Com Oil to Renewable Diesel: Proven Product Diversification Strategy for Tomorrow's Biorefinery

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Agenda

1. Saola Energy Background
2. Overview of Ethanol Industry Growth
3. Renewable Diesel Technology
4. EKAE Renewable Diesel Plant
5. Market Overview and Next Developments
6. Financial Summary
7. Next Generation Design
8. Benefits of a Renewable Diesel Plant co-located to an Ethanol Facility
Saola Energy

Based out of Wichita, KS

Technology Provider in Renewable Diesel and Biodiesel
Service Provider in Ethanol, Renewable Diesel and Biodiesel

Engineering
Project Management
Operations
Full project wrap capability
Saola Energy

- **PROCESS ENGINEERING**
  - Process Simulations/Models
  - PFD and P&ID
  - Debottlenecking
  - PHA-HAZOP-PSM
  - Hydraulic Flow Analysis
  - Equipment Specifications

- **DESIGN SERVICES**
  - AutoCAD/CADWorx 3D modeling
  - Piping design
  - Plant layout/piping plan drawings
  - Isometric generation

- **PROJECT MANAGEMENT**

- **OPERATIONS SUPPORT**

- **FULL PROJECT WRAP CAPABILITY**
Ethanol Projects

- **Expansion Projects**
  - Debottlenecking Studies
  - Fermentation
  - Dehydration
  - Distillation
  - Tank Farm

- **Efficiency Projects**
  - Turbines
  - CO2 Scrubbing
Let Down Turbine
Sieve Bottle Addition
Overview of Ethanol Industry Growth

- Ethanol industry has experienced significant growth since early 2000’s
- Enhancing Yield:
  - Front End Improvements
  - Production Changes (yeast, enzymes, etc.)
  - New Technologies
- Increasing Capacity:
  - Expanded Fermentation

<table>
<thead>
<tr>
<th></th>
<th>2004</th>
<th>2016</th>
<th>Improvement</th>
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<tbody>
<tr>
<td>Undenatured Ethanol Yield (gal/bu)</td>
<td>2.66</td>
<td>2.86</td>
<td>7.52%</td>
</tr>
<tr>
<td>Electricity Usage (kWh/gal)</td>
<td>0.82</td>
<td>0.66</td>
<td>19.51%</td>
</tr>
<tr>
<td>Energy Usage (BTU/gal)</td>
<td>33,214</td>
<td>26,429</td>
<td>20.43%</td>
</tr>
<tr>
<td>Distillers Corn Oil Yield (lbs/bu)</td>
<td>0.13</td>
<td>0.68</td>
<td>423.08%</td>
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</tbody>
</table>

Public data from Ethanol Producer Magazine and benchmarking performed by Christianson & Associates, PLLP
What’s next?
Product Diversification
Renewable Diesel Process
Renewable Diesel & Biodiesel

- Renewable Diesel is a bio-derived diesel fuel
  - Meets ASTM D975 specification for diesel
  - Drop-in fuel

- Biodiesel is fatty acid methyl esters (FAME)
  - Meets ASTM D6751 specification for biodiesel, different than diesel
  - Blend component: 2% (B2), 5% (B5), or 20% (B20)
Renewable Diesel & Biodiesel

<table>
<thead>
<tr>
<th></th>
<th>Biodiesel</th>
<th>Renewable Diesel</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Storage Stability</strong></td>
<td>Weeks</td>
<td>Months/Years</td>
</tr>
<tr>
<td><strong>Energy Content</strong></td>
<td>91% of ULSD</td>
<td>98 % of ULSD</td>
</tr>
<tr>
<td><strong>Cetane</strong></td>
<td>48</td>
<td>&gt; 75</td>
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<tr>
<td><strong>Cloud Point</strong></td>
<td>-2 to 15°C</td>
<td>Flexible</td>
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<tr>
<td><strong>NOx Emissions</strong></td>
<td>+ 10 % ULSD</td>
<td>No change</td>
</tr>
<tr>
<td><strong>D4 RIN Multiplier</strong></td>
<td>1.5</td>
<td>1.7</td>
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</table>
Renewable Diesel PFD
Renewable Diesel Plant Products

- Renewable Diesel
  - 100% drop-in fuel
- Naphtha
  - Can be used as a denaturant
  - Can generate D5 RINs
- Fuel Gas
  - Renewable diesel plant generates more than enough fuel gas to run itself
- Steam
  - A 5 MMGPY plant can generate more than 5 MMBTU/hr of excess steam
EKAE Renewable Diesel Plant
EKAE Renewable Diesel Plant
Market Overview and Next Developments
Oil steady as emerging market woes dim demand outlook

The U.S. bank said prices for Brent crude, the international benchmark, would average $70 per barrel in both 2018 and 2019, up from a forecast of $65 and $60 per barrel respectively. Brent stood at around $74 per barrel Friday.

The International Energy Agency raised its forecast for global oil demand growth by 110,000 barrels a day to 1.5 million barrels for 2019. Its monthly report also said global supply had risen by 300,000 barrels a day last month, mainly because of higher output from Russia and higher output from the Organization of the Petroleum Exporting Countries.

“It’s more positive than negative because of the demand revision,” said Tamas Varga, an analyst at brokerage PVM.

“The agency said U.S. oil demand growth was expected to be 470,000 bpd in 2018, unchanged from its previous forecast. Demand growth is expected to rise to 290,000 bpd in 2019, compared with 330,000 bpd previously expected.
Market Overview – Global Crude Oil

- Global Crude Prices
  - OPEC
  - Iran Sanctions
  - Venezuela
  - Strategic reserves
  - Outlook is generally positive

- Demand
  - Booming economy
  - Emerging markets
Market Overview – Global Crude Oil

- EIA expects Brent spot prices will average $72/b in 2018 and $71/b in 2019.

Source: Short-Term Energy Outlook, August 2018
Market Overview – Global Crude Oil

Crude Oil Historical Pricing

- Cushing, OK WTI Spot Price FOB (Dollars per Barrel)
- Europe Brent Spot Price FOB (Dollars per Barrel)

Source: U.S. Energy Information Administration
Market Overview – Diesel Price

New York Harbor Ultra-Low Sulfur No 2 Diesel Spot Price (Dollars per Gallon)

Source: U.S. Energy Information Administration
## Market Overview – Proposed and Final RVO Requirements for 2019-2020

<table>
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<tr>
<th>Fuel Type</th>
<th>2019</th>
<th>2020</th>
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<tbody>
<tr>
<td>Cellulosic biofuel (million gallons)</td>
<td>381</td>
<td>N/A</td>
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<tr>
<td>Biomass-based diesel (billion gallons)</td>
<td>2.1</td>
<td>2.43</td>
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<tr>
<td>Advanced biofuel (billion gallons)</td>
<td>4.88</td>
<td>N/A</td>
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<tr>
<td>Renewable fuel (billion gallons)</td>
<td>19.88</td>
<td>N/A</td>
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</table>
Market Overview – RINs

RIN Pricing Trendline

- Conventional RIN
- Biomass-based Diesel RIN
- Adv Biofuel RIN
Market Overview – LCFS

- California Air Resources Board – “CARB” advantage
  - CARB Carbon Market policy extended through 2030
  - Other states as well as some provinces in Canada
- Local governments shift towards green energy and broader use of bio-based diesel in their fleets and transit systems
Market Overview – Feedstocks

Feedstock Monthly Average Prices - $/lb

- Corn Oil - Kansas/Nebraska
- Yellow Grease - Kansas/Texas (delivered)
- Soybean Oil (RBD) - Central Illinois
Market Overview

- Corn Oil price: $0.24/lb
- Renewable Diesel earns 1.7 D4 RINs
- Renewable Naphtha earns 1 to 1.5 D5 RINs
- D4 RINs: $0.42
- LCFS ($/MT): $185
- New York Harbor Ultra-Low Sulfur No 2 Diesel Spot Price: $2.14
### EBITDA Waterfall Chart

<table>
<thead>
<tr>
<th>Feedstock ($/gal)</th>
<th>2.09</th>
<th>1.50</th>
<th>0.42</th>
<th>0.38</th>
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<tbody>
<tr>
<td>Diesel ($/gal)</td>
<td>$2.09</td>
<td></td>
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<tr>
<td>Naphtha ($/gal)</td>
<td></td>
<td>$1.50</td>
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<td>D4 RIN ($/gal)</td>
<td></td>
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<tr>
<td>D5 RIN ($/gal)</td>
<td></td>
<td></td>
<td></td>
<td>$0.38</td>
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<tr>
<td>CARB Price ($/mT of CO2)</td>
<td>$185.00</td>
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<tr>
<td>Feedstock ($/lb)</td>
<td>$0.24</td>
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<td></td>
<td></td>
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<tr>
<td>Electricity cost (kW)</td>
<td>$0.07</td>
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<tr>
<td>NG cost ($/MMBTU)</td>
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<td>$3.00</td>
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<td></td>
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<tr>
<td>Govt Incentives ($/gal)</td>
<td>-</td>
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<td></td>
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<tr>
<td>Revenue ($/gal)</td>
<td></td>
<td></td>
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<td>$4.29</td>
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<td>$0.16</td>
<td>$0.13</td>
<td>$0.28</td>
<td>$0.43</td>
<td>$0.58</td>
<td>$0.73</td>
<td>$0.88</td>
<td>$1.03</td>
<td>$1.18</td>
<td>$1.33</td>
<td>$1.48</td>
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<td>Naphtha ($/gal)</td>
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<td>NG cost ($/MMBTU)</td>
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</tbody>
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**No Tax Credit**
EBITDA Impact on 50MMGPY Ethanol Plant

Without 5MMGPY RD Plant

With 5MMGPY RD Plant
Next Generation Design

Saola Energy provides standard designs from 5MMGPY to 30MMGPY

- Proven Technology
- Seamless Integration
- Established Market
- Drop-in Fuel – no blending limit
Benefits of a Renewable Diesel Plant co-located to an Ethanol Facility

- Shared infrastructure and personnel
- Excess energy from the Diesel Plant can offset energy consumption at the Ethanol Plant
- Feedstock proximity
- Naphtha as denaturant for the ethanol plant
- Diversification of revenue streams
Summary

- Adding a Renewable Diesel Facility as a **Diversification Strategy** for Ethanol Plants
- Saola Energy’s Renewable Diesel Technology is **Proven**
  - Comprehensive Process Design
  - Operational Expertise
- Renewable Diesel is a Drop-in Fuel
- **Established Market**

**EBITDA Impact on 50MMGPY Ethanol Plant**

- Ethanol: 54%
- DGS: 32%
- Renewable Diesel: 13%
- Naphtha: 1%
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