Using Wood Products to Reduce Greenhouse Gases

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Outline

- Global warming--what is it?
- Greenhouse gases (GHG) a major cause
- Major interest in reducing GHG
- Carbon storage to reduce GHG
- Ways to reduce GHG using wood products
  - Forest carbon sequestration
  - Wood products storage
  - Use of wood products for fossil-fuel intensive products
  - Use of biomass fuels for fossil fuels
- In conclusion
Global Warming—Earth
Increasing in Temperature

Global Warming Predictions

2070-2100 Prediction vs. 1960-1990 Average

Based on HadCM3

Temperature Increase (°C)

The Greenhouse Effect is a natural process that warms the Earth's surface. Solar radiation passes through the clear atmosphere and is partly reflected by the Earth and the atmosphere. Some of this radiation is absorbed by the Earth's surface and warms it. Infrared radiation is emitted from the Earth's surface. Some of this radiation passes through the atmosphere, and some is absorbed by greenhouse gas molecules. The effect of this is to warm the Earth's surface and the lower atmosphere.
Greenhouse Gases (GHG)

- Water Vapor
- Carbon dioxide (CO$_2$)
- Methane (CH$_4$)
- Nitrous Oxide (N$_2$O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulfur hexafluoride (SF$_6$)

Source: IPCC 2001
- Water Vapor
- Carbon dioxide (CO$_2$)
- Methane (CH$_4$)
- Nitrous Oxide (N$_2$O)
- Hydrofluorocarbons (HFCs)
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- Sulfur hexafluoride (SF$_6$)
Global Warming Potential Index
(carbon dioxide weight equivalence)

\[ GWPI = \text{CO}_2 \text{ kg} + (\text{CH}_4 \text{ kg x 23}) + (\text{N}_2\text{O \ kg x 296}) \]

Source: IPCC 2001
Global Trends in Major GHG

GWPI = \[ \text{CO}_2 \text{ kg} + (\text{CH}_4 \text{ kg} \times 23) + (\text{N}_2\text{O} \text{ kg} \times 296) \]

CO\textsubscript{2} is the dominant contributor to GWPI.
Carbon Dioxide in Atmosphere

A Need to Reduce CO$_2$ Emissions

- 161 nations sign the Kyoto Protocol to limit CO$_2$ emissions as a GHG.
- U.S. government proposes to reduce “carbon intensity.”
- Governors of seven NE States agree to reduce CO$_2$ emissions and propose carbon credit exchange.
- Governors of OR, WA, and CA sign the Global Warming Initiative.
Carbon Stored in Wood prevents CO₂ release to atmosphere.

- Carbon Storage in Forest
- Log
- CO₂ emissions
- Building Products
- Carbon Storage in Building Products
- Reuse
- Recycle
- Disposal/Landfill

O₂

SUN
Preventing CO$_2$ Release to Atmosphere

- Storage of carbon in forest
- Storage of carbon in wood products (which includes housing)
- Substituting wood products for fossil-fuel intensive products
- Fuel switching from fossil to biomass fuel
Carbon Storage in Forest

Photosynthesis releases oxygen to atmosphere and generates carbon into wood tissue—storing carbon.
Forest Carbon Storage
“no-action taken” vs. 80-yr. harvest cycle

Forest and Products Carbon Storage

carbon in wood products adds to forest carbon

Carbon storage difference of substituting wood for some concrete products in houses

Carbon for sum of forest, wood product, and substitute carbon greater than for no-action forest management.

Storage of Carbon in U.S. Forests

<table>
<thead>
<tr>
<th>Year</th>
<th>East Forest</th>
<th>West Forest</th>
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</thead>
<tbody>
<tr>
<td>1952</td>
<td>8.0</td>
<td>4.0</td>
</tr>
<tr>
<td>1963</td>
<td>10.5</td>
<td>4.5</td>
</tr>
<tr>
<td>1977</td>
<td>12.0</td>
<td>5.0</td>
</tr>
<tr>
<td>1988</td>
<td>13.5</td>
<td>5.5</td>
</tr>
<tr>
<td>1998</td>
<td>15.0</td>
<td>6.0</td>
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</table>
Carbon Storage in U.S. Housing

Wood framed house to code

Mass of components in house

5,700 kg carbon store per house
Carbon Storage in U.S. Housing
116 million house inventory in 2000

Houses Built During Decade (millions)

Year Houses Built

U.S. Census Bureau 2001
Carbon Storage in U.S. Houses

123 million houses in 2004 store about 700 million metric tons of carbon—similar to a large forest’s store pool.
Biomass Fuel Use Impact Neutral
(US EPA states burning of biomass hogged fuel is impact neutral in terms of global warming)
■ U.S. Wood Products Industry produces about 50% of its energy needs—almost 3,500 quadrillion joules in 1998.

■ U.S. Wood Products Industry is third only to the petroleum and chemicals industries in amount of energy used.
Example of wood fuel use in industry

**Fuel use for the manufacture of plywood in the U.S.**

<table>
<thead>
<tr>
<th></th>
<th>PNW on-site energy</th>
<th></th>
<th>SE on-site energy</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MJ/m³</td>
<td>%</td>
<td>MJ/m³</td>
<td>%</td>
</tr>
<tr>
<td>Wood fuel (biomass)</td>
<td>1400</td>
<td>87.3</td>
<td>1990</td>
<td>85.6</td>
</tr>
<tr>
<td>Natural gas</td>
<td>150</td>
<td>9.4</td>
<td>277</td>
<td>11.9</td>
</tr>
<tr>
<td>Liquid petroleum gas</td>
<td>20</td>
<td>1.3</td>
<td>35</td>
<td>1.5</td>
</tr>
<tr>
<td>Diesel</td>
<td>34</td>
<td>2.1</td>
<td>23</td>
<td>1</td>
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</tbody>
</table>
Biomass Fuel Impact Neutral
US EPA states for burning of hogged fuel

Total CO₂ emissions for combustion from forest seedling through harvesting and manufacturing.

<table>
<thead>
<tr>
<th>Emissions</th>
<th>Lumber</th>
<th></th>
<th>Plywood</th>
<th></th>
<th>OSB</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kg/m³</td>
<td>%</td>
<td>kg/m³</td>
<td>%</td>
<td>kg/m³</td>
<td>%</td>
</tr>
<tr>
<td>CO₂ (wood fuel)</td>
<td>204</td>
<td>73</td>
<td>187.5</td>
<td>67</td>
<td>378</td>
<td>56</td>
</tr>
<tr>
<td>CO₂ (fossil)</td>
<td>77</td>
<td>27</td>
<td>92</td>
<td>33</td>
<td>294</td>
<td>44</td>
</tr>
</tbody>
</table>
Wood industry for primary products derives over half its energy needs from biomass fuel—this component does not contribute to global warming.

Wood industry for primary products derives over half its energy needs from fossil fuel—contributing to global warming but offering opportunity for biomass fuel substitution to reduce global warming.
Life Cycle Assessment of Wood Products and Houses

Life Cycle Assessment

- Air, Land, and Water Pollution Indices
- Global Warming Potential Index
- Resource Use
In Conclusion

- Greenhouse gases contribute to global warming.
- The major greenhouse gas is carbon dioxide that occurs due to combustion of fuels.
- Forests and wood products store carbon that has been removed as carbon dioxide from the atmosphere.
- Forests can be managed to increase the amount of carbon stored.
- Carbon storage can be increased by harvesting and using wood products when the non-wood product substitution effect is considered.
- Use of biomass fuels for fossil fuels reduces global warming.
- Wood is a “green” material and can be used to reduce greenhouse gases and in turn global warming.