Industrial Algae Revolution: Growing the World’s Fuels

Jeff Webster, Chief Operating Officer

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Sapphire produces drop-in crude oil from algae, sunlight, and CO2 – in a scalable and sustainable process

Plentiful inputs

Scalable, open pond facilities

Green Crude Oil

Fossil crude came from algae and other plants living millions of years ago; Sapphire radically accelerates a natural phenomenon

Non-potable water • Non-arable land • Enhanced algae • Proprietary process
Algae are able to use non-arable land, and can achieve highest oil yields of any energy crop

<table>
<thead>
<tr>
<th>Water source</th>
<th>Crop</th>
<th>Yield, dry mass (metric tons/acre/year)</th>
<th>Yield, diesel equivalent* (gal/acre/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 acre agricultural land</td>
<td>Sugarcane</td>
<td>30</td>
<td>380</td>
</tr>
<tr>
<td></td>
<td>Corn</td>
<td>4</td>
<td>260</td>
</tr>
<tr>
<td></td>
<td>Switchgrass</td>
<td>3</td>
<td>170</td>
</tr>
<tr>
<td></td>
<td>Soy</td>
<td>1</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>Camelina</td>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>1 acre non-agricultural land</td>
<td>Algae</td>
<td>45</td>
<td>5,000</td>
</tr>
</tbody>
</table>

* Based on conversion of fuel output (ethanol, crude oil, biodiesel, etc.) to diesel in energy-equivalent terms; algae yield is based on Sapphire’s commercial planning basis.

Source: Crago et. al, 2011; Fuentes and Taliaferro, 2002; McVay and Lamb, 2008; Oak Ridge National Laboratory, 2010; Schmer et. al, 2008; USDA, 2011; Wisner, 2011.
Algae Farming is Scalable: 50MM acres of algae could produce 100% of America’s crude requirements

Today, the United States has 94MM acres of corn planted and 58MM acres of wheat

Note: Calculated on a Btu basis. Source: Texas A&M AgriLife Research at Beaumont, iAIMS Cropland Data

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A new agricultural revolution

Actual site for the Green Crude Farm in Columbus, NM

- Land was used for farming until 1973
- Land was abandoned for farming use because the underlying water source became to saline
- Few other productive uses until Sapphire started developing the current project

The Green Crude farm in November 2012

- Built on-time and on-budget
- In continuous integrated operations since summer of 2012
- The commercial demonstration project is expected to prove techno-economics for commercial scale facilities
Sapphire links multiple capabilities to create an algae-to-energy process across the entire value chain

Keys to realize economic potential

Sophisticated Biology

Agricultural Engineering & Agronomic Practices

Large-scale Civil and Process Engineering

Downstream Engineering (e.g., refining)
Sapphire has integrated processes validated by world class partners

**Sapphire advantages**

**Strain development**
- High-speed screening & selection: millions of variants
- Protected by Sapphire patents
- Advanced strains that are fit-for-purpose

**Cultivation**
- Low cost and scalable open pond system
- Robust crop protection methods to maximize algae biomass yield

**Harvesting**
- Low cost and scalable harvest system using existing world-scale technology
- Concentrates algae for downstream processing

**Conversion & extraction**
- Low cost and scalable conversion & extraction system
- Protected by Sapphire patents
- Greatly increases oil yield and improves oil quality
- Oil quality enables processing in today’s refineries

Validated partners:
- Monsanto
- DOE/USDA
- Tesoro
Sapphire has the most experience in large-scale production of photosynthetic algae

<table>
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<th>Pilot technology facility</th>
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<td>• 22-acre pilot facility operated since 2009</td>
</tr>
<tr>
<td>• Over 180,000 hours of large pond cultivation piloting</td>
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<th>Commercial demonstration facility</th>
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<tr>
<td>• Sapphire is operating the world’s first integrated algal-oil production facility</td>
</tr>
<tr>
<td>• Operations began in Q3 2012</td>
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</tbody>
</table>

![Pilot technology facility image](image1)

![Commercial demonstration facility image](image2)
The Green Crude farm has been in continuous integrated operation since June 2012.
1.1 acre (.45 hectare) pond next to a pickup truck
Challenges and Successes

Corn Husks

Green Ponds

Tumbleweeds

Black Oil
Sapphire is currently producing barrels of Green Crude Oil