2018 Glycerine Structural Shift

ICIS Pan American Conference

October 2018
AGENDA

- Introduction

- Glycerine Sources
  - Oleochemicals
    - Fatty Acids
    - Soap
    - Methyl Esters

- Structural Shift, Glycerine from Biodiesel
  - Regional
  - Technology
  - Trade Flows

- US Glycerine Supply-Demand Balance

- Refined Demand
  - By Region, Focus on Americas
  - By Application
    - Traditional
    - Substitution
  - China Impact

- Regional Price Trends
Global Glycerine Supply

Palm

Soy

Rapeseed

Canola

Tallow
Natural Glycerine
Supply Side Drivers

Crushers/Refiners
Renderers

Fats/Oils Triglycerides

NaOH/H₂O

Soap

O

RC — O Na⁺

H₂O

Fatty Acid

O

RC — OH

CH₃OH

Methyl Esters

RCH₂OCH₃

CH₂O

O

R₂C — OCH₃

R₃C — OCH₂

O

R₁C — OCH₂

O

Glycerine

• Cost Fats & Oils
• Price Diesel
• Legislation Policies

• Demand for Oleochemicals/Soap
• Regional Refining Capacity

R= Alkyl (C8 – C20)
Historical US Market Price, Refined Glycerine

US supply – Inventories are balanced

Source: Oleoline Delivered (Ave)
Ave Freight = 6 cents
Global Crude Glycerine
Supply by Industry, 2018F

3.8 mil MT, 8.4 bil Lb

Source: LMC 2018 Glycerine Report, IHS, Oleoline
The primary growing source of glycerine going forward will come from oleochemicals to support rapid demand growth in Asia (China and India).

Total crude glycerine supply by end 2018 ≈ 8.4 billion pounds

Source: Oleoline; IHS; Frost & Sullivan; LMC; Market Knowledge
Global Biodiesel Consumption

2018F, 24.7 Million MT, 54.55 Bil Lb

Source: Oleoline; IHS; Frost & Sullivan; LMC; Market Knowledge

Europe and US consume ≈ 80%
Europe, Malaysia, Argentina, Indonesia all chasing the same EU Market share.
Global Crude Glycerine Supply 2018F

3.8 mil MT, 8.4 bil Lb

Glycerine Production by Industry

Global Crude Glycerine Supply

Source: Oleoline; IHS; LMC; Market Knowledge
Crude Glycerine from Biodiesel by Region

Brazil and US produce BBD to fulfill domestic mandates.
Argentina and SE Asia produce primarily for export.
[Biodiesel exports from Argentina: uncertain pending EU AS Ruling]

Source: Oleoline; IHS; LMC; Market Knowledge
BBD = Biomass Based Diesel; AS = Antisubsidy
Glycerine Market

Structural Shifts: Technology
Europe and Americas
US Biomass Based Diesel

- 2.6 bil gal produced 2017 (US and Import)
- 2.1 bil gal mandate; limiting Q1 production.
- Tax credit retroactive 2017; no 2018 BTC.

- US market matures and stabilizes
- Mandates: 2.1 bil gallons 2017, 2018, 2019
- Import tariffs protect producers through 2022
- ≈ 21% US BD/RD is imported.

Source: FAPRI 2018 Longterm Projections, EPA RFS, EIA

FAPRI (Food and Agricultural Policy Research Institute) March 2018; Source: USDA GAIN; EPA; EIA
EIA (Energy Information Administration); USITC (US International Trade Commission); Market Knowledge; BTC = Blenders Tax Credit.
The trans-esterification (methyl ester) process yields crude glycerine.

The growth in popularity of Renewable Diesel/HVO and co-processing could mean a reduction in glycerine supply. This process does not yield glycerine and is chemically identical to diesel.
Global Legislative Implications

- Indonesia: Tariffs lifted in EU; Tariffs imposed US.
- Argentina: Tariffs lifted in EU; new EU lawsuit filed, Anti-subsidy. Tariffs imposed US.
- China demand appears to resume.

- EU BD market cycle is declining.
- EU will not support food oil BD/RD after 2020.
- EU trend to RD & coprocessing yields no glycerine.
- EU double counting consumes 2.9 MM MT FAME.
- Germany has moved to GHG scheme.

Double Counting
Veg Glycerine Impact
-640 MM Lb

Glycerine Impact
2016-2017: -1.4 bil Lb
2018-2020: -2.2 bil Lb

Renewable Diesel Market Penetration

Global structural changes impact vegetable glycerine supply by 1 mil MT (2.2 billion Lb)

EIA (Energy Information Administration); Oleoline; NESTE Annual Report
USITC (US International Trade Commission); Market Knowledge
Double counting and renewable diesel are replacing est 3.7 MM MT EU biodiesel.

Double counting is when Used Cooking Oil or PFAD are used as feedstocks; petrol companies can use ½ mandate requirement.
New Players in HVO

- NESTE >50% > HVO market share.
- Total refinery commissioning Summer 2018.
- Diamond Green expansion, Aug ‘18: 1.2 bil Lb ➔ 2.0 bil Lb

### Company | HVO capacity, 2018
---|---
NESTE | 2,500 5.5
Total Petrol | 500 1.1
ENI | 300 2.0
UPM | 100 .55
Diamond Green | 900 2.0
REG | 250 .55
TOTAL | 4,550 10.0

Glycerine Impact: 455 kte (1 billion Lb)

Source: NESTE Annual Reports; Darling Quarterly Earnings, REG Quarterly Earnings; Greenea

HVO: Hydrogenated Vegetable Oil
Glycerine Demand Drivers

Substitution (Glycols)

Growing Applications

- Regional
- GDP
- Population growth
- Income Growth

New Technology
Propylene Glycol
Global Refined Glycerine Demand by Region 2017

6.7 billion pounds
3.1 million MT

Americas: 20% of Global Demand
≈ 620 kte (1.4 bil Lb)

Europe 25%
US 15%
China 31%
Other Asia 16%
Other 8%
Other Americas 5%

Americas Supply 1.25 mil MT

HBI; HIS; LMC; Market Knowledge
Kte = thousand metric tons
Refined Glycerine Demand Americas 2017

Source: IHS, Frost & Sullivan and Market Knowledge
Canada

CAGR (2017-2022), 2.5%
GDP (2018F), 2.9%

United States

CAGR (2014-2016), 3.0%
GDP (2018F), 2.1%

Mexico

CAGR (2017-2022), 3.7%
GDP (2018F), 2.2%

Brazil

CAGR (2018-2022), 3.1%
GDP (2018F), 1.4%

Other, Central & S America

CAGR (2018-2022), 2.3%
GDP (2018F), 0.6%

Source: World Bank, CEH, Frost & Sullivan,
Vantage Estimate
USA

Manufacturing PMI

GDP Growth

Source: IMF

Source: Institute of Supply Management
Global vs US Refined Glycerine Demand by Application
3.1 million MT, 6.7 billion Lb

18% of refined glycerine consumption is from new applications; +560 kte (1.2B pounds) vs 2013). Substitution applications will be sensitive to price.

Source: LMC, IHS; Market Knowledge
US Glycerine Supply
US Fats and Oil Consumption
Biodiesel 2018 \(^1\) (12.4 billion Lb; 5.6 MM MT)

- Oleochemical supply is stable vs robust demand.
- Biodiesel consumption \(\approx\) Mandates
- \(\approx60\%\) yields kosher crude quality glycerine.
- \(\approx40\%\) feed, deicing, export.
- Feedstocks are balanced.
- Vertically integrated production is sustainable without a tax credit.

<table>
<thead>
<tr>
<th></th>
<th>Jan-July 2018 million Lb</th>
<th>Est 2018 FY million pounds</th>
<th>2017 million pounds</th>
<th>% of Supply</th>
<th>Primary Application</th>
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</thead>
<tbody>
<tr>
<td>Soyoil</td>
<td>3,978</td>
<td>6,819</td>
<td>6,230</td>
<td>=31</td>
<td>Food</td>
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<tr>
<td>Canola Oil</td>
<td>631</td>
<td>768</td>
<td>1,452</td>
<td>=8</td>
<td>Food</td>
</tr>
<tr>
<td>Corn Oil</td>
<td>673</td>
<td>2,005</td>
<td>1,579</td>
<td>=70</td>
<td>Animal Feed</td>
</tr>
<tr>
<td>Tallow</td>
<td>191</td>
<td>433</td>
<td>374</td>
<td>=11</td>
<td>Animal Feed &amp; Oleo/Soap</td>
</tr>
<tr>
<td>Greases</td>
<td>1,226</td>
<td>2,341</td>
<td>2,235</td>
<td>=30</td>
<td>Animal Feed</td>
</tr>
</tbody>
</table>

Source: EIA Monthly Biodiesel Production Report; USDA

\(^1\) 2018 FY based on Jan-July and historical seasonality vs mandate.
US Crude and Refined Glycerine Imports
2013 – 2016 Q1-Q3

Imports of crude and refined 2018 Jan-August:
Imports remain at a robust pace to satisfy US increasing demand.

Source: US Harmonized Tariff System
US Refined Glycerine Imports
2014 – 2018

Malaysia and Indonesia compete for US market share.
Argentina imports are supply driven.

Source: US Harmonized Tariff System
US Crude Glycerine Exports

(Source: US Harmonized Tariff System)

Crude glycerine exports: Market diversification is beginning.
US Glycerine Supply –Demand

- Crude Imports
- Production Refined
- Net Imports Refined
- Consumption

CAGR: 7%, 2014-2016

2017 Capacity
≈ 370 kte

US consumption >70% Vegetable/Kosher
Kosher crude glycerine will continue to be imported.
Refined glycerine will be rationalized as capacity is built.

Source: Oleoline; IHS; Market Knowledge
2017F vs 2016 Actual
Crude Glycerine from Biodiesel

Δ 2017F vs 2016 ≈ -375 MM Lb

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<th>Area</th>
<th>2017F vs 2016</th>
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<tr>
<td>Europe</td>
<td>66</td>
</tr>
<tr>
<td>US</td>
<td>0</td>
</tr>
<tr>
<td>Argentina</td>
<td>(155)</td>
</tr>
<tr>
<td>Brazil</td>
<td>(66)</td>
</tr>
<tr>
<td>SE Asia</td>
<td>(220)</td>
</tr>
</tbody>
</table>

Source: Oleoline; USDA GAIN Reports; EIA; EPA RFS;
2017 vs 2016 Actual
Crude Glycerine from Biodiesel

Δ 2017F vs 2016 ≈ -375 MM Lb
Δ 2017 vs 2016 ≈ +51 MM Lb

<table>
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<tr>
<th>Region</th>
<th>2017F vs 2016</th>
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</tr>
</thead>
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<tr>
<td>Europe</td>
<td>66</td>
<td>(13)</td>
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<td>SE Asia</td>
<td>(220)</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Oleoline; USDA GAIN Reports; EIA; EPA RFS
2018F vs 2017
Crude Glycerine from Biodiesel

\[ \Delta 2018F \text{ vs } 2017 \approx +235 \text{ MM Lb} \]

Primarily 1st half 2018

Source: Oleoline; USDA GAIN Reports; EIA; EPA RFS

ROW is -(44) MM Lb
Glycerine Supply – Demand China

- China’s population is 1.39 billion and estimated to be 1.42 billion by 2020.
- China realized exponential growth of glycerine consumption from 2005 – 2014.
- Lower propylene prices reduced glycerin consumption in the Epichlorohydrin market 2015-16.
- Govt. Environmental concerns shut EPI factories down due to chlorinated waste water in 2017.  
  - This facilitated glycerine to epi (GTE)

Average annual GDP growth 2010 – 2014: 8.6%
Average annual GDP growth 2018-2022: 6.2%

- Growth rate has stagnated in manufacturing sector
- Growth in consumption in consumer goods continues to rise with GDP.

Source: IMF; Worldbank; HBI; IHS; Market Knowledge
Evolution of Price Trends
Regional Kosher Crude Glycerine Price Trend

Kosher Crude Glycerine

EU | Crude - South America | Crude Veg - China | Crude US Veg

Crude Glycerine prices appear to be near bottom in EU, China and South America.
US Crude glycerine prices are showing signs of softening.

Source: ICIS Pricing; Oleoline
Structural shortage of Kosher Glycerine in EU leads multi-regional shift in supply-demand balance. Global glycerine markets are balancing following discretionary blending of biodiesel.
Government Intervention
Potential Impacts in the US

- US final AD and CVD duties ranging from 60-276%: Argentina and Indonesia. Companies named,
  - Indonesia: Wilmar, Musim Mas
  - Argentina: Renova, Cargill, Louis Dreyfus, Bunge, Molinos, Aceitera


- Argentina and Indonesia are effectively locked out of US market.

- Biodiesel Tax Credit has not been extended into 2018.

- RFS EPA proposed mandates were announced June 26th and will be finalized by Nov 30th.
  - BBD Current mandate - 2.1 billion gallons.
  - 2019 = 2.1 billion gallons; 2020 = 2.43 billion gallons.

•BBD: Biomass based diesel; includes biodiesel (methyl ester) and HVO/Renewable Diesel
•CVD: Countervailing Duties, Government facilitated dumping through subsidies or tax policy.
•AD: Anti-dumping, Selling below cost or under local equivalent ex works prices.
•NBB: US National Biodiesel Board
EU has reduced tariffs for Argentina and Indonesia from 2013 AD lawsuit due to WTO ruling.
- Argentina shipped large volumes BD to EU Aug ‘17 through July ‘18.
- EU filed a new lawsuit in January ‘18- Anti-Subsidy.
- EU requires all Argentina BD to be registered effective May 24th.
  - Anti-subsidy is same as CVD; Argentina govt increased export tax to 8% Jan; 15% July 1.
  - Severe drought has impacted soybean supply; Argentina will have a difficult time competing with Indonesia, Malaysia and EU for market share in EU.
  - Provisional Tariff- EU opted to not issue October 31st.
  - Final decision on AS due February 2018.
  - This is causing uncertainty in glycerine supply to Americas.
- Indonesia will likely produce palm based biodiesel for EU to reduce palm oil stocks.

CVD: Countervailing Duties, Government facilitated dumping through subsidies or tax policy.
AD: Anti-dumping, Selling below cost or under local equivalent ex works prices.
Renewable Energy Directive (RED II)

- EU Renewable Energy Directive (RED)
  - Member States: pathway to reach 10% renewable energy by 2020.

- RED II to be finalized 2\textsuperscript{nd} half 2018 and implemented Jan 1 2021.

  - Called on EC (EU Commission) to define Sustainability criteria for palm oil and derivatives entering EU market.

- RED II: Food Oils Cap, 7% 2020 $\rightarrow$ 3.8% 2030
  - Member states can set lower caps.
  - Focus on GHG and ILUC

- Petroleum environmental groups applaud draft RED II.

- EBB and Farmers criticize decision to focus on 2\textsuperscript{nd} generation and move away from food oils.
What does the future look like?
Supply/Demand

- Global glycerine supply from biodiesel is volatile in 2018/19 with changing legislation in multiple regions.
  - Germany GHG Savings favors mixed feedstock.
  - EU moving to 2nd generation by 2020.
  - US mandates steadily increasing.
  - US tax credit distorting raw material market and causing intense fight for market share of biomass based diesel in years it is extended.
  - California LCFS (Low Carbon Fuel Standard)
  - Brazil mandate steadily increasing.

- Crude oil prices risk rising above >$80/barrel due geopolitical influences. Structurally, crude oil remains balanced. The net effect is volatility as it relates to discretionary blending economics.

- Vegetable oil stock levels are relatively high (especially palm oil) causing pressure on raw material prices; until it becomes economical to produce biodiesel. Once stock levels moderate, discretionary blending will pull back.

- New glycerine supply between 2019 – 2020 will come from oleochemical factories being built to support growth in Asian demand.

- Geographical shifts in supply will require EU to import glycerine and will limit exports. The Americas will become more important to global supply and world trade flows.

- Technology shift to renewable diesel/HVO/Co-processing will tighten the glycerine market over time.

- Substitution applications will remain sensitive to price swings as the markets restructure.
Market Sources

- Oleoline: Market Reports - Glycerine Weekly and Quarterly; Biodiesel
  - www.oleoline.com
  - Contact Jonathan Heming @ 33 139 346 613

- ICIS Pricing: Market Reports – Glycerine – US, Europe, Asia
  - www.icispricing.com
  - Contact Leela Landris @ 713-525-2607

- Chemical Economics Handbook/SRI Consulting/IHS
  - www.sriconsulting.com
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