At 700 billion tons, 

**Cellulose** is the Earth’s most widespread natural organic chemical. 
Let’s put it to work.
Biofuel Momentum

- Cellulosic is a leading, next-generation biofuel
  - Reduced carbon, food-price impact
  - U.S. RFS2: **Triple biofuel production by 2022**
    - 21B gallons cellulosic
  - European interest in biodiesel

Current

- Corn
- Sugarcane

Future

- Wood
- Corn stover
- Switchgrass
- Waste
$10B
Cellulosic Ethanol Landscape

2010

- 20 demo plants
- Poet: Full-scale, 100M gal./yr plant in 2011

2022

- 1000 plants
- $300B invested
Deconstruction Problem

Step 1. Pretreatment
Step 2. Hydrolysis
Step 3. Fermentation

Deconstruction enzymes are expensive and inefficient
Feedstock costs are not included. For more information please visit econ.jbei.org.
Solution: A Better Enzyme

- Compatible with Industrial Bio-refining
- Twice as Efficient
- Agnostic to End Fuel
- Stable in Heat, Acid & Ionic Liquids
- Decreases Risk of Microbial Infection
Result: Cheaper Enzyme

![Cost Comparison Chart]

- **Current Market Enzyme**
  - Enzyme Production Cost: $0.2
  - Guaranteed Profit: $0.2

- **JBEI Enzyme**
  - Enzyme Production Cost: $0.1
  - Guaranteed Profit: $0.5
Possibility 1: License to Enzyme Producers

**Upside**
- Broad Distribution
- Efficient Production
- Financial Strength

**Downside**
- 10-year Lead Time
- Low Revenue
- Production Compatibility
- Stagnation Risk

Logos: Novozymes, Genencor, DSM
Possibility 2: Start up with VC Funding

**Upside**
- Control of Technology
- Maximum Flexibility
- Financial Upside

**Downside**
- Experience Curve
- Funding Gap
Possibility 2: Scale with Strategic Partnerships

Future targets: Chevron, Amyris, LS9, INC., POET, IOGEN, Catchlight Energy, bp

<table>
<thead>
<tr>
<th>Upside</th>
<th>Downside</th>
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<tbody>
<tr>
<td>Prove Technology</td>
<td>Few Potential Partners</td>
</tr>
<tr>
<td>Access to Capital</td>
<td>Loss of Autonomy</td>
</tr>
<tr>
<td>Established Infrastructure</td>
<td></td>
</tr>
</tbody>
</table>
Risks

- **Market Risk**
  - Regulation
  - Price of oil
  - Industry standards

- **Technology Risk**
  - Scalability
  - Obsolescence
  - Intellectual property
  - Limited customers
I.P. Opportunity

- Core IP: Patents pending on engineered enzymes
  - 3 provisional applications – conversion upcoming
  - Recommendation: Broaden claim scope
    - Method claims
    - Composition + function claims

- Strategic IP
  - Company should expand portfolio of patents
    - Other enzymes and cocktails
Better Enzyme + $10B Market = Attractive Opportunity
Enzyme Team

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**Jaime Hennessey**
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**Richard Kenny**
1st year MBA student, holds a Master of Chemistry from Oxford. Thesis work in genetic modification of enzymes for clean tech applications. 5 years Investment Banking experience working with publically listed SMEs in London
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**Lucian Orbai**
2nd year law student, works in patent law (IP strategy and IP diligence) and used to be a scientist
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Appendix
Temperature Performance

% Activity

JBEI Enzyme

Current Market Enzyme

50°C
60°C
70°C
80°C
90°C
99°C
Promise of Cellulosic Ethanol

Promise of Cellulosic Ethanol

![Fossil Energy Requirements of Different Fuels](image)

- Gasoline: Fossil Btu = 1.23
- Corn Ethanol: Fossil Btu = 0.74
- Cellulosic Ethanol: Fossil Btu ~ 0.1

DOE Energy Efficiency & Renewable Energy
Promise of Cellulosic Ethanol

Figure 3: Ethanol generally produces fewer greenhouse gas (GHG) emissions.
Result: Cheaper Biofuel

Minimum Selling Price of Ethanol ($/gallon) vs. Price of Enzyme ($/gallon)

- Current Market Enzyme
- JBEI Enzyme

Most believable

- 1.50 gallon

The graph shows the minimum selling price of ethanol in relation to the price of enzyme. The most believable scenario is at 1.50 gallon, where the enzyme price is lower compared to the current market.
<table>
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<th>Summary</th>
<th>Loc.</th>
<th>Scale</th>
<th>Tech claims</th>
<th>Owner/partners</th>
<th>Hydrolysis</th>
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<tr>
<td>Enzyme manufacturer (47% world market)</td>
<td>DK</td>
<td>$1.5B revenues (18% corn ethanol)</td>
<td>EtOH from proprietary enzymes at $2.25/gal</td>
<td>Publically listed</td>
<td></td>
</tr>
<tr>
<td>Enzyme manufacturer (21% world market)</td>
<td>DK</td>
<td>$1.4B revenues. Pilot plant TN (250K gallons/yr)</td>
<td>Accelerase line feedstock/pretreatment flexible, improved hemicellulase, lower dose, cheaper</td>
<td>NREL</td>
<td></td>
</tr>
<tr>
<td>Bio-EtOH producer</td>
<td>CA</td>
<td>Demo plant Commercial plant under construction</td>
<td></td>
<td>Shell Goldman DSM</td>
<td></td>
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<tr>
<td>Enzyme manufacturer</td>
<td>US</td>
<td>Proprietary enzymes</td>
<td></td>
<td>Shell, Chevron</td>
<td>Acid, Heat</td>
</tr>
<tr>
<td>Cellulosic EtOH developer and enzyme manufacturer</td>
<td>US</td>
<td>$70M revenues. Pilot plant LA (50K gallon/yr), demo plant in San Diego under construction (1.4M gallons/yr)</td>
<td>Sugarcane, grass EtOH. Focusing on hemicellulases</td>
<td>DOE, BP</td>
<td></td>
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<tr>
<td>Bio-EtOH producer</td>
<td>US</td>
<td>--</td>
<td>--</td>
<td>CalCEF X/Seed</td>
<td>Acid, Heat</td>
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<tr>
<td>Bio-EtOH producer</td>
<td>US</td>
<td>Demo plant Commercial plant under construction</td>
<td>EtOH production at $2.50/gal</td>
<td>Khosla Flagship</td>
<td>Bacterial</td>
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