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Moderator

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CEO, TotalGEN

Jim Ramm
Director of Engineering, EcoEngineers
Carbon Certainty At your Facility

Adam Herink
Bluestem Energy Solutions
YOUR TRUSTED ENERGY PARTNER
Affordable. Reliable. Sustainable.
Benefits of Carbon Certainty At your Facility

Bluestem Business Model

- Distribution Connected Generation – Electric generation connected to the low voltage distribution system customized for a specific retail load

Developments Which Create Certainty Through Power Supply

- Carbon
- Financial
- Regulatory

Process

- Energy Master Planning
- Utility Engagement
- Ownership & Financing
Why CHP Is Important to the Ethanol Industry

Bernie Hoffman
TotalGEN
1. When most ethanol plants were first constructed, the financial and energy markets were dramatically different from today’s Markets:
   a. Electricity was generally cheap with abundant coal generation.
   b. Ethanol plants typically had ZERO excess capital available when first built.
   c. Carbon intensity and carbon markets were not on an ethanol plant’s “radar screen”.

*Ethanol 2019: Emerging Issues Forum*
*Presenter: Bernie Hoffman*
1. Over the past decade many ethanol plants have experienced significant electric power rate increases.

2. Gas turbine efficiencies have increased dramatically in the last ten years.

3. Carbon markets are maturing and expanding rapidly.

4. The importance of carbon intensity and the value opportunities they enable are significant.

5. Uncertainty around grid power – Pricing (various capacity, demand and other charges), Unplanned Outages and Security Issues.

6. Natural gas is abundant, relatively inexpensive and should remain so for many years.

*Ethanol 2019: Emerging Issues Forum*
*Presenter: Bernie Hoffman*
## Why CHP Is Important to the Ethanol Industry

<table>
<thead>
<tr>
<th>Plants</th>
<th>Plant Design/Size (Million Gallons per Year)</th>
<th>Current Energy Cost ($ Million)</th>
<th>Energy Cost - Optimal CHP Design ($ Million)</th>
<th>Energy Savings ($ Million)</th>
<th>Energy Savings ($0.00/Gallon)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant A</td>
<td>ICM 58</td>
<td>$7.85M</td>
<td>$5.5M</td>
<td>$2.3M</td>
<td>$0.040</td>
</tr>
<tr>
<td>Plant B</td>
<td>ICM 116</td>
<td>$15.67M</td>
<td>$10.97M</td>
<td>$4.7M</td>
<td>$0.041</td>
</tr>
<tr>
<td>Plant C</td>
<td>Delta T - 60</td>
<td>$10.37M</td>
<td>$5.64M</td>
<td>$4.73M</td>
<td>$0.079</td>
</tr>
</tbody>
</table>
### Why CHP Is Important to the Ethanol Industry

<table>
<thead>
<tr>
<th>Plants</th>
<th>Carbon Intensity(^1) before CHP</th>
<th>Carbon Intensity(^1) after CHP</th>
<th>Difference - (MgCO(_2)e/Mjoule)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant Top</td>
<td>82.91</td>
<td>67.91</td>
<td>15</td>
</tr>
<tr>
<td>Plant Middle</td>
<td>75.96</td>
<td>63.96</td>
<td>12</td>
</tr>
<tr>
<td>Plant Low</td>
<td>66.3</td>
<td>60.7</td>
<td>5.6</td>
</tr>
</tbody>
</table>

\(^1\) Measured in gCO\(_2\)e/MJ

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*Ethanol 2019: Emerging Issues Forum*
*Presenter: Bernie Hoffman*
Why CHP Is Important to the Ethanol Industry

1. Host ethanol plant becomes completely grid independent
   a) Greater reliability – eliminates unplanned outages
   b) Eliminates costly utility surcharges (Time of Use, Demand Charges, etc.)
   c)Eliminates the possibility of cyber-hacking of the electric supply

2. Turbine/HRSG provides all of the process steam
   a) Eliminates natural gas burn for process heating at the host plant
   b) Higher thermal efficiency of the combined cycle process greatly improves CI scores

3. Mothball aging, less efficient boilers
   a) Ends boiler maintenance expense
   b) Eliminates costly boiler refurbishment/replacement

4. CHP’s Heat Recovery Steam Generator (HRSG) can easily generate more steam for plant expansion without expensive additional boilers

5. Our CHP installation corrects some known safety issues with TO's and dryers

6. Final Analysis – Enhances the value of your shareholders’ asset
Energy Management & Lowering CI

Jim Ramm
EcoEngineers
Low Carbon Fuels in The News

- Pacific Ethanol
  - 5 MW solar
  - Whitefox membrane
  - Kernel Fiber Ethanol
  - CHP

- Calgren
  - Distillation-Dehydration-Evaporation (DDE)
  - On-site anaerobic digester
  - Cogeneration of 11 MW
  - On-site biodiesel
  - Pipeline to 12 dairy digesters

- Aemetis
  - Pipeline to 12 dairy digesters
  - Zebex membrane dehydration

- Element
  - Waste wood and CHP
  - Kernel Fiber Ethanol
Goals of The LCFS Program

Reduce GHG emissions from transportation fuels in California by 10% by 2020, 20% total by 2030

- Incentivize the development of low carbon fuels
  - Performance based
  - Fuel neutral
- The LCFS is an example for other programs:
  - Oregon
  - British Columbia
  - Others
Reasons to Invest in Lower Carbon Intensity

- Market preference & higher credit prices
- Uncertainties in RFS market due to USEPA administration, small refinery waivers, D6 RINs post-2022, EP3 production registration (75 Producers as of Jun 2017)
- Lower energy costs (2nd largest cost, 10% of overall costs of production)
- Reducing carbon footprint by 1 CI point per year to keep pace with the market
- Producer’s are looking for ways to differentiate themselves in the marketplace and be in the bottom 20% of CI values
Volume Weighted Sales into CA

Average Monthly LCFS Credit Price
($ per Credit)
## Ethanol of the Future

### CA LCFS Targets

<table>
<thead>
<tr>
<th>CA LCFS Targets</th>
<th>PAST</th>
<th>PRESENT</th>
<th>FUTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2017 GREET 2.0</td>
<td>2019 GREET 2.0</td>
<td>2022</td>
</tr>
<tr>
<td>Total Credits, MT</td>
<td>9,747,052</td>
<td>24,001,225</td>
<td>46,106,500</td>
</tr>
<tr>
<td>Total Deficits, MT</td>
<td>9,716,635</td>
<td>24,001,225</td>
<td>46,106,500</td>
</tr>
<tr>
<td>% Growth of Deficits</td>
<td>97%</td>
<td>147%</td>
<td>375%</td>
</tr>
<tr>
<td>CI Required by Market to keep</td>
<td>73</td>
<td>70</td>
<td>66</td>
</tr>
<tr>
<td>pace with program</td>
<td></td>
<td></td>
<td>59.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>48.4</td>
</tr>
</tbody>
</table>

### Assumptions:

1. Same volume consumption for fossil fuel and ethanol (E10)
## Key Contributors to CI of Ethanol

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Assumed value</th>
<th>Contribution to CI of EtOH</th>
<th>Potential Reduction Method</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iluc</td>
<td></td>
<td>19.8</td>
<td>Better and More Accurate Modeling</td>
<td>Fixed Under Current LCFS</td>
</tr>
<tr>
<td>Corn Farming And Transport at EtOH Plant</td>
<td>Default In CA-GREET 2.0</td>
<td>30.1</td>
<td>No Till, Less Fertilizer, Less Fuel Use</td>
<td>Almost Fixed Under Current LCFS</td>
</tr>
<tr>
<td>Co-product Credit</td>
<td>5 Dry Lbs DGS/Gal</td>
<td>-11.1</td>
<td>Higher Quality Co-products</td>
<td>Almost Fixed Under Current LCFS</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>24,000 Btu/Gal</td>
<td>19.8</td>
<td>Biogas, Biomass Boiler, CHP, Heat Recovery</td>
<td>Plant Specific</td>
</tr>
<tr>
<td>Electricity</td>
<td>0.7 Kwh/Gal</td>
<td>5.9</td>
<td>Onsite Renewable Power, CHP, Higher Efficiency</td>
<td>Plant Specific</td>
</tr>
<tr>
<td>Chemicals</td>
<td>Industrial Typical</td>
<td>2.0</td>
<td>Advanced Enzymes, Less Chemical Use</td>
<td>Plant Specific</td>
</tr>
<tr>
<td>T&amp;D Of EtOH</td>
<td>Midwest To CA By Rail For 1,899 Miles</td>
<td>2.4</td>
<td>Higher Transportation Efficiency</td>
<td>Plant Specific, not Much Flexibility</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>69.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameters</td>
<td>Natural Gas</td>
<td>Electricity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------------------------------------------------</td>
<td>----------------------</td>
<td>---------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assumed Usage</td>
<td>24,000 btu/gal</td>
<td>0.7 kwh/gal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contribution to CI of Ethanol (g CO2e/MJ)</td>
<td>19.8</td>
<td>5.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$/gal value for 50% reduction based on $150/MT CO2 LCFS credit</td>
<td>$0.119</td>
<td>$0.035</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$/100 MGY value for 50% reduction based on $150/MT CO2 LCFS credit</td>
<td>$ 11.9 M</td>
<td>$ 3.5 M</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potential GHG reduction method</td>
<td>Biogas Boiler,</td>
<td>Onsite solar power,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Biomass Boiler,</td>
<td>Onsite wind power,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CHP, Better heat integration</td>
<td>CHP, Higher electricity use efficiency</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Weekly LCFS Credit Price for 02/11 – 02/17: Low, Weighted-Average, High: $85, $180, $195
# Ethanol Pathways Under the LCFS

<table>
<thead>
<tr>
<th># of Pathways</th>
<th>Less than 30</th>
<th>30 - 40</th>
<th>40 - 50</th>
<th>50 – 60</th>
<th>60 – 70</th>
<th>70 - 75</th>
<th>75- 80</th>
<th>80+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Wine, Corn Kernel Fiber, Sugar Beets, Stover</td>
<td>6</td>
<td>7</td>
<td>87</td>
<td>16</td>
<td>26</td>
<td>32</td>
<td>34</td>
<td>15</td>
</tr>
<tr>
<td>Sugarcane, Molasses, Stover, Corn Kernel Fiber, Sorghum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugarcane, Molasses, Waste Wheat Slurry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn, Molasses, Spent Seed, Sugar Cane, Waste Wheat Slurry</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn, Sorghum, Waste Beverage</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn, Sorghum</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Corn, Sorghum</td>
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<td></td>
<td></td>
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<tr>
<td>Corn, Sorghum</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Feedstock Types</th>
<th>Percentage</th>
<th>Energy Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Wine, Corn Kernel Fiber, Sugar Beets, Stover</td>
<td>2.7%</td>
<td>Biogas, Kernel Fiber</td>
</tr>
<tr>
<td>Sugarcane, Molasses, Stover, Corn Kernel Fiber, Sorghum</td>
<td>3.1%</td>
<td>CHP, Biomass, Onsite Power, CCS</td>
</tr>
<tr>
<td>Sugarcane, Molasses, Waste Wheat Slurry</td>
<td>39%</td>
<td>WDG, Onsite Solar, Wind</td>
</tr>
<tr>
<td>Corn, Molasses, Spent Seed, Sugar Cane, Waste Wheat Slurry</td>
<td>7.2%</td>
<td></td>
</tr>
<tr>
<td>Corn, Sorghum, Waste Beverage</td>
<td>11.7%</td>
<td></td>
</tr>
<tr>
<td>Corn, Sorghum</td>
<td>14.3%</td>
<td></td>
</tr>
<tr>
<td>Corn, Sorghum</td>
<td>15.2%</td>
<td></td>
</tr>
<tr>
<td>Corn, Sorghum</td>
<td>6.7%</td>
<td></td>
</tr>
</tbody>
</table>

- Based on CA-GREET 2.0 pathways. CI for CA-GREET 3.0 pathways are expected to shift 3-5 points down.
Agricultural Practices

- Planting cover crops increases crop diversity, improves soil health and reduces nutrient run off.
- Digesting manure prevents methane emissions, removes pathogens, reduces odor and returns the nutrients in the manure to the grower.
- Rural anaerobic digesters trigger new investments, reduce waste disposal costs for local industry and produce clean-burning biofuels.
Potential Connection to Renewable Fuel

Cover Crops
Agricultural Residue
Energy Crops

Liquid Fertilizer

Storage

Hog Farm

Anaerobic Digester

Phase 1 Biogas

Manure

Dairy Farm

Gas Upgrading

Phase 2 RNG

Natural Gas Pipeline

Ethanol or Biodiesel Plant

Phase 2 RNG

Gas Upgrading

Energy Crops

Agricultural Residue

Bedding

Manure

Storage

Hog Farm

Dairy Farm
Site Specific Farm Practices

Corn farming and transportation burden of 30 g/MJ

- Establish standards for low CI farming practices;
  - No till
  - Fertilizer usage
  - Nutrient runoff prevention
  - Carbon sequestration

- Establish farm practices verification program for Midwest

- The farm practices verification program must be recognized by LCFS programs
Energy Management Solutions

Energy Management Solutions for Low CI Ethanol:

- Biomass
- Conceptual design
- Contract review
- Feasibility studies, CI impact
- Financial proforma

Technologies:

- Wind
- Solar, Solar steam
- CHP
- Biomass heat
- Carbon sequestration
- Biogas

Farm Practices:

- No till and/or Fertilizer
- Nutrient runoff prevention
- Carbon sequestration
Creating sustainable solutions for a better tomorrow
Questions?
Contact Information

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Thank you!