Future of Renewable Energy & Role of State Government

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Wisconsin Department of Agriculture, Trade & Consumer Protection

Overview

• BioEnergy Scope and Future
  – BioFuels
  – BioPower
  – BioProducts

• Rationale for Government Intervention
  – Federal Role
  – State Role
BioEconomy Scope

Renewable Product Matrix

<table>
<thead>
<tr>
<th>Biomass Feedstocks</th>
<th>Intermediate Platforms</th>
<th>Building Blocks</th>
<th>Secondary Chemicals</th>
<th>Intermediates</th>
<th>Products/Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hemicellulose</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cellulose</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lignin</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protein</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

DOE Biomass Program Multi-Year Technical Plan, 2003
BioProducts

- Chemicals
- Materials
**BioMaterials**

*BioMaterials include novel applications and traditional items.*

- **PLA**: Corn-based polymer can be used in fabric or in heavy duty plastic.

- **Milk Paint**: Traditional form of paint used in the 1800s that utilizes dairy milk as its base.

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**Substantial Influence of Industrial Biotechnology in Selected Markets**

<table>
<thead>
<tr>
<th>Market Size (USD billion)</th>
<th>2000</th>
<th>2010</th>
<th>CAGR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fine</td>
<td>1,000</td>
<td>90</td>
<td>+5.5%</td>
</tr>
<tr>
<td>Polymers</td>
<td>250</td>
<td>370</td>
<td>+3.5%</td>
</tr>
<tr>
<td>Bulk</td>
<td>300</td>
<td>380</td>
<td>+2.0%</td>
</tr>
<tr>
<td>Specialties</td>
<td>400</td>
<td>560</td>
<td>+3.0%</td>
</tr>
</tbody>
</table>

**Biotech Inroads today**

*Examples*

- Biopharmaceuticals
- 3GT, polylactic acid
- Ethanol, adipic acid, acrylamide
- Detergents, lubricants, Fragrances, food chemicals

**2010 Share**

- 60%
- 10-15%
- 0-50%

**Source**: McKinsey and Company, 2003

$160 - 280 billion
When will the BioIndustry Happen?

Achieving the vision will require an entirely new toolbox – a set of technologies that is unique from that of the petroleum-based chemical industry.

Renewable Energy Report Card

<table>
<thead>
<tr>
<th></th>
<th>Renewable Energy Use (percent of total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>6%</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>4.5%</td>
</tr>
<tr>
<td>Minnesota</td>
<td>2.0%</td>
</tr>
<tr>
<td>Iowa</td>
<td>4.0%</td>
</tr>
</tbody>
</table>

Source: US Energy Information Agency
### US Energy Consumption by Energy Source

<table>
<thead>
<tr>
<th>Energy Source</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total</strong></td>
<td>98.961</td>
<td>96.464</td>
<td>97.952</td>
<td>98.714</td>
<td>100.28</td>
</tr>
<tr>
<td><strong>Fossil Fuels</strong></td>
<td>84.965</td>
<td>83.176</td>
<td>84.070</td>
<td>84.889</td>
<td>86.186</td>
</tr>
<tr>
<td><strong>Natural Gas</strong></td>
<td>23.916</td>
<td>22.861</td>
<td>23.628</td>
<td>23.069</td>
<td>23.000</td>
</tr>
<tr>
<td><strong>Petroleum</strong></td>
<td>38.404</td>
<td>38.333</td>
<td>38.401</td>
<td>39.047</td>
<td>40.130</td>
</tr>
<tr>
<td><strong>Renewables</strong></td>
<td>6.158</td>
<td>5.328</td>
<td>5.835</td>
<td>6.082</td>
<td>6.117</td>
</tr>
<tr>
<td><strong>Hydroelectric</strong></td>
<td>2.811</td>
<td>2.242</td>
<td>2.689</td>
<td>2.825</td>
<td>2.725</td>
</tr>
<tr>
<td><strong>Geothermal</strong></td>
<td>0.317</td>
<td>0.311</td>
<td>0.328</td>
<td>0.339</td>
<td>0.340</td>
</tr>
<tr>
<td><strong>Biomass</strong></td>
<td>2.907</td>
<td>2.640</td>
<td>2.648</td>
<td>2.740</td>
<td>2.845</td>
</tr>
<tr>
<td><strong>Solar</strong></td>
<td>0.066</td>
<td>0.065</td>
<td>0.064</td>
<td>0.064</td>
<td>0.063</td>
</tr>
<tr>
<td><strong>Wind</strong></td>
<td>0.057</td>
<td>0.070</td>
<td>0.105</td>
<td>0.115</td>
<td>0.143</td>
</tr>
</tbody>
</table>

### Clean Energy Projected Growth

<table>
<thead>
<tr>
<th>Source</th>
<th>2005</th>
<th>2015</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Biofuels</strong></td>
<td>$52.5</td>
<td>$51.1</td>
</tr>
<tr>
<td><strong>Wind Power</strong></td>
<td>$48.5</td>
<td>$48.5</td>
</tr>
<tr>
<td><strong>Solar Power</strong></td>
<td>$11.8</td>
<td>$11.2</td>
</tr>
<tr>
<td><strong>Fuel Cells</strong></td>
<td>$1.2</td>
<td>$1.2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>$39.9</td>
<td>$167.2</td>
</tr>
</tbody>
</table>

Source: Clean Energy Trends 2006
Biofuels

• Ethanol

• Biodiesel

• Future Technology
  – Cellulosic
  – Forestry
Ethanol among the first and biggest markets to profit from low-cost biomass feedstock

**Cost reduction**

US cent/gallon

Cost

- 90 Corn
- 130 Now
- 70 Mid
- 40 Long

Ethanol Price Range

**Biomass-based ethanol**

**US market growth**

(DOE estimate)

Billion gallons

(Legislation to support fuel ethanol also in Canada, Europe, Brazil, others)

March of the Biohols with the right combination of technological breakthroughs and investment, the US transportation fuel economy could make the transition to biofuels by 2030. Here’s how that might play out:

Source: http://www.kholaventures.com/presentations/ImaginingTomorrowSept2006

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BIOHOL TRAJECTORY

Biodiesel Facilities in U.S.
US Biodiesel Capacity Outlook

If the tax incentive is not extended beyond 2008, then capacity expansion will be flat or decline.

Source: Informa Economics

Wind Energy Projects
Throughout the United States of America

Total installed U.S. wind energy capacity: 10,039 MW as of July 31, 2006
Installed MW for each state in black.
Updated: August 4, 2006; http://www.awea.org/projects/
New National Goals

US Senate and House signed concurrent resolutions to support all 25x25 policy.

- 25% fuel and 25% power by 2025

- Wisconsin 25 x 25
  - 1.0> billion gallons of renewable fuel
  - Top 10 bioproduct producing state
Government Intervention

Governor Doyle Announces Four UW Campuses to Be Energy Independent By 2012

Governor Doyle Proposes $450 Million Public, Private Investment Strategy to Develop Renewable Energy

Governor Blagojevich unveils ambitious energy independence plan to reduce Illinois’ reliance on foreign oil

Illinois provides $25 million in grants for biofuels plants

GOVERNOR PAWLENTY ANNOUNCES TESTING OF E85 CONVERSION KITS

Governor Pataki Unveils Innovative National Policy To Dramatically Reduce Our Dependence On Foreign Oil

USDA–DOE MAKE AVAILABLE $4 MILLION FOR BIOMASS GENOMICS RESEARCH

First E85 station opens in Florida

Rationale for Intervention

• Macro Policy
  – Energy Independence
  – Economic Development
  – Environmental Benefits

• Micro Policy
  – Shared Risk
    • Research and Development
    • Commercialization
    • Market/Consumption
Federal Intervention

• US Energy Consumption
• US Energy Policy

2005 Energy Policy Act

• Mandate 7.5 billion gallons of biofuels by 2012
  – Cellulosic 1 billion gallons by 2015
• Ethanol Excise Tax Credit
  – Ethanol blend $.51/gal
  – Small producer production credit
  – Bidiesel tax credit -$1/gal thru 2008
• CCC BioEnergy Program
US Energy Policy

*Focus on renewable energy and energy efficiency for vehicles and homes.*

**Vehicles**
- Flex Fuel Vehicle Tax Incentive
- Clean Diesel Regulations
- Extend Ethanol and Biodiesel Tax Benefits
- Advanced Batteries--Lithium
- Cellulosic Ethanol
- Hydrogen Fuel Cell Vehicles

**State Renewable Energy Incentives with Biomass Provisions**

http://www.dsireusa.org/

1) **Financial Incentives**
   - State Grant Programs 53
   - Production Incentives for Renewable Power Generation 27
   - Loan Programs 60
   - Property Tax Incentives 37
   - Personal Income Tax Incentives 25
   - Corporate Tax Incentives 27
   - Sales Tax Incentives 20
   - Industrial Recruitment Incentives 10
   - Rebate Programs 104
State Renewable Energy Incentives with Biomass Provisions (cont’d)

2) Rules & Regulations
   - Construction and Design Policies 14
   - Generation Disclosure Rules 23
   - Green Power Purchasing/Aggregation Policies 19
   - Net Metering Rules 36
   - Public Benefit Funds 17
   - Renewable Portfolio Standards/Set Asides/Goals 24
   - Mandatory Utility Green Power Option 5

Fuel Incentives-Fed/State (use and conservation)

<table>
<thead>
<tr>
<th></th>
<th>Grants</th>
<th>Tax Incentive</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal</td>
<td>20</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Minnesota</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Iowa</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Source: US Energy Information Agency
Ag/Forestry Value Chain

- Seed Development
  - Input traits
  - Output traits
  - Process traits
  - Plants as factories
- Crop Production
  - Pest control
  - Quality
  - Post-harvest
  - Stress management
- Crop Processing
  - Food
  - Feed
  - Chemicals
  - Materials
- Crop Utilization
  - Food
  - Fuels
  - Pharmaceuticals
  - Automotive
  - Aerospace
  - Electronics

BIOTECHNOLOGY
State Intervention

- Midwest Best Energy Practice
- Wisconsin’s Energy Picture

![Image of Governor Richardson, Mark Heffernan, Will Allen and Governor Doyle]

Midwest States’ Best Practices

- **Implement statewide biofuels use requirement**
  - Since 1997, Minnesota has required all gasoline sold in the state to be E10.

- **Encourage the purchase of flex fuel vehicles**
  - Governor Blagojevich proposed a $500 in state sales tax credit on flex fuel vehicles

- **Adjust tax rates to encourage additional biofuel consumption**
  - Kansas signed a bill to reduce motor vehicle fuel tax on E85 by 7 cents.
**Midwest States’ Best Practices**

- *Create R&D fund to encourage emerging technology*
  - Kentucky’s public universities support energy research through their Energy Research and Development Program
  - WI BIO grants 12 projects; $1m,

- *Use state’s purchasing power to create demand for biofuels*
  - Executive Order 141- cut State’s petro gas by 20% by 2010 and 50% by 2015

**The Future**

“Our plan for the emerging bio-based economy will rely on our natural and agricultural resources, historic strengths in manufacturing, research and quality workforce. These world class assets are what sets Wisconsin apart from competitors. And we want local and producer ownership to be a priority as this part of our economy develops.”

*Rod Nilsestuen, Secretary, Wisconsin Department of Agriculture, Trade & Consumer Protection*