Sustainable Biofuels Growth: Hurdles and Outcomes

Raoul Oberman
Biofuels consumption is expected to more than double propelled by regulatory support

Global biofuels consumption
Billion gallons per year

<table>
<thead>
<tr>
<th>Year</th>
<th>1st Gen</th>
<th>2nd Gen</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>25</td>
<td>10-15</td>
</tr>
<tr>
<td>2020</td>
<td>50-55</td>
<td>65</td>
</tr>
</tbody>
</table>

Penetration in liquid fuel

- 2010: 2%
- 2020: 5%

Top drivers for biofuels growth
Percent

- Mandate: 31%
- Improved energy security: 20%
- Development of affordable fuels: 19%
- Need for sustainable fuels: 19%
- Other: 11%

SOURCE: 2010 McKinsey BIO survey; McKinsey analysis
An expanding global biofuels market will create distinct opportunities and challenges for different countries and regions.

- **Help reduce dependency on oil; Remain 2nd Generation technology innovator**
  - **US**

- **Exploit land and water resources to support domestic demand and exports**
  - **Brazil**

- **Convert fields into energy crops in Eastern Europe**
  - **EU**

- **Short on biomass to fulfil expectation**
  - **Africa**

- **Huge potential for feedstock cultivation; Less oil dependent growth**
  - **South East Asia**

- **Emulate Brazilian sugar-cane success**
  - **Brazil**
Growth will not happen if industry wide hurdles are not overcome

- Broader feedstock mobilization
- Steady-state economics reached
- Blend wall overcome
- Sustainability standards set
- Investor confidence restored

68% Industry would benefit from more coordination

Biofuels must mobilize broader biomass sources

Mandated primary energy demand

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>2000 TWh, 2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat</td>
<td>7.0</td>
</tr>
<tr>
<td>Power</td>
<td>2.7</td>
</tr>
<tr>
<td>Biofuels</td>
<td>1.9</td>
</tr>
</tbody>
</table>

Supply mobilization potential

<table>
<thead>
<tr>
<th>Source</th>
<th>Low mobilization of farmers</th>
<th>Technical potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste</td>
<td>0.7</td>
<td>12</td>
</tr>
<tr>
<td>Other land</td>
<td>4.8</td>
<td>9.4</td>
</tr>
<tr>
<td>Forestry</td>
<td>3.9</td>
<td>3.9</td>
</tr>
<tr>
<td>Agric. residues</td>
<td>0.7</td>
<td>2.8</td>
</tr>
<tr>
<td>Cropland</td>
<td>1.8</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Mobilizing agricultural residues will require

- Cost competitive technology: 80%
- Overcoming collection issues: 70%
- Incentives for residues use: 50%
- Farmer long-term contracts: 40%

Cellulosic ethanol commercialization will require coordinated investments throughout the chain...

Farmers will only mobilize for a minimum of $70-100/ton (US) or $45-55/ton (China)

Value chain must be backwards integrated to feedstock with clear alliances throughout the value chain

… and technology maturation to ensure an economic proposition for cellulosic biomass providers

65% Cellulosic based technology will not reach maturity until 2020

Affordable cost of biomass USD per ton

<table>
<thead>
<tr>
<th></th>
<th>1st Version LC</th>
<th>Nth Version LC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afforable cost</td>
<td>60-90</td>
<td>90-120</td>
</tr>
<tr>
<td>of biomass</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Blend wall can be overcome with E85 or Bio-butanol but stakeholders are not aligned on the best option

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E85</td>
</tr>
<tr>
<td>LC-ethanol</td>
<td>✔</td>
</tr>
<tr>
<td>Bio-butanol</td>
<td>✔</td>
</tr>
<tr>
<td>EPC</td>
<td>✔</td>
</tr>
<tr>
<td>Ethanol plant owners</td>
<td>✔</td>
</tr>
<tr>
<td>Refiner/blender</td>
<td>✔</td>
</tr>
<tr>
<td>Distributor</td>
<td>✔</td>
</tr>
<tr>
<td>Auto OEMs</td>
<td>✔</td>
</tr>
</tbody>
</table>

Sustainability standards can help overcome important perceptions but should not restrict growth

Key challenges facing biofuels sustainability

1. Demonstration of acceptable GHG footprint
2. Acceptable burden on water supply
3. Minimal impact on food supply

Should sustainability standards be changed?

- Too few criteria will restrict growth
- Too many criteria could restrict growth

80% Sustainability standards are critical to growth
6% No – they are good as they are today

Biofuels will need to position itself against other solutions within the energy matrix

**Land use Efficiency**
kMiles per acre crop, US example

1. **Biofuels**
   - 30

2. **Electric vehicles**
   - 37

- Tight value proposition given
  - Sensitivity to type of crop, process and car efficiency
  - Other non-land use related advantages

**By the year 2025, what will be the dominant fossil fuel alternative?**

- **60%** Bio-substitutes for gasoline
- **19%** Bio-diesel
- **16%** Electric vehicles

**SOURCE:** 2010 McKinsey BIO survey, McKinsey analysis
Private sector is still investing but may need to overcome anxiety to support significant investments required

### Biofuels investments needed to support 2020 growth
USD billions

| Next 10 years | 200 |

“Shares in publicly owned ethanol companies have mostly been slumping all year. [Some] have lost more than 80 percent of their value since the beginning of the year “

"Very few investors in any cleantech sector are going to be investing the amounts of capital we saw at the height in 2008,"
– *CleanTech Group*, 2010

### Potential actions to strengthen investor confidence

- **76%** Governments create long-term regulatory frameworks and offer incentives
- **60%** Science offers clear evidence of biofuel efficiency and carbon impact

Industry must coordinate to overcome these critical hurdles

- Availability of broader biomass feedstocks at affordable prices
- Nth version economics can be quickly achieved for new biofuels
- Agreement to blend wall solution
- Establishment of robust yet practical sustainability standards
- Restoration of investor confidence
Shape of the future depends on how these issues are tackled by the industry

**Future state**

- All players in the industry drive the growth with many winning
- Players pursuing their own growth with few winning
- Electric vehicles wins over biofuels

**Becomes reality if…**

- Industry coordinates to overcome major hurdles to drive growth
- Investor confidence restored
- Large players resolve many of the issues on their own
- Smaller players unable to solve issues to support their own growth
- Uncoordinated answer to biofuels resulting in unanswered challenges
- Investors not confident in biofuels
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