The Institute for Massachusetts Biofuels Research

April 30, 2010
Amherst, MA
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Senior VP and Chief Technical Officer
Outline

• The U.S. needs to rapidly develop, scale and commercialize advanced biofuels; cellulosic ethanol represents the greatest near-term solution as prescribed by the RFS

• Commercial scale deployment continues to be a challenge due to high capital and operating costs of those processes being developed

• Consolidated bio-processing represents the major step-function change required for the industry to accelerate the broad and profitable commercial-scale deployment of cellulosic ethanol

• Qteros is developing the industry-leading solution for consolidated bio-processing
Qteros’ Mission

Development and integration of the industry-standard consolidated bio-processing (CBP) platform for **lowest-cost** cellulose ethanol production . . .

. . . which serves to catalyze and accelerate the worldwide commercialization of advanced biofuels.
Numerous Macroeconomic Trends Securely Established To Drive Worldwide Biomass-Derived Biofuels Growth

- Energy Security
- Environmental Preservation
- Renewable Resources
- Non-Food / Waste Feedstocks
- Lower Green House Gas Emissions
- Higher Potential Economic Profit

GHG Data from Renewable Fuels Association: What do biofuels displace and why does it matter?
The U.S. Government Has Mandated Demand For Domestically-Produced Cellulosic Ethanol

Cellulosic Biofuels (Billion Gallons / Year)  New Plants / Year (30MM gal/yr)

<table>
<thead>
<tr>
<th>Year</th>
<th>Biofuels</th>
<th>Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>0.10</td>
<td>0.0065*</td>
</tr>
<tr>
<td>2011</td>
<td>0.25</td>
<td>5</td>
</tr>
<tr>
<td>2012</td>
<td>0.50</td>
<td>8</td>
</tr>
<tr>
<td>2013</td>
<td>1.00</td>
<td>17</td>
</tr>
<tr>
<td>2014</td>
<td>1.75</td>
<td>25</td>
</tr>
<tr>
<td>2015</td>
<td>3.00</td>
<td>42</td>
</tr>
<tr>
<td>2016</td>
<td>4.25</td>
<td>42</td>
</tr>
<tr>
<td>2017</td>
<td>5.50</td>
<td>42</td>
</tr>
<tr>
<td>2018</td>
<td>7.00</td>
<td>50</td>
</tr>
<tr>
<td>2019</td>
<td>8.50</td>
<td>50</td>
</tr>
<tr>
<td>2020</td>
<td>10.50</td>
<td>67</td>
</tr>
<tr>
<td>2021</td>
<td>13.50</td>
<td>100</td>
</tr>
<tr>
<td>2022</td>
<td>16.00</td>
<td>83</td>
</tr>
</tbody>
</table>

* EPA adjustment per RFS2 for 2010

Cellulosic ethanol can be immediately integrated into the existing ethanol infrastructure

Corn ethanol already represents an existing and well-developed, multi-billion dollar market
The Supply Side Of The Equation Represents The Major Constraint For Commercial-Scale Deployment Of Cellulosic Ethanol

- There are currently no commercial-scale cellulosic ethanol plants
- Complex value chain requiring development of many technologies
- The first meaningful commercial-scale plants are not expected to be on-line until late 2011 or 2012
- Numerous hurdles remain to be overcome . . .

### Technical

- **Feedstock**
  - Diversity
  - Variability

- **Pretreatment**
  - High capital costs
  - High energy and chemical costs

- **Hydrolysis**
  - High enzyme usage rates and costs

- **Fermentation**
  - C5 and C6 fermentation
  - Inhibitor tolerance
  - Process robustness

- **Biological Scaling**

### Financial

- **Lack of capital / limited credit**
  - Private & public
  - “1st plant” technology aversion
  - Consistent Federal policies?

- **Without industry performance benchmarks (due to variations in plant size and performance) it will be difficult for investors to evaluate new proposals**

- **Unpredictable feedstock costs**
  - Lack of LT feedstock supply agreements
  - Undeveloped infrastructure/logistics

- **Requirement for LT off-take contracts**

- **Significant gasoline price variability**
Consolidated BioProcessing Offers the Lowest Cost Solution

Efficiency, Industrial-Scale Optimization => Low-Cost Production

Traditional Multi-Step Process
3 seed trains
2 independent fermentation processes

Pretreatment -> Liquid/solid separation -> Biomass hydrolysis -> Enzyme production

C5 fermentation

C6 fermentation

Distillation

Qteros CBP Process
Single consolidated process

Pretreatment -> Liquid/solid separation -> CBP via the Q process

Distillation

Capital Savings* => $50 to $100 million
Quantified Cash Operating Cost Savings: => 25+% lower
Unquantified Cash Operating Cost Savings => TBD, but significant
Incremental Annual Co-Product Revenue => $7 to $10 million

* Assumed 30 MGY facility
Qteros R&D Organization

Focused effort to develop and scale-up a process around C. phytofermentans

- **Current staff**
  - 28 scientists - 12 PhD's
- **Current facilities and capabilities**
  - 20,000 Sq ft general labs
  - Molecular biology, anaerobic microbiology, enzyme catalysis, analytical support, process development and engineering
  - Process Scale up 0.1L-5L, 20 and 100L STR
- **Core platform competencies**
  - Multiple feedstock assessment
  - Strain development
  - Fermentation process development and improvement
  - Technology transfer and implementation
Key Attributes of the Q Microbe®

*Clostridium phytofermentans* is well-suited to carry out Consolidated BioProcessing

- Co-ferments all 5 sugars present in biomass (C5 and C6 sugars)

- Ferments oligomeric sugars

- Produces ethanol as the primary product of fermentation

- Produces all of the enzymes required to digest biomass into fermentable sugars and all pathways required for conversion into ethanol
Biomass Degrading Enzymes in the Q Microbe®
The Q microbe® has 108 different biomass degrading enzymes

- Endoglucanases (7)
- Processive endoglucanases (1)
- Glucosidases (19)
- Cellobiose phosphorylases (5)
- CBM proteins (12)
- Xylanases & Xylosidases (17)
- Arabinofuranosidases (9)
- Acetyl Xylan Esterases (10)
- α-xylosidase, α-glucuronidase (9)
- Mannanases (3)
- Pectate lyases (4)
- Pectin methyl esterases (1)
- Arabinogalactosidases (1)
- α-fucosidases (5)
Q Microbe® Produces Ethanol at High Yield

*Ethanol is the primary product of metabolism of the Q microbe®*

### Glucose Equivalents

<table>
<thead>
<tr>
<th>Glucose Equivalents</th>
<th>Initial (g/l)</th>
<th>Final (g/l)</th>
<th>Yield (g/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol</td>
<td>0.4</td>
<td>25.2</td>
<td>0.45</td>
</tr>
<tr>
<td>Acetic Acid</td>
<td>0.19</td>
<td>1.96</td>
<td>0.03</td>
</tr>
<tr>
<td>Lactic Acid</td>
<td>1.35</td>
<td>1.66</td>
<td>0.01</td>
</tr>
<tr>
<td>Formic Acid</td>
<td>0.01</td>
<td>0.10</td>
<td>0.01</td>
</tr>
</tbody>
</table>
Q Microbe® Technical Value Proposition
Requires 80% Less Enzyme and Improves Yield

- Q microbe® converts both C6 and C5 sugars resulting in overall higher conversion as compared to yeast
- Q microbe® produces all the requisite enzymes required for fermentation therefore requires far less externally added enzyme as compared to yeast
To Reduce The **Technical Risks** And Optimize The Viability Of Large-Scale Supply, Qteros Is Investing In The Commercial Deployment Of The Q Microbe® Process

<table>
<thead>
<tr>
<th>Q Microbe® Attribute</th>
<th>Biomass</th>
<th>Pretreatment</th>
<th>Enzyme Production</th>
<th>Fermentation</th>
<th>Ethanol</th>
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</thead>
<tbody>
<tr>
<td>Digests a variety of feedstocks (corn stover, fiber, sugarcane bagasse, switchgrass)</td>
<td>Ferments oligomeric sugars</td>
<td>Naturally produces all of the enzymes required to digest biomass</td>
<td>Co-ferments C5 and C6 sugars</td>
<td>Ethanol is the primary natural product of the Q Microbe’s metabolism, at commercially-relevant yields</td>
<td></td>
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<tr>
<td>Metabolism adjusts to feedstock</td>
<td></td>
<td>Over 100 different genes for plant cell wall degradation</td>
<td>Anaerobic fermentation</td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Value to Customer</th>
<th>Utilizes low cost non-food/feed raw materials</th>
<th>Less acid</th>
<th>80% reduction in enzymes used</th>
<th>Fewer unit operations</th>
<th>Lower CAPEX and OPEX due to higher rates, titers, yields, fewer side products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum raw material and geographic flexibility for site selection</td>
<td>Lower pressure</td>
<td>Elimination of separate unit operations (saccharification, hydrolysis)</td>
<td>Less water</td>
<td></td>
<td></td>
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<tr>
<td>Less energy</td>
<td>Fewer inhibitors</td>
<td>Fewer FTEs</td>
<td>Less energy</td>
<td></td>
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<tr>
<td>Less complex engineering and design criteria</td>
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<td>Higher efficiency</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Fewer unit operations</td>
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<td></td>
<td>Lower OPEX due to</td>
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**Consolidated bio-processing represents the major step-function change required to accelerate broad and profitable commercial-scale deployment**
Ethanol is the primary natural product of the Q Microbe’s metabolism at commercially relevant yields.