Primus’ Status, Vision and Challenges 2013
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Status - Primus Green Energy, Inc.

- Started in 2007, Primus has ~50 employees and consultants
- Offices & labs: 30,000 sq. ft., near Princeton, NJ
- Funded to date with $54mm from IC Green, a subsidiary of Israel Corporation ($26 million in 2012)
- Currently completing construction of demonstration plant and commercializing STG+, its leading proprietary Gas-To-Liquids (“GTL”) process technology
- STG+ fuels and chemicals have superior product quality, and are produced with far lower CAPEX and OPEX than alternative GTL processes such as ExxonMobil’s MTG and Fischer-Tropsch
- Economical today and going forward with crude oil above $60/bbl (with natural gas at $5/mmbtu)
- Primus’ first commercial plant is expected to break ground in mid 2014 to produce 25 million gallons per year of “drop-in” gasoline
Primus GTL Technology Vision

Traditional Refinery

Primus

Primus STG+ Technology

Step 1: Syngas Generation

- Biomass
  - Wood pellets
  - Wood chips
  - Miscanthus
  - Willow (w/ no preference)

- Biogas
- Natural Gas

Syngas Generation

Cleaning the syngas and adjusting syngas composition to the following ratio:

\[ M = \frac{\left( H_2 - CO_2 \right)}{\left( CO + CO_2 \right)} = 2.23 \]

Step 2: Primus' STG+: Syngas-to-Gasoline

- Methanol Synthesis
- DME Synthesis
- Gasoline Synthesis
- Gasoline Treatment

Gasoline

Recycle

Water

A methanol to olefins (“MTO”) process using the same equipment but different catalysts allows the process to be tuned to produce diesel or jet fuel.
Advantages of the Primus STG+ Process

- **Simple process** and **proven chemistry** – evolution of the ExxonMobil MTG process
- **Low cost** production at relatively **small scale** compared to other GTL technologies.
- **High product yield** (0.18 mmbtu of syngas/gallon of gasoline, or 35% by mass) is 82% of theoretical limit
- **High quality premium 90-93 octane gasoline** (with no sulfur, low benzene and superior stability, lower corrosion and lower vapor pressure). Already meets Tier III requirements
- Ability to produce **diesel, jet fuel and aromatic chemicals** in the same hardware.
- Process lends itself to use of **modularization**

100,000 gal/yr natural gas to gasoline demo plant commissioning; biomass as feedstock and diesel/jet fuel as product to come

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Key challenge to using biomass as feedstock lies in economical generation of on-spec syngas

Cost comparison of using different feedstocks for the Primus STG+ process

<table>
<thead>
<tr>
<th></th>
<th>Acquisition</th>
<th>Transportation</th>
<th>Handling</th>
<th>Syngas generation</th>
<th>Syngas cleanup</th>
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<tr>
<td>1</td>
<td>Natural gas</td>
<td>Lo</td>
<td>Lo</td>
<td>Lo</td>
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<tr>
<td>2</td>
<td>Biogas</td>
<td>Med-Lo</td>
<td>Lo</td>
<td>Med</td>
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<td>4</td>
<td>MSW</td>
<td>Hi</td>
<td>Lo</td>
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Challenges to Primus using biomass as feedstock

- Biomass challenges to Primus
  - Sourcing/cost/reliability of supply
  - Handling
  - Gasification to our syngas spec: no $N_2$

- We will always have natural gas as a feedstock in any plant

- **Biomass can be a bolt-on component to ANY Primus plant**