Global Trends Affecting
the U.S. Forest Sector

Jim L. Bowyer
University of Minnesota
Department of Bio-based Products
St. Paul, MN
Global Trends Affecting the U.S. Forest Sector

- Global mega-trends that will impact the forest sector
- National trends important to forestry
- Implications of global and national trends for the forest products industry of the N.E.
- The emerging bio-economy
- The bio-economy, bio-energy and the N.E. forest products industry – threat or opportunity?
- Positioning for the future
Global Mega-Trends that will Impact the Forest Sector
Global Mega-Trends

- Globalization
- Expansion of the global economy
- Growth of energy demand and the approach of peak petroleum
- Increasing interest in bio-energy
- Growth of global fiber supplies
- Rising global competition
Global Mega-Trends

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Global Mega-Trends

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Gross World Product, 1970-2004

An increase of 174 percent.

GDP in the U.S. vs. Other Economies, 2003

GDP in the U.S. vs Other Economies, 2050

China’s Gross Domestic Product
(Exchange Rate Valuation)

Billions of 1987 U.S. Dollars

The result is unprecedented growth of consumption worldwide.
Considering the combined effect of population growth and economic growth within developing nations, demand for new housing units globally over the next 50 years is likely to exceed one billion.
Global Mega-Trends

- Globalization
- Expansion of the global economy
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World Energy Consumption, 1970-2025

<table>
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<tr>
<th>Year</th>
<th>Average Daily Imports</th>
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<tr>
<td>1970</td>
<td>&lt; 10,000&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>1997</td>
<td>800,000&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>2004</td>
<td>2,100,000&lt;sup&gt;b&lt;/sup&gt;</td>
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<tr>
<td>2025 (est.)</td>
<td>9,400,000&lt;sup&gt;b&lt;/sup&gt;</td>
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World Petroleum Consumption 1800 - 2100
Consensus is Emerging that Peak Petroleum Production is in Sight

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<tr>
<th>Source</th>
<th>Forecast Period</th>
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<tr>
<td>OECD International Energy Agency</td>
<td>2010-2020</td>
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<tr>
<td>World Resources Institute</td>
<td>2007-2014</td>
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<tr>
<td>J. Edwards, Colo. School of Mines</td>
<td>2020</td>
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<td>U.S. Department of Energy</td>
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US Energy Production, Consumption, and Imports, 1960 - 2025
(Quadrillion Btu)

U.S. Petroleum Supply, Consumption, and Imports, 1970-2025
(million barrels per day)

U.S. Trade Deficit, Energy Products, 1974 - 2004

Global Mega-Trends

- Globalization
- Expansion of the global economy
- Growth of energy demand and the approach of peak petroleum
- **Increasing interest in bio-energy**
- Growth of global fiber supplies
- Rising global competition
Bio-Energy Sources

- Trees
- Grasses
- Agricultural Crops
- Agricultural Residues
- Animal Wastes
- Municipal Solid Waste
Bio-Energy Options

- Hydrogen
- Ethanol
- Biodiesel
- Replacement for fossil fuels in electricity generation
- Steam generation for district heating
Bio-Energy Options

- Hydrogen
- Ethanol
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- Replacement for fossil fuels in electricity generation
- Steam generation for district heating
Beyond energy, there are opportunities for producing a wide range of chemicals and industrial feedstocks from biomass.
Bio-Energy Options

- Hydrogen
- Ethanol
- Biodiesel
- Replacement for fossil fuels in electricity generation
- Steam generation for district heating
- Olefins
Many of these chemicals and materials are currently obtained from petroleum.
Many are predicting the emergence of a **Bio-economy** - an economy where basic **building blocks for industry and the raw materials for energy** are derived from **plant/crop-based** (i.e. renewable) sources.

A Vision of the BioEconomy in the Year 2020

**Biorefinery:**
Cluster of biobased industries producing chemicals, fuels, power, products, and materials

Source: NREL
An Integrated Bio-Economy Has Many Facets

Raw Material Options
- Trees
- Grasses
- Agricultural Crops
- Agricultural Residues
- Animal Wastes
- Municipal Solid Waste

Technologies
- Acid/enzymatic hydrolysis
- Fermentation
- Bioconversion
- Chemical Conversion
- Composite products technologies
- Gasification
- Combustion
- Co-firing

End-Uses

Products
- Plastics
- Functional Monomers
- Solvents
- Chemical Intermediates
- Phenolics
- Adhesives
- Hydraulic Fluids
- Fatty acids
- Carbon black
- Paints
- Dyes, Pigments, and Ink
- Detergents
- Paper
- Horticultural products
- Fiber boards
- Solvents
- Plastic filler
- Abrasives
- Building products

Fuel Power

An Integrated Bio-Economy Has Many Facets

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Fuel Power

In the future, products now derived from petroleum will be made from a variety of biochemicals and biofeedstocks arising from biorefineries.
Bio-economy – the Future is Now

Chemical and Material Demand 10% from Renewable Resources by 2020
~$400 billion/year in products (2 times current Forest Products)

US DOE Technology Roadmap for Plant/Crop based Renewable Resources
Increasing economic importance of biomass has major implications for the forest products industry.
Globalization

Expansion of the global economy

Growth of energy demand and the approach of peak petroleum

Increasing interest in bio-energy

Growth of global fiber supplies

Rising global competition
Growth of Global Fiber Supplies

- Plantations
- Re-emergence of the forest sector of Russia and Eastern Europe
- Increasing Availability of Tropical Timber
Growth of Global Fiber Supplies

- Plantations
- Re-emergence of the forest sector of Russia and Eastern Europe
- Increasing Availability of Tropical Timber
Productive industrial wood plantations globally covered 109 million hectares (269 million acres) in 2005. This is 2.8% of the forest area globally.

Percent of Forest Plantation Area Globally by Region, 2004

Contribution of Plantations to World Timber Harvest

Source: ABARE 1999

Source: Brooks, USDA Forest Service (2002)
The impact of this development on the forest products industry globally will be profound.
Growth of Global Fiber Supplies

- Plantations
- Re-emergence of the forest sector of Russia and Eastern Europe
- Increasing Availability of Tropical Timber
Softwood Lumber Production in the USSR and Russian Federation

Source: Historical FAO (FAOSTAT) (2003); projections Kangas and Baudin (2003).
Potential Increase in Russian Timber Harvest

- Harvest level in 2005 was 140-160 million m³.
- The net annual increment in Russian forests is estimated at about 900 million m³.
- The annual allowable cut announced by the Russian government in 2004 is 559 million m³.
- Potential increase in harvest ~ 410 million m³.
- The entire U.S. timber harvest in 2005 was approximately 450 million m³.
Russian Foreign Trade in Paper and Timber Products, 1994-2003

Recent and Coming Sawmill Investment in Russia, Baltics, and E. Europe (2002-2006)

- Proposed for Russia - 40 sawmills
- Proposed for Baltics & E. Eur. - 15 sawmills
  
  Total ’02 – ’06 55 sawmills

A total of 8.5 million m³ (3.7 billion bf – net; or ~ 6 billion board feet (nominal) so far.


Growth of Global Fiber Supplies

- Plantations
- Re-emergence of the forest sector of Russia and Eastern Europe
- Increasing Availability of Tropical Timber
Global Mega-Trends

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Top 10 Hardwood Log Exporters Globally

$ Million

Source: Global Trade Atlas as reported by FAS – Note: Ukraine and Uruguay data unavailable for 2000 and 2001.
U.S. Hardwood Lumber Exports as a Percentage of Hardwood Lumber Production, 1994-2004

U.S. Hardwood Lumber Exports by Destination, 1994

U.S. Hardwood Lumber Exports by Destination, 2004

China Lumber Imports by Species Type, 1992-2004

Top 10 Softwood Lumber Importers

China Log Imports by Species Type, 1986-2004

Top 10 Hardwood Log Importers

Top 10 Wood Product Importers

Source: Global Trade Atlas (reporting countries)
Domestically Produced Share of U.S. Consumption, 1990 and 2002

U.S. Trade Balance, Timber Products, 1965-2004

## North American Hardwood Lumber

### Production and Estimated Uses

(Billion Board Feet)

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U.S. Hardwood Lumber Consumption, 1977-2004

Consumption up 44.2%, 1977-1999

U.S. Hardwood Lumber Consumption, 1977-2004

Consumption down 12.6%, 1999-2004

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Hardwood Lumber Consumption by U.S. Furniture Industry, 1994-2004

U.S. Wood Household Furniture Imports vs. Exports, 1993-2004

## Wood Household Furniture Imports by Country, 1993-2005
(Million $)

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<tr>
<td>China</td>
<td>$139.2</td>
<td>$2,893.6</td>
<td>$3,592.5</td>
<td>$4,179.5</td>
<td>$4,759.2</td>
<td>13.9</td>
<td>3,319.0</td>
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<td>Canada</td>
<td>307.3</td>
<td>1,267.7</td>
<td>1,240.4</td>
<td>1,276.8</td>
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<td>Malaysia</td>
<td>158.3</td>
<td>414.5</td>
<td>442.6</td>
<td>521.3</td>
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<tr>
<td>Vietnam</td>
<td>0.0</td>
<td>63.1</td>
<td>148.3</td>
<td>321.6</td>
<td>612.1</td>
<td>90.3</td>
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<td>Indonesia</td>
<td>85.5</td>
<td>414.2</td>
<td>405.1</td>
<td>422.8</td>
<td>480.1</td>
<td>13.5</td>
<td>461.5</td>
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<td>Italy</td>
<td>135.8</td>
<td>484.3</td>
<td>479.2</td>
<td>451.3</td>
<td>413.1</td>
<td>-8.5</td>
<td>204.2</td>
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<td>Mexico</td>
<td>148.4</td>
<td>372.1</td>
<td>341.6</td>
<td>336.0</td>
<td>371.0</td>
<td>10.4</td>
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<td>Thailand</td>
<td>129.9</td>
<td>297.7</td>
<td>310.2</td>
<td>392.5</td>
<td>344.0</td>
<td>-12.3</td>
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<td>Brazil</td>
<td>28.6</td>
<td>187.9</td>
<td>200.1</td>
<td>272.6</td>
<td>305.5</td>
<td>12.1</td>
<td>968.2</td>
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<tr>
<td>Philippines</td>
<td>109.5</td>
<td>109.2</td>
<td>106.3</td>
<td>112.1</td>
<td>137.2</td>
<td>22.4</td>
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<td>Total Imports</td>
<td>$2,148.5</td>
<td>7,605.1</td>
<td>8,349.3</td>
<td>9,485.6</td>
<td>10,491.2</td>
<td>10.6</td>
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U.S. Cabinet Exports, 1989-2005

U.S. Cabinet Imports vs. Exports, 1989-2005

# North American Hardwood Lumber Production and Estimated Uses

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<td>0.83</td>
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</tr>
<tr>
<td>Pallets/Crating</td>
<td>4.40</td>
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<td>4.93</td>
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</tr>
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<td>1.40</td>
<td>1.40</td>
<td>1.43</td>
<td>1.40</td>
<td>1.40</td>
<td>1.40</td>
<td>1.50</td>
</tr>
<tr>
<td>Exports</td>
<td>0.95</td>
<td>1.10</td>
<td>1.20</td>
<td>1.10</td>
<td>1.17</td>
<td>1.16</td>
<td>1.20</td>
</tr>
<tr>
<td>Misc.</td>
<td>0.75</td>
<td>0.75</td>
<td>0.72</td>
<td>0.65</td>
<td>0.65</td>
<td>0.60</td>
<td>0.60</td>
</tr>
</tbody>
</table>

Hardwood Lumber Consumption by U.S. Mouldings Industry, 1998-2004

U.S. Hardwood Moulding Imports vs. Exports, 1993-2005

# Hardwood Molding Imports by Country, 1998-2005

*(Million Lineal Meters)*

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>China</td>
<td>1,574</td>
<td>5,578</td>
<td>38,282</td>
<td>45,068</td>
<td>45,423</td>
<td>75,912</td>
<td>102,078</td>
<td>101,794</td>
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<tr>
<td>Chile</td>
<td>352</td>
<td>2,065</td>
<td>1,008</td>
<td>6,554</td>
<td>8,860</td>
<td>25,734</td>
<td>33,820</td>
<td>23,127</td>
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<tr>
<td>Malaysia</td>
<td>27,354</td>
<td>26,923</td>
<td>29,406</td>
<td>24,843</td>
<td>27,628</td>
<td>23,437</td>
<td>25,484</td>
<td>21,297</td>
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<tr>
<td>Brazil</td>
<td>4,366</td>
<td>12,251</td>
<td>17,005</td>
<td>11,253</td>
<td>13,194</td>
<td>16,102</td>
<td>15,880</td>
<td>12,438</td>
</tr>
<tr>
<td>Indonesia</td>
<td>51,356</td>
<td>59,071</td>
<td>53,052</td>
<td>25,619</td>
<td>20,952</td>
<td>15,977</td>
<td>22,510</td>
<td>20,766</td>
</tr>
<tr>
<td>Canada</td>
<td>10,520</td>
<td>11,637</td>
<td>12,460</td>
<td>12,005</td>
<td>10,367</td>
<td>13,934</td>
<td>17,087</td>
<td>15,909</td>
</tr>
<tr>
<td>Argentina</td>
<td>52</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>460</td>
<td>4,206</td>
<td>3,891</td>
<td>345</td>
</tr>
<tr>
<td>Total Imports</td>
<td>113,953</td>
<td>145,781</td>
<td>180,818</td>
<td>146,092</td>
<td>144,698</td>
<td>186,674</td>
<td>235,553</td>
<td>211,219</td>
</tr>
</tbody>
</table>

## North American Hardwood Lumber Production and Estimated Uses

(Billion Board Feet)

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>N. Amer. Production</td>
<td>14.00</td>
<td>14.25</td>
<td>14.00</td>
<td>11.50</td>
<td>11.20</td>
<td>10.32</td>
<td>11.35</td>
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<tr>
<td>Utilization by Sector</td>
<td>13.54</td>
<td>13.43</td>
<td>14.32</td>
<td>11.73</td>
<td>11.22</td>
<td>10.74</td>
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<td>Furniture</td>
<td>3.40</td>
<td>3.40</td>
<td>3.45</td>
<td>1.80</td>
<td>1.70</td>
<td>1.56</td>
<td>1.40</td>
</tr>
<tr>
<td>Cabinets</td>
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<td>0.56</td>
<td>0.55</td>
<td>0.58</td>
<td>0.61</td>
<td>0.64</td>
<td>0.78</td>
</tr>
<tr>
<td>Dim./Millwork/Mdg.</td>
<td>0.60</td>
<td>0.60</td>
<td>0.86</td>
<td>0.85</td>
<td>0.70</td>
<td>0.67</td>
<td>0.70</td>
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<tr>
<td>Flooring</td>
<td>0.58</td>
<td>0.62</td>
<td>0.49</td>
<td>0.83</td>
<td>0.84</td>
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</tr>
</tbody>
</table>

Hardwood Lumber Consumption by U.S. Flooring Industry, 1998-2004

U.S. Hardwood Flooring Imports vs. Exports, 1993-2005

U.S. Hardwood Flooring Imports vs. Exports, 1993-2005

# Hardwood Flooring Imports by Country, 2000-2005

(000$)

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>8,077</td>
<td>6,700</td>
<td>15,148</td>
<td>36,486</td>
<td>101,419</td>
<td>147,810</td>
<td>1,730</td>
</tr>
<tr>
<td>Brazil</td>
<td>9,628</td>
<td>6,051</td>
<td>7,743</td>
<td>18,857</td>
<td>54,444</td>
<td>94,125</td>
<td>877</td>
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<tr>
<td>Canada</td>
<td>11,298</td>
<td>4,962</td>
<td>15,479</td>
<td>38,906</td>
<td>28,187</td>
<td>17,147</td>
<td>14</td>
</tr>
<tr>
<td>Indonesia</td>
<td>27,306</td>
<td>18,668</td>
<td>17,046</td>
<td>20,608</td>
<td>23,776</td>
<td>20,051</td>
<td>-27</td>
</tr>
<tr>
<td>Italy</td>
<td>605</td>
<td>760</td>
<td>2,709</td>
<td>6,690</td>
<td>6,496</td>
<td>6,985</td>
<td>1,055</td>
</tr>
<tr>
<td>Taiwan</td>
<td>894</td>
<td>313</td>
<td>979</td>
<td>1,720</td>
<td>5,341</td>
<td>5,834</td>
<td>553</td>
</tr>
<tr>
<td>Malaysia</td>
<td>19,932</td>
<td>8,858</td>
<td>7,601</td>
<td>6,775</td>
<td>5,240</td>
<td>8,740</td>
<td>-56</td>
</tr>
<tr>
<td>Germany</td>
<td>2,493</td>
<td>2,420</td>
<td>5,719</td>
<td>7,633</td>
<td>4,861</td>
<td>2,842</td>
<td>14</td>
</tr>
<tr>
<td>Paraguay</td>
<td>385</td>
<td>606</td>
<td>1,638</td>
<td>3,267</td>
<td>4,161</td>
<td>4,944</td>
<td>1,184</td>
</tr>
<tr>
<td>Thailand</td>
<td>12,994</td>
<td>4,867</td>
<td>8,287</td>
<td>6,781</td>
<td>3,696</td>
<td>4,463</td>
<td>-66</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>161,257</td>
<td>114,135</td>
<td>140,321</td>
<td>12,206</td>
<td>318,454</td>
<td>415,019</td>
<td><strong>+ 157</strong></td>
</tr>
</tbody>
</table>

Source: Foreign Agricultural Service (2006)
U.S. Softwood Lumber Production by Region and Net Imports as a Percent of Consumption, 1990-2005

Imports now 46%

U.S. Softwood Lumber Imports from Canada and Other Regions, 1990-2005

U.S. Softwood Lumber Trade with China, 1989-2005

So far a very positive picture, but . . .

U.S. Particleboard Trade with China, 1989-2005

U.S. Particleboard Trade with China, 1989-2005

U.S. OSB Trade with China, 1998-2005

U.S. Softwood Flooring Trade with China, 1989-2005

U.S. Softwood Siding Imports from China, 1989-2005

Exports at or near zero throughout this period

U.S. Trade of Softwood Plywood with China, 1989-2005

U.S. Trade of Hardboard with China, 1999-2005

U.S. Trade of Medium Density Fiberboard with China, 1989-2005

China’s Paper Production, 1961 – 2004
(thousand metric tons)

Total exports in 1997 – 45,000 mt
Total exports in 2002 – 206,000 mt
2002 U.S. trade deficit with China, paper & pbd, $806 million.

Implications of Global Trends for the Forest Sector of the United States
Implications of Global Trends for the Forest Sector of the U.S.

- Expanding global economies are stimulating consumption worldwide, creating market opportunities.

- Global demand for housing is growing more rapidly than population.

- U.S. population growth will ensure growing domestic consumption.

- Expanding middle classes in developing economies around the world will lead to increasing demand for quality goods.
Implications of Global Trends for the Forest Sector

- Supplies of low-cost fiber are increasing as fast-growing forest plantations expand globally.

- In the near term, raw materials will flow to installed capacity. In the longer term, capital will flow to regions with abundant, low cost fiber.

- The reemergence of Russia as a wood products producer will add to global timber and wood fiber supplies.
Implications of Global Trends for the Forest Sector

- China and other developing nations are aggressively seeking to compete in the wood products arena, severely challenging traditional producing regions.

- Little of the wood flowing through Asian wood products industries is certified. Considerable quantities are from illegal sources.
Implications of Global Trends for the Forest Sector

- Rising energy consumption and approaching limits to petroleum production translate to rising interest in alternatives, including bio-energy and biochemicals and feedstocks.

- Bio-energy development will mean new markets for wood, but also rising prices for wood raw materials.
From a number of perspectives, the changing situation presents a clear and substantial opportunity.
The Bio-Economy, Bio-Energy and the U.S. Forest Sector – Threat or Opportunity?
Liquid Fuels Represent an Enormous Opportunity for the Forest Sector
# Energy Required to Deliver 1,000,000 Btu to a Vehicle Fuel Tank

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Total Energy Required (Btu)</th>
<th>Fossil Energy Required (Btu)</th>
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<td>Gasoline</td>
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## Energy Required to Deliver 1,000,000 Btu to a Vehicle Fuel Tank

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<tr>
<td>Ethanol (corn-starch)</td>
<td>1,587,000</td>
<td>600,000</td>
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(http://egov.oregon.gov/ENERGY/RENEW/Biomass/forum.shtml)
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<td>600,000</td>
</tr>
<tr>
<td>Ethanol (corn cellulose)</td>
<td>1,250,000</td>
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<tr>
<td>Ethanol (corn cellulose)</td>
<td>1,250,000</td>
<td>230,000</td>
</tr>
<tr>
<td>Ethanol (wood)</td>
<td>2,600,000</td>
<td>10,000</td>
</tr>
</tbody>
</table>

(http://egov.oregon.gov/ENERGY/RENEW/Biomass/forum.shtml)
The potential for production of biochemicals and biofeedstocks presents a further opportunity.
Current Chemical Paper Mill

90 x 10^6 mt CO_2
Purchased Energy (30% of energy needs - $2.0 billion)

Pulpmill
Energy, Steam, Chemicals

BL Recovery Power Boiler
Black liquor, residuals
Energy, Steam, Chemicals

Paper Manufacture

Chemical Paper Mill
The Forest Biorefinery

- Extract Hemicelluloses
- New products, chemicals, polymers ($3.3 billion)

- Black liquor gasifier
- Wood residual gasifier
- Combined cycle system
- Process to mfg. liquid fuels and chemicals

CO₂ + O₂ → Syngas

Power export ($3.8 billion) or Liquid Fuels/Chemicals ($5.5 billion)

66 x 10⁴ mt CO₂
Positioning for the Future
Positioning for the Future

- Develop a revitalized program of wood products research and development
  - Industry, academia, government
  - Fast, nimble, applied
  - Proprietary

- Position research establishment for more effective monitoring of R&D globally.

- Seek to understand foreign competitors on an ongoing basis
  - Benchmark
  - Monitor
  - Profile consumer trends, market trends
Positioning for the Future (Cont.)

- Strategically plan on a region-wide basis.
- Carefully consider the role of northeastern forests in bio-fuels initiatives – take steps to proactively anticipate the future.
- Ensure that opportunities for production of bio-chemicals/bio-feedstocks are part of bio-fuels development.
- Seek win-win opportunities between agricultural and wood products sectors.
The bottom line is that the existence and vitality of a future wood products industry in the northeastern U.S. will be largely determined by the region’s residents and leaders.
For More Information on this Topic:

- [www.dovetailinc.org](http://www.dovetailinc.org)