Ethanol Industry Investments

The combination of COVID-19, volatile margins, and uncertain policy has created a catalyst for change within the fuel ethanol industry. Traditional ethanol producers are investing or announcing projects in four key areas in pursuit of growth.

- **High-Quality Alcohol.** The onset of COVID-19 resulted in an undersupplied market for high-quality alcohol blended in hand sanitizers. Large spot market premiums inspired many traditional fuel ethanol players to shift towards high-quality alcohol.

- **High-Protein Coproducts.** Technology optimization in ethanol production has enabled the transition towards high-value protein coproducts from DDGS and yeast.

- **Low-Carbon Initiatives.** Growing momentum towards projects aimed at lowering the carbon intensity score of fuel driven by financial incentives including California’s LCFS and federal 45Q tax credit.
  - Combined heat and power (CHP)
  - Carbon capture and sequestration / storage (CCS)
    - Direct injection into geologic formation onsite
    - Pipeline project for permanent storage or enhanced oil recovery

- **Capacity Expansion.** A few producers are moving forward with low-cost, incremental production expansion projects mainly through additional fermentation capacity.
Ethanol Industry Investments (cont’d)

- **Green Plains**
  - **Apr 2020**: Completes $38M high protein system in Shenandoah, IA
  - **Jul 2020**: Launches USP grade alcohol production in Keyes, CA
  - **Sep 2020**: Begins installation of 20 MGPY of USP grade ethanol capacity
  - **Oct 2020**: Expands USP grade ethanol production in Grand Forks, ND

- **AEMETIS**
  - **Aug 2020**: Announces transition to USP grade alcohol production in Keyes, CA

- **RED RIVER BIOREFINERY**
  - **Oct 2020**: Expands USP grade ethanol production in Grand Forks, ND

- **Green Plains**
  - **Feb 2021**: Announces large-scale CCS project in Midwest

- **SIOUXLAND ETHANOL**
  - **Jul 2021**: Generates electricity using CHP system in Jackson, NE

- **ALTO INGREDIENTS**
  - **Aug 2021**: Launches high protein project at its plant in Magic Valley, ID

- **ADM**
  - **Jun 2020**: Expands industrial alcohol production in Clinton, IA

- **POET**
  - **Aug 2020**: Announces plan to scale production of industrial and beverage-grade alcohol at two plants

- **FLINT HILLS RESOURCES**
  - **Oct 2020**: Begins shipping high protein ingredient. Previously invested $50M for high protein system in Fairmont, NE

- **Valero**
  - **Mar 2021**: Announces large-scale CCS project in the Midwest

- **CHIEF ETHANOL**
  - **Jul 2021**: Announces CCS project in NE

- **Marquis**
  - **Oct 2021**: Launches CCS project in Hennepin, IL

- **Homeland Energy Solutions**
  - **Mar 2020**: Begins drilling well for CCS project in Richardson, ND

- **SME**
  - **Jul 2020**: Begins construction of USP grade industrial ethanol system in Lawler, IA
  - **Sep 2020**: Invests $18.7M for commercial grade alcohol production in Carrollton, MO

- **Golden Grain Energy**
  - **Feb 2021**: Expands specialty alcohol capacity by 30 MGPY to 140 MGPY in Pekin, IL

- **Three Rivers Energy**
  - **May 2021**: Announces installation of high-quality alcohol system in Coshocton, OH

- **Green Plains**
  - **Oct 2020**: Begins shipping high protein ingredient. Previously invested $50M for high protein system in Fairmont, NE

- **Valero**
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Renewable Diesel (RD) Plants

Twelve plants are operating or making rapid progress.

By 2024, these 12 plants will have 3.9 BGPY of production capacity.

Source: Company filings and press releases, OP research and analysis.
Other Potential RD Projects

Additional announced RD projects total 3.3 BGPY. The status of these projects is uncertain from public information.

To the extent any of these projects are successfully completed, it will only amplify market forces.

Source: Company filings and press releases, OP research and analysis.
(1) Potential capacity has not been disclosed.
RD Economics – Feedstock Costs

RD (and BD) feedstocks are expensive – costing twice as much as diesel.

Feedstock Costs vs. Diesel Prices – Per Gallon

- **Current Price**
- **RBD Soybean Oil**

<table>
<thead>
<tr>
<th>Feedstock</th>
<th>Current Price</th>
<th>RBD Soybean Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel</td>
<td>$1.05</td>
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</tr>
<tr>
<td>White Grease</td>
<td>$2.28</td>
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</tr>
<tr>
<td>Yellow Grease</td>
<td>$2.06</td>
<td>$2.53</td>
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<tr>
<td>Crude Soybean Oil</td>
<td>$2.55</td>
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<tr>
<td>Tallow</td>
<td>$2.64</td>
<td>$5.68</td>
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<tr>
<td>Corn Oil</td>
<td>$2.62</td>
<td>$5.25</td>
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</tbody>
</table>

Finished Product

<table>
<thead>
<tr>
<th>Feedstock</th>
<th>Feedstock Costs for RD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$/lbs</td>
</tr>
<tr>
<td>Diesel</td>
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<tr>
<td>Crude Soybean Oil</td>
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<tr>
<td>Tallow</td>
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<tr>
<td>Corn Oil</td>
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</tr>
</tbody>
</table>

Source: The Jacobsen, Nasdaq, EIA, OP research and analysis.
Note: Current prices shown are as of Oct 27, 2021. Based on conversion of 8.5 lbs/gal for YG, 7.5 lbs/gal for SBO, 8.0 lbs/gal for WG/Tallow and 8.2 lbs/gal for Corn Oil.
RD Economics – Policy Incentives Bridge the Gap

Cumulative policy incentives provide the economics for RD and BD production.

Value of Policy Incentives


(1) Based on credit price of $167/MT and average CI Score of 26.3. RD conversion CI scores range from 20 to 32.

(2) Based on D4 RINs value of $2.57/gal for RD ($1.51 x 1.7 factor.)

How long will the market pay this premium?
Feedstocks – New RD Demand

Fuels are projected use 40% of feedstocks in 2021. By 2024, they would consume 95%.

If all US feedstock were used for RD/BD, it would only produce 5.4B gallons of fuel.

Source: Render Magazine, USDA, EIA, National Agricultural Statistics Service (NASS), OP research and analysis.
Wrap-Up

• It is all about feedstock for nature-based climate solutions.

• Additional corn starch is available, but the vehicle market is currently stuck at around 10% blend – alternative jet fuel, biochemicals and exports are future markets.

• Soy and waste feedstocks are effectively gone for renewable diesel.

• The next investment frontier is biomass to liquid (not alcohols).