NORTH AMERICA - RECENT ADVANCES AND FUTURE TRENDS

Michael R. Milota
Department of Wood Science and Engineering
Oregon State University
Corvallis, OR, USA

US Lumber Production (2005)

- Softwoods $82.2 \times 10^6$ m$^3$ (40.1 bbf)
  - West $37.7 \times 10^6$ m$^3$
  - South $38.9 \times 10^6$ m$^3$
  - Other $7.2 \times 10^6$ m$^3$

- Hardwoods $28.2 \times 10^6$ m$^3$ (HW includes Canada)

Recent times were good

- **2006**
  - higher log prices
  - lower lumber prices
- **general economic slowdown**
- **added capacity**

Spike down in west U.S. in '03

Western Canada prices more stable

Delivered softwood sawlog prices in North America, 2001-2005

- US West
- Canada East
- US South
- Canada West

**Note:** Index is based on delivered log prices in local currency.

**Source:** Wood Resource Quarterly, Wood Resources International, 2006.
SAWMILL IMPROVEMENTS

- Improved size control
- Moisture sorting
- Species sorting

57% privately owned

Top 10 States for Forestland in 2002

Source: USDA Forest Service, Forest Resources of the U.S., 2002
- 29% state and federal
- 58% in non-industrial private ownership
- 13% industrial private forests

**Top 10 States for Timberland in 2002**

Source: USDA Forest Service, *Forest Resources of the U.S., 2002*

**TABLE 5.6**

Ten countries with greatest annual increase in productive forest plantation area 1990–2005

<table>
<thead>
<tr>
<th>Country/Area</th>
<th>Area of productive forest plantations (1 000 ha)</th>
<th>Annual change (1 000 ha)</th>
<th>Annual change rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>17 131</td>
<td>21 765</td>
<td>28 530</td>
</tr>
<tr>
<td>Russian Federation</td>
<td>9 244</td>
<td>10 712</td>
<td>11 888</td>
</tr>
<tr>
<td>United States</td>
<td>10 305</td>
<td>16 274</td>
<td>17 061</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>664</td>
<td>1 384</td>
<td>1 792</td>
</tr>
<tr>
<td>Indonesia</td>
<td>2 209</td>
<td>3 002</td>
<td>3 399</td>
</tr>
<tr>
<td>Chile</td>
<td>1 741</td>
<td>2 354</td>
<td>2 661</td>
</tr>
<tr>
<td>Australia</td>
<td>1 023</td>
<td>1 485</td>
<td>1 766</td>
</tr>
<tr>
<td>Portugal</td>
<td>383</td>
<td>867</td>
<td>1 067</td>
</tr>
<tr>
<td>Republic of Korea</td>
<td>748</td>
<td>1 188</td>
<td>1 364</td>
</tr>
<tr>
<td>Turkey</td>
<td>1 459</td>
<td>1 763</td>
<td>1 916</td>
</tr>
</tbody>
</table>
Growth and Removals in the U.S. in 2002

- Total: 30 billion cubic feet
- Softwoods: 15 billion cubic feet
- Hardwoods: 10 billion cubic feet

Net Growth and Removals (28.3 ft³ per m³)

Source: USDA Forest Service, Forest Resources of the U.S., 2002

Top Exported Forest Products in 2005

Source: USDA Foreign Agricultural Service U.S. Trade Data
Softwoods exported from U.S. \((m^3 \times 10^6)\)

Source: Random Lengths 2005 Yearbook
US Softwood Imports (m$^3 \times 10^{-6}$)

Source: Random Lengths 2005 Yearbook

Source: Random Lengths 2005 Yearbook
Secondary manufacturing is important to wood products

Global development
Chinese export destinations

Source: CNFA 2004
TREND: Market Shifts

- Big box retailers
  - dictate quantity, quality, price, terms-of-sale

- Green certification
  - Environmental pressure
  - Is the market aware?

- Substitute products
  - Wood (e.g., I-beams, OSB)
  - Non-wood (steel studs, vinyl windows)
  - Combinations (composite decking)

TREND: U.S. Companies divesting themselves of U.S. timberland

- Timber Investment Management Organizations purchasing forest land
  - 2001-2006, 22 million to 24 million acres of U.S. timberland has changed hands
  - 19 largest U.S. timberland owners, as of Dec. 31, consisted of nine TIMOs, three REITs and six forest-products companies

- Manufacturing companies
  - wood is a raw material
  - where wood originates is less important

Divesting timberland provides import opportunities

- Price
- Quality
  - Grade
  - Moisture content
  - Stress
  - Color
- Reliability
  - Delivery
  - Supply

Just pull up to the beach and unload North Bend, OR 1999

TREND: Company consolidation

- Stora (Sweden) & Enso (Finland)
- International Paper & Champion Int.
- Fort Howard & James River
- Weyerhaeuser & MacMillan Bloedel (Canada)
- Willamette & Weyerhaeuser
- Mead & Westvaco

http://www.members.tripod.com/sallyrae3/carissa.html
TREND: Mill consolidation

- Oregon sawmills (number)
  - 1968: 300
  - 1985: 173
  - 1994: 106
  - 1998: 93
  - 2003: 126

Source: Brandt et al. 2006. Oregon’s forest products industry and timber harvest

- Impact on drying
  - Longer haul distances ~150 km average
  - More variability in raw material
  - More variability into kiln
  - Larger kilns, faster production
Sudden Oak Death

- Severe in California, limited in Oregon
- *Phytophthora ramorum* a water mold
- Attacks hardwoods
  - Tanoak, Live Oak, Black Oak, Madrone
  - Big-leaf Maple
- Can attack softwoods
  - Douglas-fir
  - Coast redwood

MAJOR ISSUE: Forest Health

- Overstocked stands from fire suppression
- Stressed trees
- Beetle attack
- Standing dead timber
- Impact on drying
  - Blue-stained lumber
  - MC variability
  - Lower quality
  - Checks/splits before the kiln

Forest Insect & Disease Leaflet
http://www.fs.fed.us/r6/nr/fid/fidl2.htm
Energy

- Natural gas prices
- 10 years ago mills made a switch to NG
  - Low cost
  - Plentiful
- 5 years ago prices started to climb
- Permit problems for wood boilers

### Industrial Natural Gas in Oregon

<table>
<thead>
<tr>
<th>Year</th>
<th>Price (US$/1000 ft³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>5.70</td>
</tr>
<tr>
<td>2005</td>
<td>7.13</td>
</tr>
<tr>
<td>2006</td>
<td>9.04</td>
</tr>
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</table>


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U.S. Department of Energy, Washington, DC

### Biomass use will increase

- \(2.3 \times 10^{17} \) J
- Down a little, but now increasing

#### Drivers

- Cost of natural gas
- Fuels reduction
- \(\text{CO}_2\) (future)
Biomass

- Billion ton per year goal (30% of fossil fuel)
- Forest thinnings
  - Harvest and transport costs
  - Environmental issues
- CO₂ benefits
- Warm Springs project

Eastern Oregon Pine Stand
http://www.nifc.gov/harvesting/

Yosemite, 1920s
http://www.nifc.gov/harvesting/
Yosemite, 1990s

ENERGY EFFICIENCY WILL BECOME MORE IMPORTANT

Theoretical: heating intake air = 5 to 15% of kiln energy. Higher for hardwood kilns

Payback based on energy only has been unfavorable for widespread adoption

Economics are changing with energy prices

Tax incentives

Other benefits? - better airflow, more uniform conditions in kiln
The Redry Problem

- Distribution from western hemlock

![Bar chart showing moisture content distribution](image)

- Average = 14.3
- 15% are <10% MC
- 10% are >19% MC

LARGE RFV KILN

- Operating in Washington State, USA since ’02
- Used for redry of dimension lumber
- 33% to 18% MC in 6 hours
- Elustondo et al. FPJ 55(1):76-83
- 4.6% reduction in drying time
- Shrinkage went from 4.65 to 4.14 % (reduce the target size)
- 4.7% less degrade
- Payback could be 10-20 months
Smaller RFV Kilns

- Five smaller units in Oregon
- Drying large timbers (up to 0.7 m squares)
- In 20x20 cm pieces, core minus shell MC
  - 3 to 4 % in RF
  - 7 to 8 % in conventionally
- Advantage is clearly drying time

The Mold Issue

- Causes
  - Wet pieces
  - Condensation inside of package
  - Too many lawyers

TRENDS:

- Spray wettest pieces of dry lumber
- Spray all pieces of dry lumber
- More attention to moisture content of product
International Plant Protection Convention (IPPC) 2002

- Created a market for heat treatment kilns
- Pallets are the largest single use of hardwood lumber in U.S.
- Simpson, FPJ 56(7/8):26-28
  - Regressions for heating in saturated steam
  - Easier to use than theoretical equations
- Slahor et al. FPJ 55(4):59-61
  - 2x4s – 40 or 96 (frozen) minutes
  - Water pollution problem?

TREND: Lower temperature drying for hardwoods

- Maple and other species
- Lower wet-bulb depressions
  (28°C in past, 20-22°C now)
WATER FOR HUMIDIFICATION

- No kiln overheat
- Use fewer boiler chemicals
- Less make up water to boiler

- Spinning disc
- Sprays

IN-KILN MOISTURE METERS

- Important change in the way we dry lumber
- Many large facilities have installed in past five years
- Kiln shut down
- MC-based schedules
- Zone control
DRY-END MOISTURE METERS

- Moisture distribution
- Automatic calibration of in-kiln based on meter at planer
- In the future – more integration of moisture information

TREND: Measurement of emissions from drying

- Volatile organic compounds
- Hazardous air pollutants
- No emission control equipment required on lumber kilns in U.S. except a stack at one location
DEHUMIDIFICATION
DRYING TO 112°C

- Heat pump
- No boiler
- Environmentally friendly refrigerant
- No venting
- No air VOC emissions

Warp reduction

- Side restraint:
  - Shmulshey: FPJ 56(3):41-43 and FPJ 55(10)25-27
- Saw twist into boards
  - Kliger et al. FPJ 56(2):61-65
- Warp reduction – drying after curve sawing
  - Deutschlander et al. FPJ 56(2):78-84
POLYESTER BANDING

- Strap package prior to drying
- Band is in a stretched condition
- Straighter lumber
- Safer handling

Wetwood NIR

Measure reflectance from 700-2500 nm
Certain chemicals absorb at certain wavelengths
Was not successful in separating "slow-to-dry" wood
Will easily sort by MC

Graphs showing predicted vs. measured extractives content and principal component analysis.
Control by acoustic emissions

- Beall et al., FPJ 55(12):167-174
- Acoustic emissions – noises given off as the lumber dries
- Accelerate schedule by drying faster when the board is quiet
- Also some research in ultrasonics

THE FUTURE

- Timber supply not diminishing
- Sensing and control
  - in-kiln MC
  - adaptive control
- Small cogen facilities
- Information sharing in mill
- Public awareness of forest overstocking
- The closed dry kiln

- Housing slowdown
- Added capacity
- Higher log prices
- Lower log quality
- Higher natural gas prices
- Urbanization