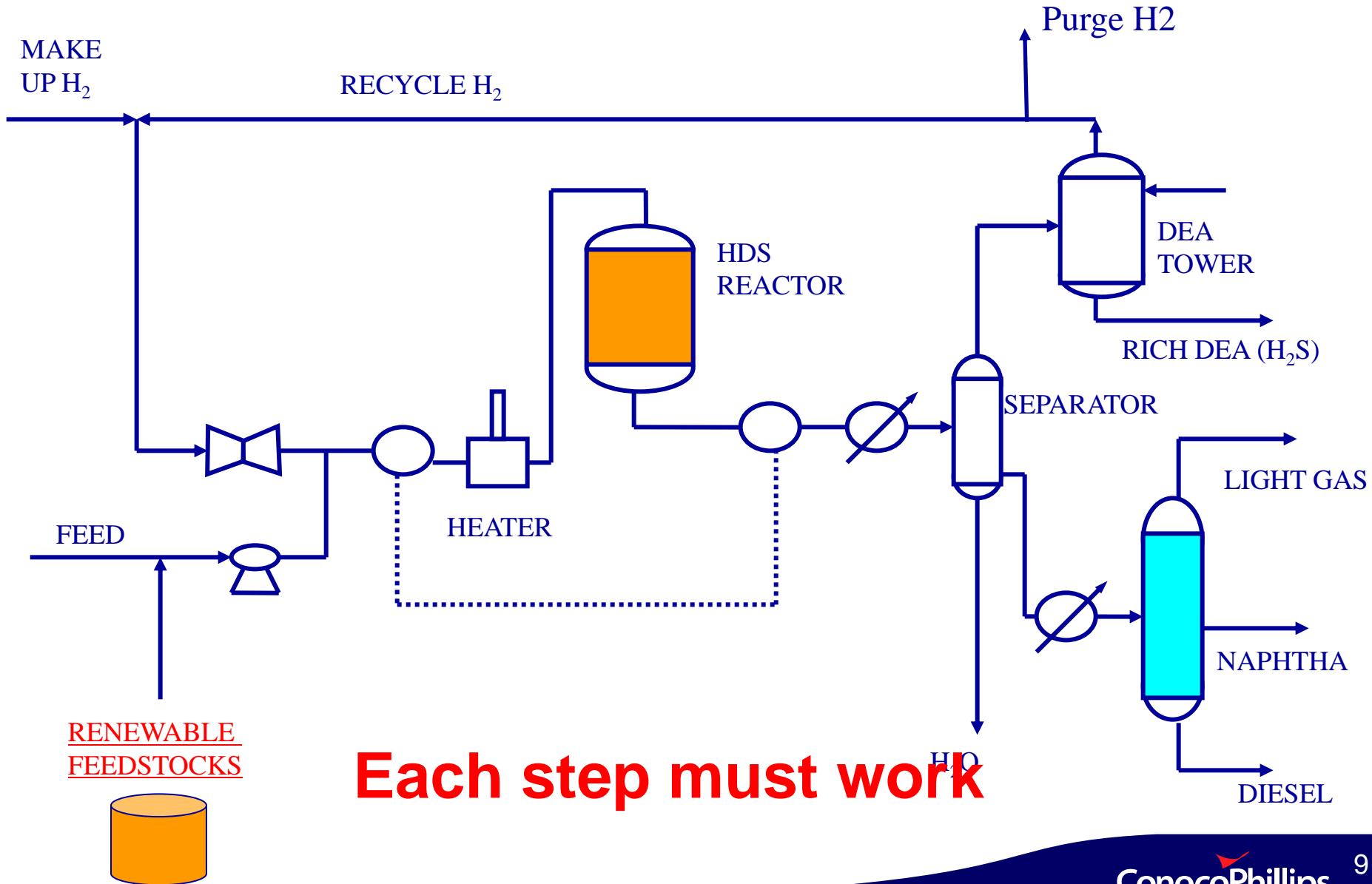


What does it take to be viable?

Refinery Diesel Hydrotreater



HYDROTREATING



Each step must work

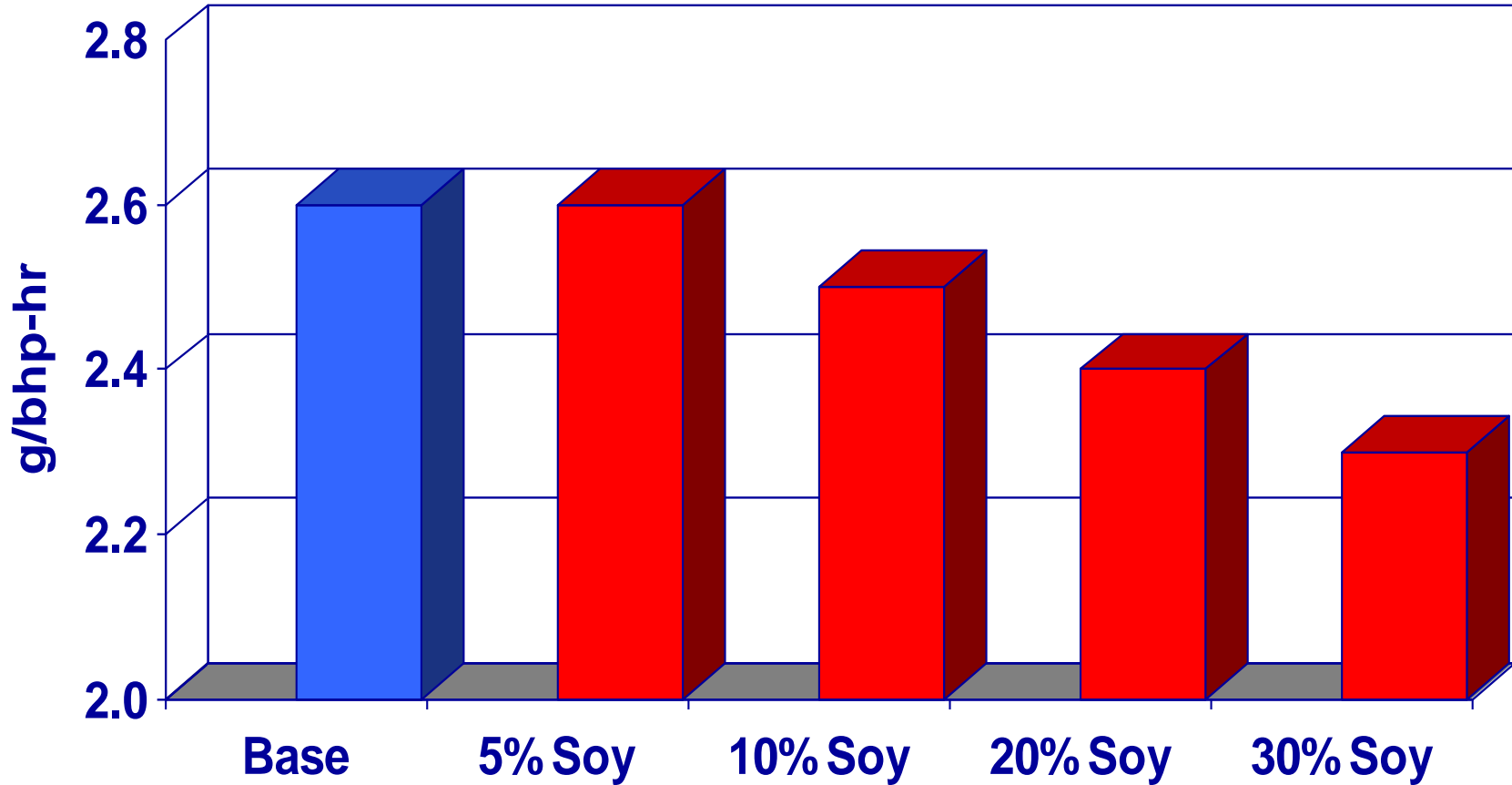
Renewable Diesel

Effect on Fuel Specs

Property	ASTM D975	Base Fuel	10% Ren Content	30% Ren Content
Flash Point	≥126°F	152	146	133
Visc. (mm ² /s)	1.9-4.1	2.3	2.4	2.4
Sulfur (ppm)	15 max	5	6	5
Cetane number	40 min.	41.2	47.4	54.2
Lubricity	520μ max.	591	603	586
Cloud Point, F	Seasonal/Regional	-9	8	17
Pour Point, F	Seasonal/Regional	-24	0	9

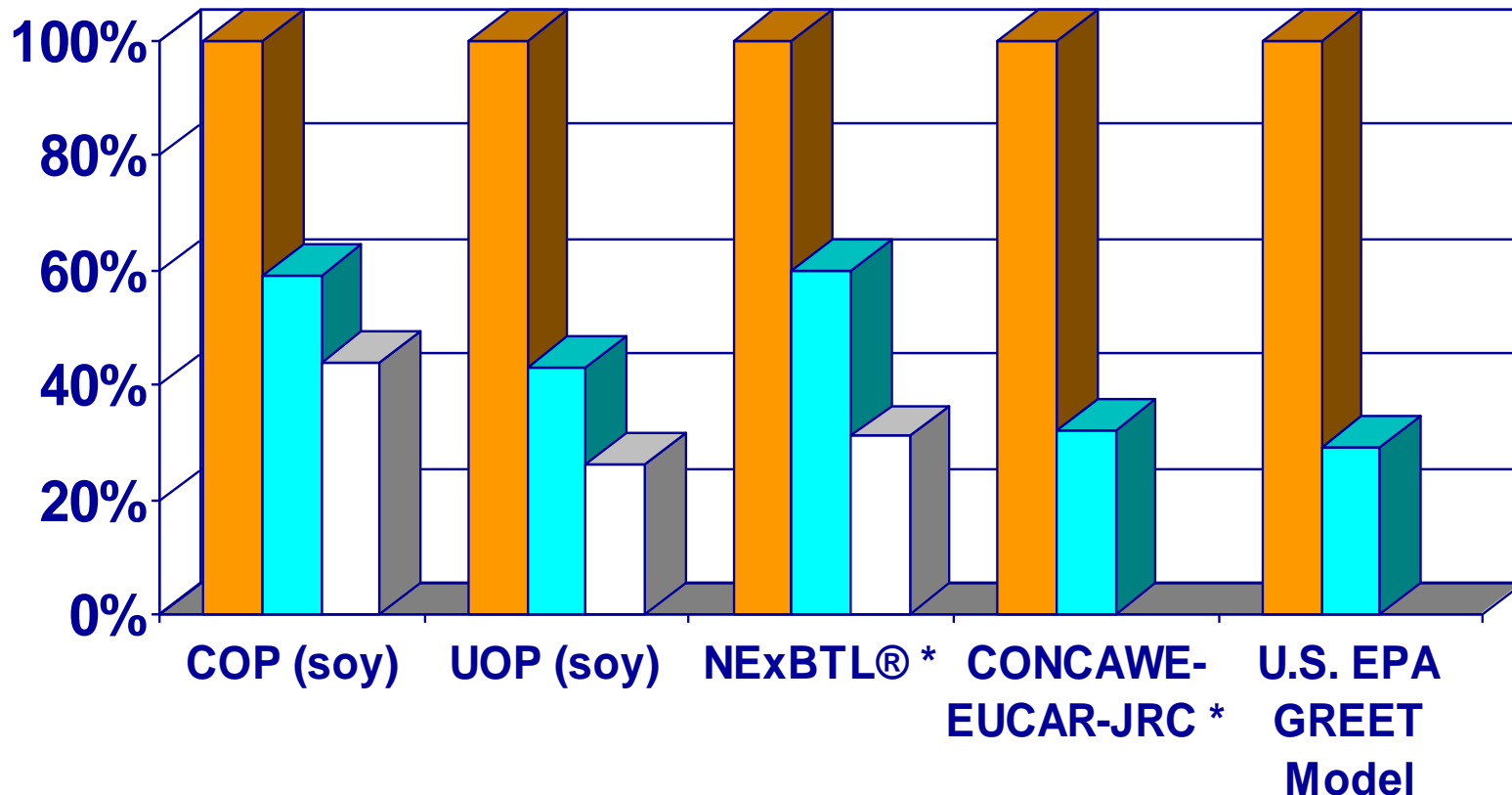
Renewable Diesel

Effect on NOx



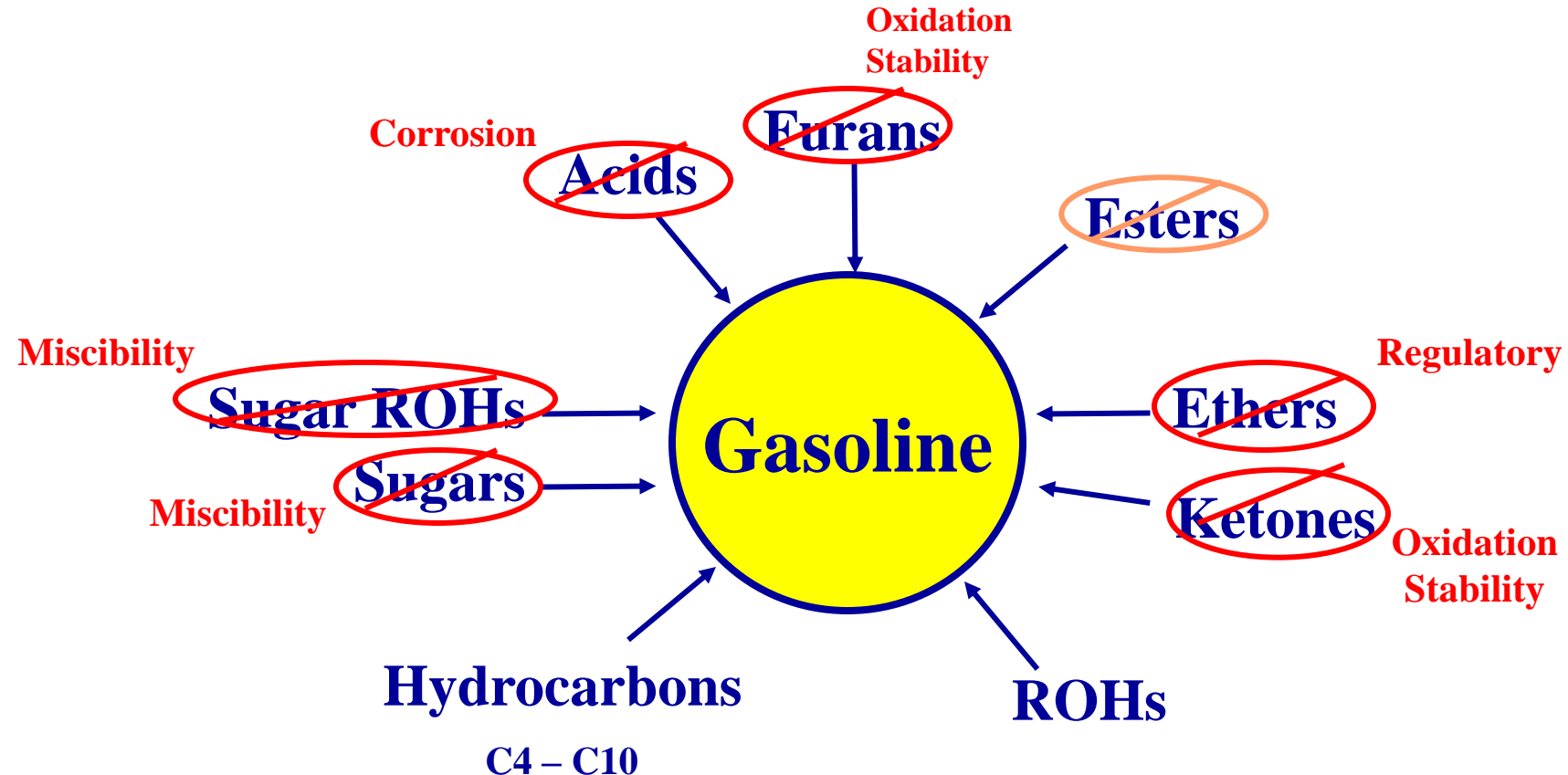
Renewable Diesel

Life Cycle – Relative CO2 Production



■ Petroleum Diesel ■ Biodiesel, B100 □ Co-processed Renewable Diesel, R100eq

Product: ???? To Fungible



What oxygenates are fungible with gasoline?

Biofuels At COP

- **Size: Huge**
- **Technology: Minimize new**
- **Products: Hydrocarbons**