INTRO TO PRIMUS GREEN ENERGY
May 2016
Company Profile

- Global leader in Gas-to-Liquids (GTL) solutions
- Standardized modular units uniquely designed to be profitable at all scales, unlike large stick-built units
- 50 employees, based 45 min from New York City
STG+™ Gas-to-Liquids Solution

Feed Gas
- natural gas
- NGLs
- syngas

Single Ready-to-Use Liquid
- gasoline
- methanol
- diluent

✓ Only one product stream
✓ 100% standard components
✓ Accepts CO₂ in feed gas, up to 25%
✓ Long catalyst lifetime
✓ Wide variety of feed gas compositions accepted from wellhead through midstream
✓ Products require no additional refining
✓ No wastewater
Primus GTL Solution Examples

Flare/Off Gas
from Refinery or Petrochemical Plant

Pipeline Gas

Associated Gas
at Oil Wellpad

Primus STG+ Unit

Liquid

(Methanol or Gasoline)
A number of regions across North America exhibit large methanol price differentials from the Gulf. These regions also have ample access to cheap natural gas, making them prime markets for Primus’ small-scale methanol plants.

**Select Domestic Methanol Shipment Costs**

- $0.20 - $0.25 / gallon to Niobara
- $0.40 - $0.50 / gallon to Alberta
- $0.20 - $0.25 / gallon to Marcellus

(1) Map: EIA  
(2) Shipment Costs: Chemical Intelligence
## Example Projects Underway

<table>
<thead>
<tr>
<th>Location</th>
<th>Central Asia</th>
<th>US Midwest</th>
<th>US Marcellus Region</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Feedstock</strong></td>
<td>Associated gas, currently being flared</td>
<td>Syngas</td>
<td>Pipeline natural gas</td>
</tr>
<tr>
<td><strong>Production Capacity</strong></td>
<td>500 bpd gasoline</td>
<td>2000 bpd gasoline</td>
<td>5200 bpd methanol</td>
</tr>
<tr>
<td><strong>Driver</strong></td>
<td>Gov’t will block oil drilling if associated gas flaring continues</td>
<td>Desire for profitable use of onsite syngas</td>
<td>Fulfill local methanol demand using low-cost natural gas. Save on methanol transport costs.</td>
</tr>
<tr>
<td><strong>Partner</strong></td>
<td>O&amp;G Services Company</td>
<td>Major Utility Company</td>
<td>Tauber Oil (major methanol distributor)</td>
</tr>
</tbody>
</table>
Standard Commercial Plants

<table>
<thead>
<tr>
<th>Feed Gas Type</th>
<th>Liquid Product</th>
<th>Feed Gas Flow MMSCF/D*</th>
<th>Feed Gas Flow NM^3/D*</th>
<th>Production Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural Gas</td>
<td>Methanol</td>
<td>4-5</td>
<td>110,000-130,000</td>
<td>160 mt/d</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Methanol</td>
<td>17-20</td>
<td>450,000-540,000</td>
<td>640 mt/d</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Gasoline</td>
<td>4-5</td>
<td>110,000-130,000</td>
<td>500 bpd</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Gasoline</td>
<td>17-20</td>
<td>450,000-540,000</td>
<td>2000 bpd</td>
</tr>
<tr>
<td>Syngas</td>
<td>Gasoline</td>
<td>17-20</td>
<td>450,000-540,000</td>
<td>500 bpd</td>
</tr>
<tr>
<td>Syngas</td>
<td>Gasoline</td>
<td>68-80</td>
<td>1.8-2.1 million</td>
<td>2000 bpd</td>
</tr>
</tbody>
</table>

* Exact value depends on gas composition
Standard STG+™ Plant
Modular Construction Approach

- Pre-fabricated to the maximum extent possible. Reduced project timeline.
- All equipment, piping, instrumentation, electrical, controls, insulation and safety systems fabricated and pre-installed within structural steel frames.
- System is constructed off-site and transported via roadway/ship
Feed Gas Sources in Refineries & Chemical Plants

- Flare/Off-gas
- Syngas from underutilized reformer
- CO₂ (e.g. from amine or hot potassium carbonate unit)

_**STG+ is an ideal option for upgrading off/flare gas or excess syngas**_
Flexible Feed Gas Requirements

- Wide range of feed gas types possible, no need for composition adjustment
- Accepts any mixture of C1-C5 or syngas as feed gas.
- Tolerant to fluctuations in gas composition
- Sulfur < 30 ppm, CO₂ < 25%, N₂ < 5%, no particulates
- Examples of acceptable feedstock compositions:

<table>
<thead>
<tr>
<th>Component</th>
<th>Case 1 Kazakhstan</th>
<th>Case 2 USA - Bakken</th>
<th>Case 3 Offshore</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>70%</td>
<td>57%</td>
<td>78%</td>
</tr>
<tr>
<td>C2</td>
<td>15%</td>
<td>20%</td>
<td>6%</td>
</tr>
<tr>
<td>C3</td>
<td>7%</td>
<td>11%</td>
<td>3%</td>
</tr>
<tr>
<td>C4</td>
<td>3%</td>
<td>12%</td>
<td>1%</td>
</tr>
<tr>
<td>CO₂</td>
<td>2%</td>
<td>0.6%</td>
<td>10%</td>
</tr>
<tr>
<td>N₂</td>
<td>3%</td>
<td>5%</td>
<td>1%</td>
</tr>
</tbody>
</table>
Methanol Process in Detail

- Syngas generated with widely used steam reforming technology
- Standard catalyst with long lifetime
- Methanol meets IMPCA/ASTM specs
- Low piece count optimized for smaller scale production
- Standardized modular proprietary design
## High Quality Methanol

<table>
<thead>
<tr>
<th>Property</th>
<th>IMPCA Methanol Spec</th>
<th>Primus Methanol</th>
<th>Meets Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purity (% WT dry basis)</td>
<td>≥ 99.85</td>
<td>≥ 99.85</td>
<td>✓</td>
</tr>
<tr>
<td>Acetone (mg/kg)</td>
<td>≤ 30</td>
<td>≤ 30</td>
<td>✓</td>
</tr>
<tr>
<td>Water (% W/W)</td>
<td>≤ 0.1</td>
<td>≤ 0.1</td>
<td>✓</td>
</tr>
<tr>
<td>Specific Gravity (20°/20°)</td>
<td>0.791-0.793</td>
<td>0.791-0.793</td>
<td>✓</td>
</tr>
<tr>
<td>Potassium Permanganate Time Test at 15°C (minutes)</td>
<td>≥ 60</td>
<td>≥ 60</td>
<td>✓</td>
</tr>
<tr>
<td>Ethanol (mg/kg)</td>
<td>≤ 50</td>
<td>≤ 50</td>
<td>✓</td>
</tr>
<tr>
<td>Chloride as Cl⁻ (mg/kg)</td>
<td>≤ 0.5</td>
<td>≤ 0.5</td>
<td>✓</td>
</tr>
<tr>
<td>Hydrocarbons (ASTM D1722-04)</td>
<td>pass</td>
<td>Pass</td>
<td>✓</td>
</tr>
<tr>
<td>Carbonisable Substances (Pt-CO Scale)</td>
<td>≤ 30</td>
<td>≤ 30</td>
<td>✓</td>
</tr>
<tr>
<td>Acidity as Acetic Acid (mg/kg)</td>
<td>≤ 30</td>
<td>≤ 30</td>
<td>✓</td>
</tr>
<tr>
<td>Total Iron (mg/kg)</td>
<td>≤ 0.1</td>
<td>≤ 0.1</td>
<td>✓</td>
</tr>
<tr>
<td>Non Volatile Matter (mg/1000 mL)</td>
<td>≤ 8</td>
<td>N.D.</td>
<td>✓</td>
</tr>
<tr>
<td>Sulfur (mg/kg)</td>
<td>≤ 0.5</td>
<td>N.D.</td>
<td>✓</td>
</tr>
</tbody>
</table>

*Primus Methanol meets standard specifications*
Gasoline Process in Detail

Continuous gas-phase process, no intermediate condensations
- Standard fixed-bed catalytic reactors
- Syngas generated with widely used steam reforming technology

Standard catalysts with long lifetimes
- Gasoline meets RBOB/CBOB specs
- Primus’ proprietary patented system
High Quality Gasoline

Comparative Distillation Curve

- High quality gasoline, no refining needed
- Zero sulfur, zero benzene
- Meets standard specifications (RBOB/CBOB)
Commercial Testing Plant – Gasoline, Methanol

- Start up: Oct 2013
- Commercial testing for variable gas composition and process optimization
- Small scale commercial plant
- >8000 hrs operation
- >99.5% availability

“Primus has constructed a first class demonstration facility that has substantially demonstrated the efficacy of its STG+ technology”

Experienced Technical Team

John Doyle
Chief Infrastructure Officer

- Background
  - BP, Head Appl. Eng. Biofuels
  - Verenium Biofuels - VP
  - GE Env. Systems – Sr. Project Manager
  - Booz, Allen & Hamilton – Marine Engineering Manager

- Expertise
  - Project Development
  - Technology Licensing

Eli Gal, PhD
Chief Technology Officer

- Background
  - GE Power Systems, Sr. Technology Bus. Manager
  - Nexant, VP Technology Power, Oil, Gas

- Expertise
  - CO₂ separation, gasification, air pollution control.
  - 15 patents

Howard Fang, PhD
VP Research & Development

- Background
  - Exxon Mobil, Sr. Industrial Scientist
  - Cummins Engines, Sr. Technical Advisor
  - BP, Scientist

- Expertise
  - Catalyst development, Fuel formulation
  - 24 patents

Bob Koros, PhD
Reactor Design

- Background
  - Exxon Mobil, Group Leader
  - Fellow, AIChE
  - Founding member ASTM Catalyst Committee

- Expertise
  - Reactor design & sizing
  - 23 patents

Arnold Keller
Head Process Engineer

- Background
  - Conoco Phillips
  - Fluor
  - Bechtel

- Expertise
  - O&G Processing, Reforming, Gasification.
  - 3 Patents

Gautam Khatu
VP Program Development

- Background
  - Chemtex International
  - Reliance Industries
  - Indian Organic Chemicals

- Expertise
  - Project Development
  - LNG Petrochemical

200+ yrs. Aggregate Experience in Energy, O&G Sectors