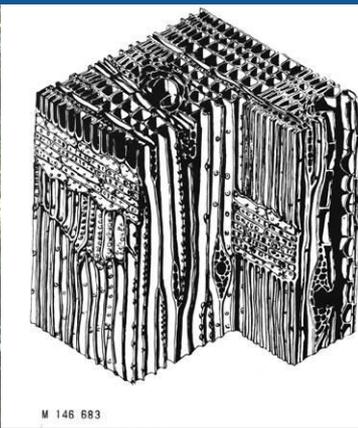


Cellulose Nanomaterials: The Sustainable Material of Choice for the 21st Century

Theodore H. Wegner, Ph.D.
Assistant Director
USDA Forest Service
Forest Products Laboratory
June 26, 2012

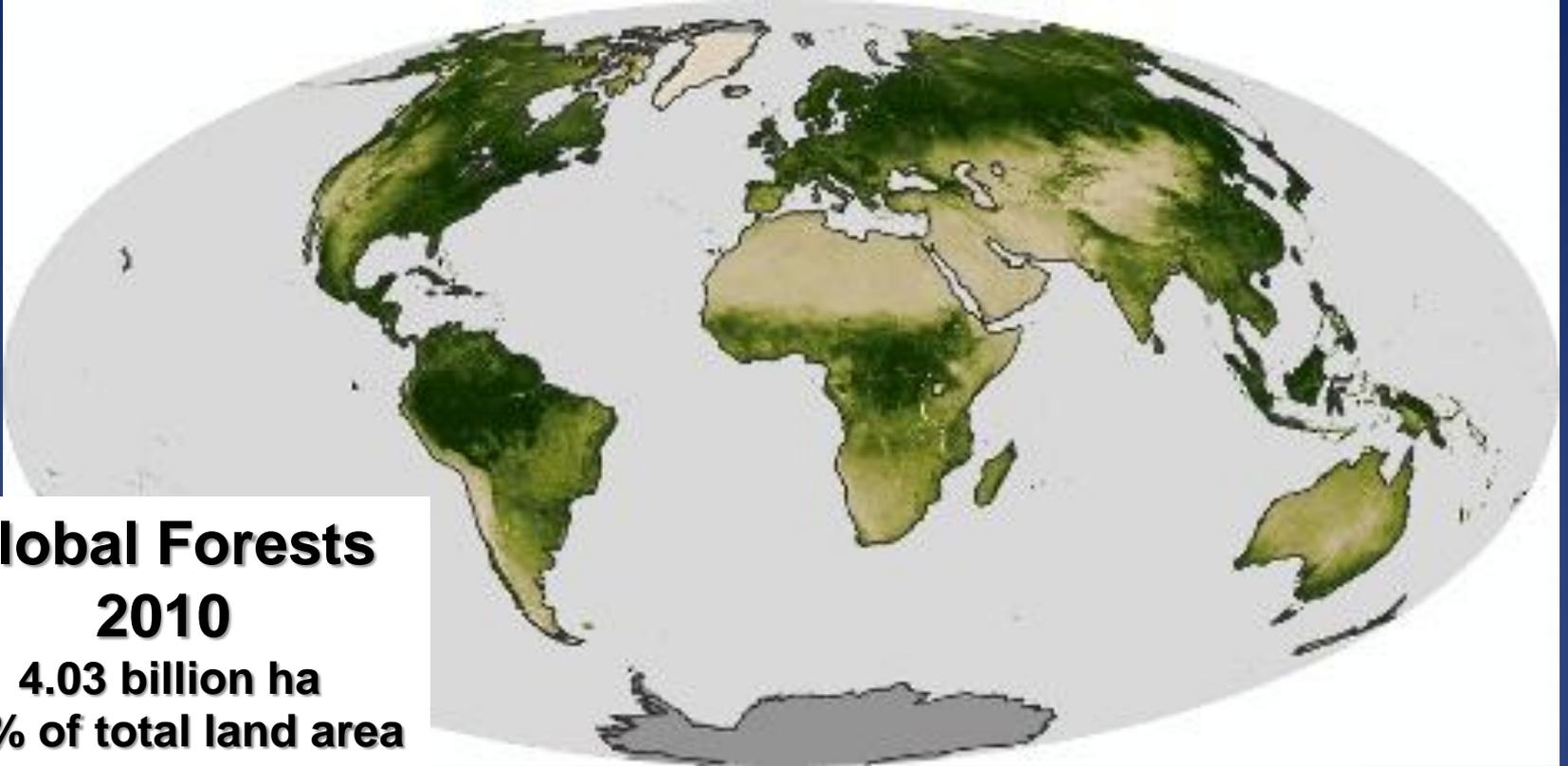


Sustainable Nanomaterials Workshop

Overview

- **Wood: a Sustainable & Renewable Material**
- **Cellulosic Nanomaterials From Wood**





Global Forests 2010

**4.03 billion ha
31% of total land area**

Top 5 forested countries:

Russian Federation.....	809 million ha.....	20.6% world's forests
Brazil.....	520 million ha.....	12.9% world's forests
Canada.....	310 million ha.....	7.7% world's forests
U.S.....	304 million ha.....	7.5% world's forests
China.....	207 million ha.....	5.1% world's forests

Food and Agriculture Organization, 2010. *Global Forest Resources Assessment, 2010*. Forestry Paper 163, Food and Agriculture Organization. Rome, Italy. 378p.

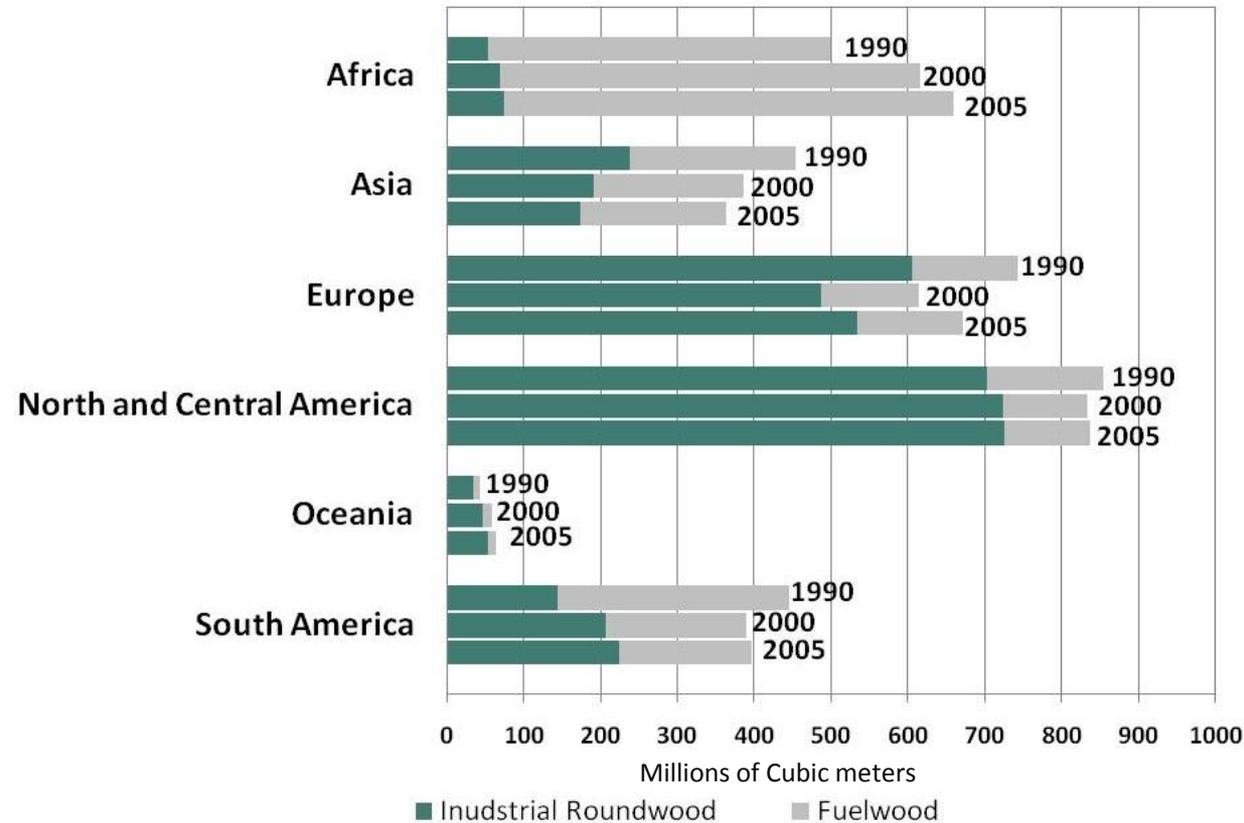
<http://www.fao.org/docrep/013/i1757e/i1757e.pdf>

Global Production for Wood Products

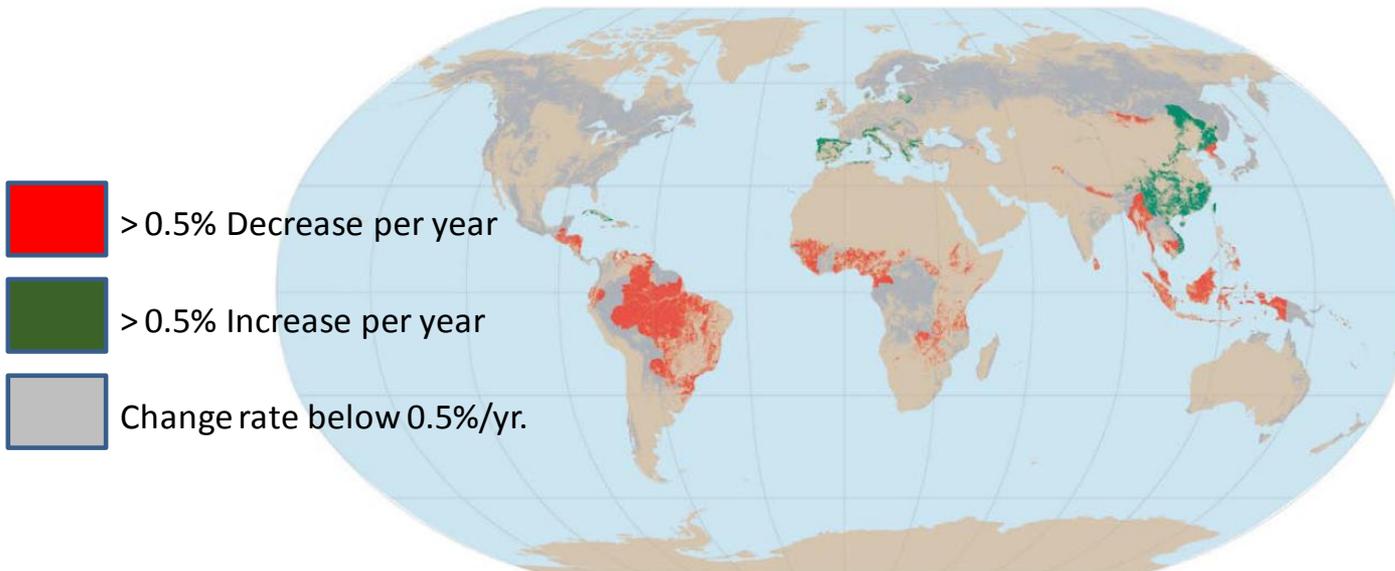
Top 10 Countries in 2005

(industrial roundwood, in thousand cubic meters)

Country	1990	2000	2005	Change 1990-2005
United States	499,193	495,740	481,006	-3.6%
Canada	188,753	212,012	214,057	+13.4%
Russian Fed.	268,396	104,546	134,870	-49.7%
Brazil	115,254	92,102	117,048	+1.6%
Sweden	56,476	64,729	75,539	+33.8%
China	64,814	55,502	63,882	-1.6%
Germany	37,043	47,265	58,788	+58.7%
Finland	43,840	55,721	55,152	+25.8%
India	35,055	41,173	45,957	+31.1%
Chile	16,455	28,862	36,032	+119.0%



Countries with Highest Industrial use of wood have the most stable forest base



America's Forest Resource

304million hectares (751 million acres)

78.1 % of 1630 area

2/3 of
America's
forests are
east of the
Mississippi

Growth to Harvest
Ratio 2:1

- Public forest
- Private forest
- Nonforest
- Urban areas

About 3/4 of America's
private forests are in
the East

100 0 100 200 300 400 500 Miles



Data sources:
Forest: National Land Cover Data (1992)
Ownership: Protected Areas Database (2001)
Urban areas: Digital Chart of the World (1998)

Timberland*, Contiguous US

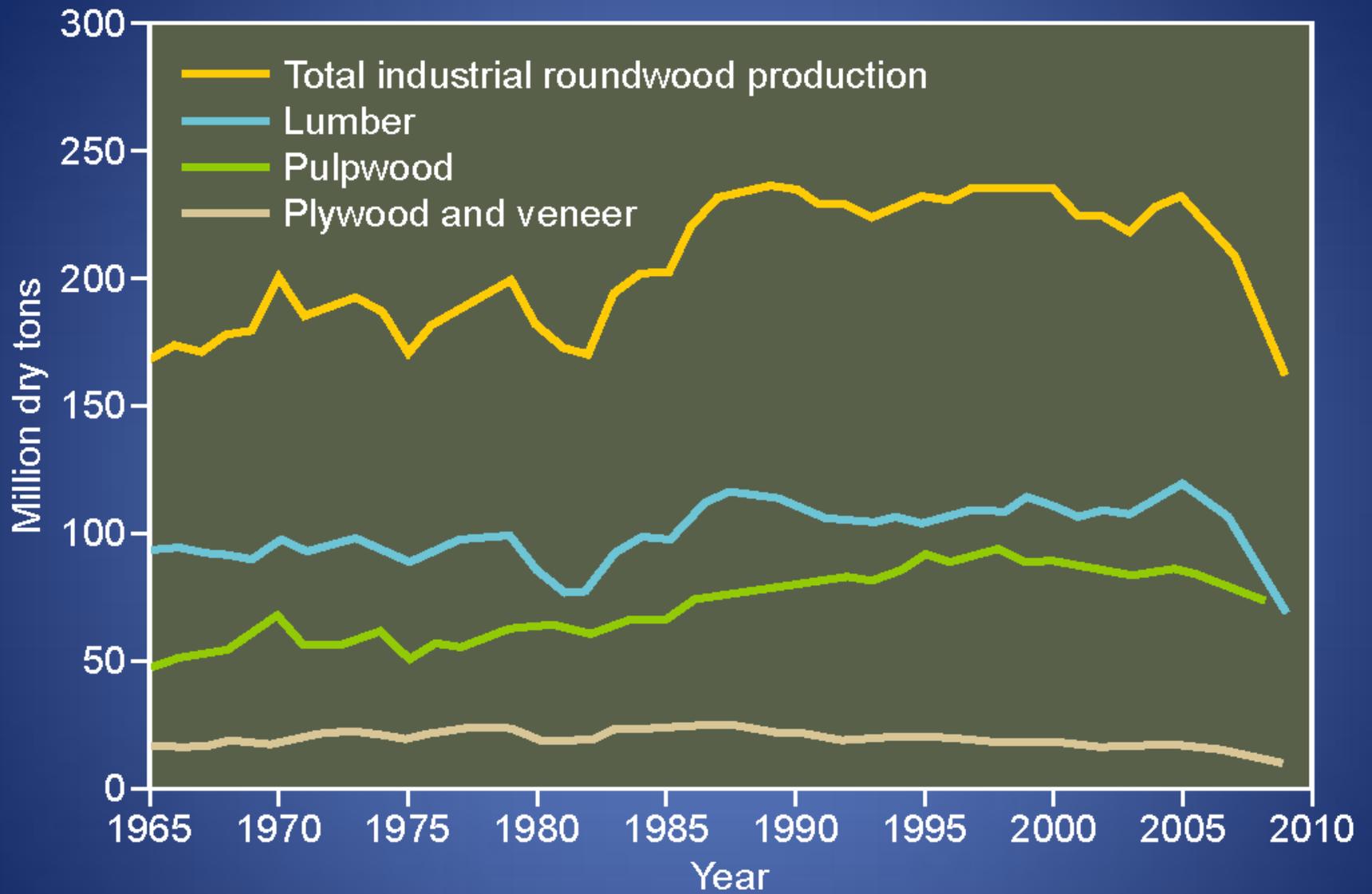
	Standing Biomass	Net Annual Timber Growth	Annual Timber Removals	Annual Timber Mortality
Region	million dry tons			
NE	4082	49	18	14
NC	3376	50	25	16
SE	3745	92	65	18
SC	4928	107	81	25
Great Plains	157	1	1	1
Intermountain	2857	25	8	20
OR & WA	3122	50	29	14
CA	1381	23	7	5
Total	23648	397	232	114

(~1%)

http://nrs.fs.fed.us/pubs/gtr/gtr_wo78.pdf

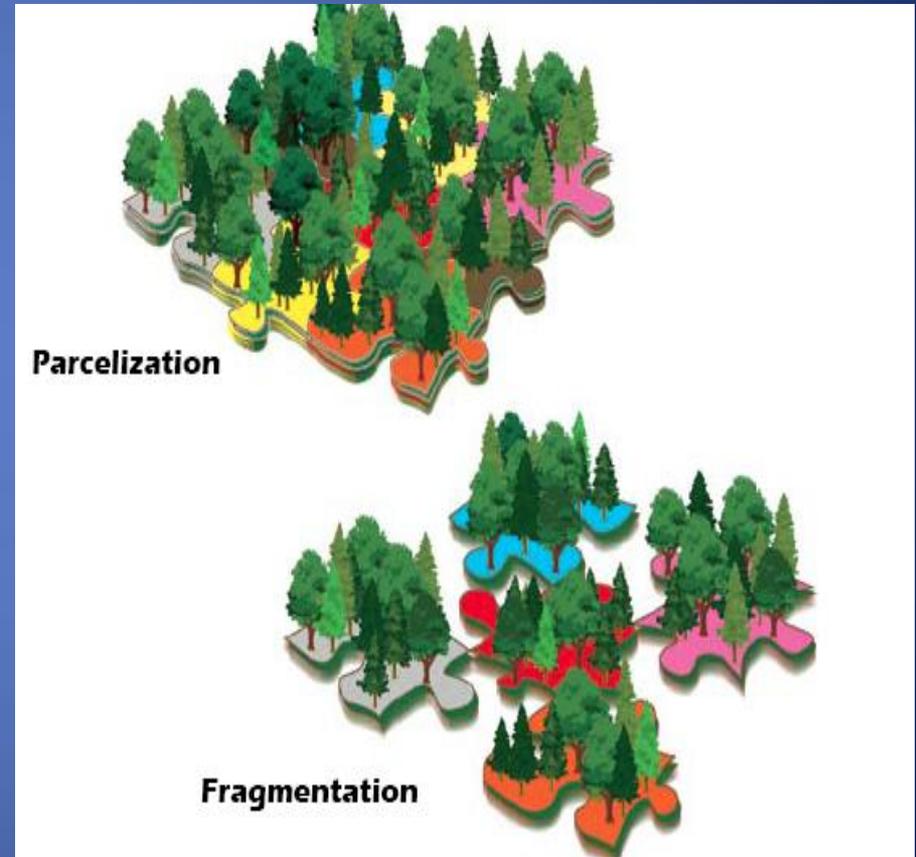
* Growing >20 cubic feet of timber/acre/year (data exclude Alaska & Hawaii)



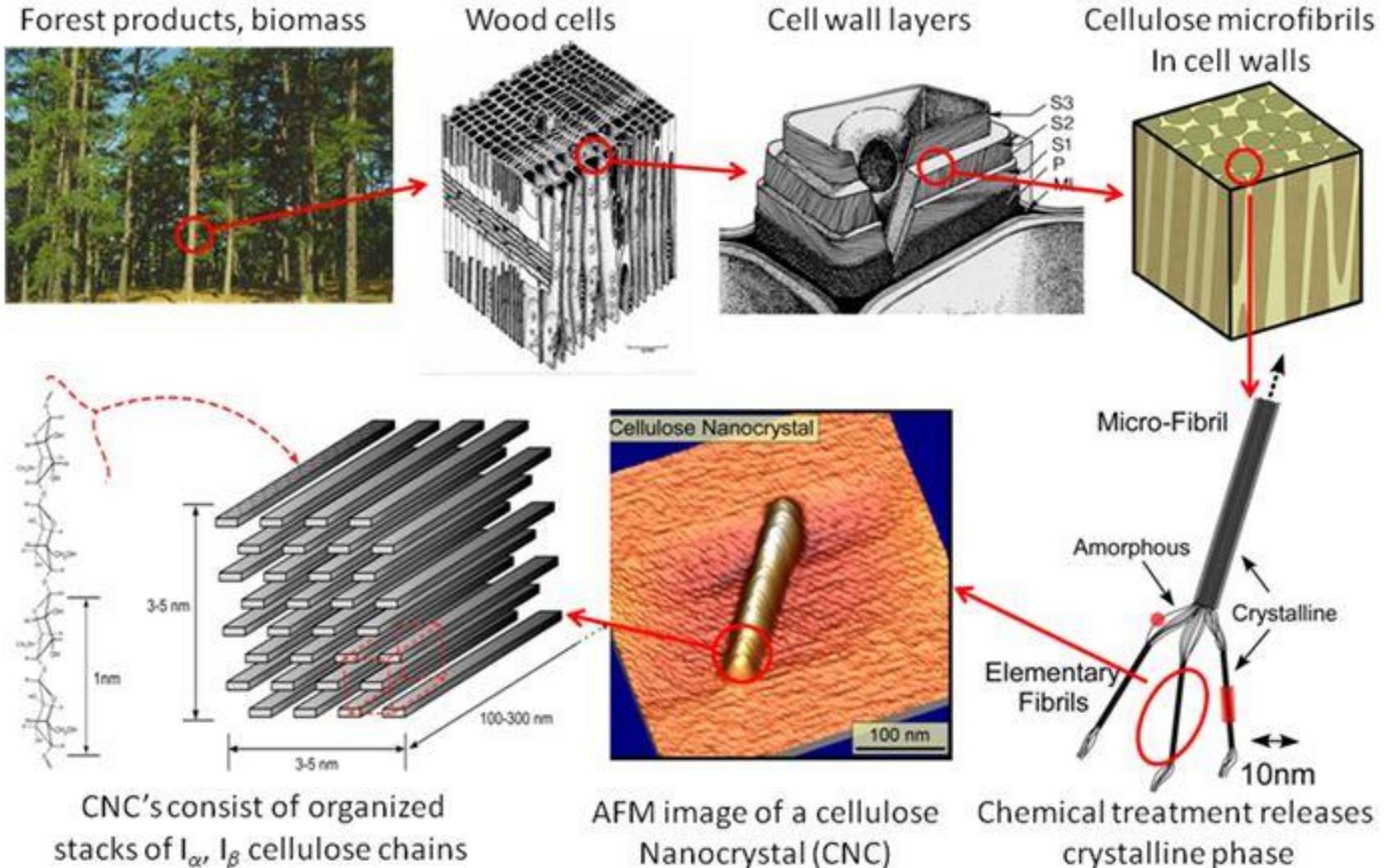


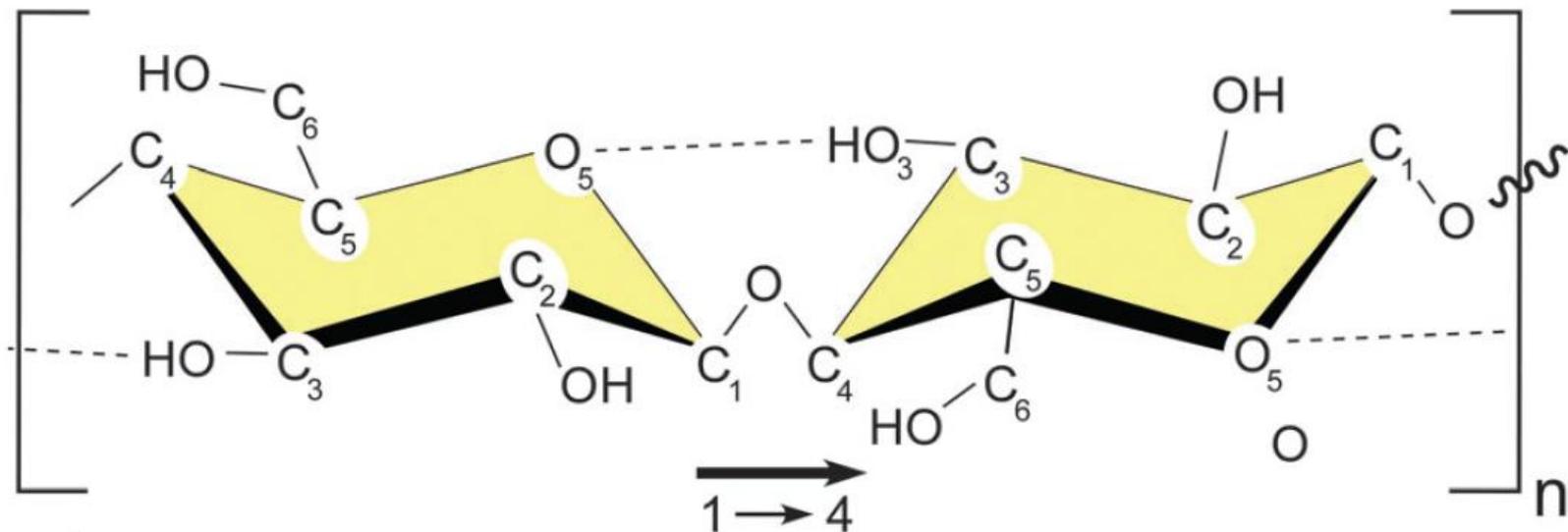
Forests in the U.S.

- U.S. forest inventory has been growing for almost a century and the greatest threats to America's forests come not from forest products production but from fragmentation, parcelization, and conversion of forestland to non-forest uses.
- Forest products production offsets the cost of forest management and helps prevent the conversion of forestlands to non-forest uses by providing return on investment to forestland owners.

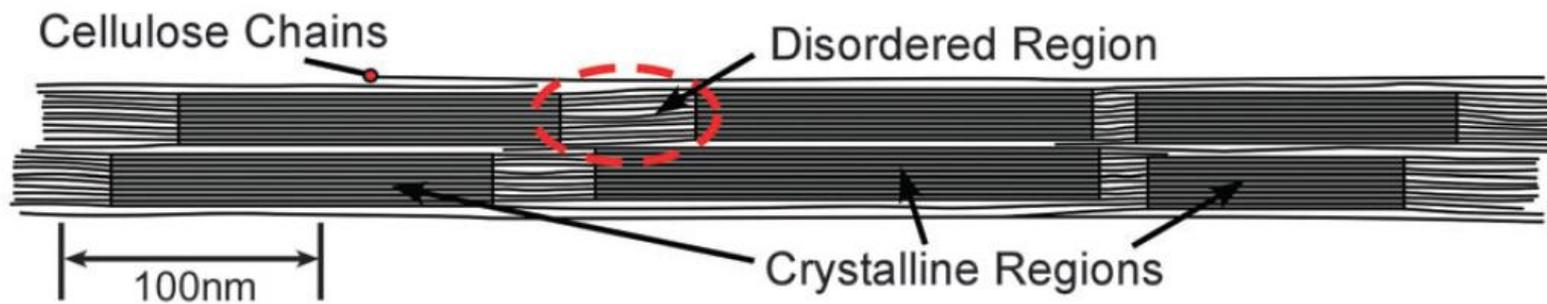


Size Scale of Lignocellulosics

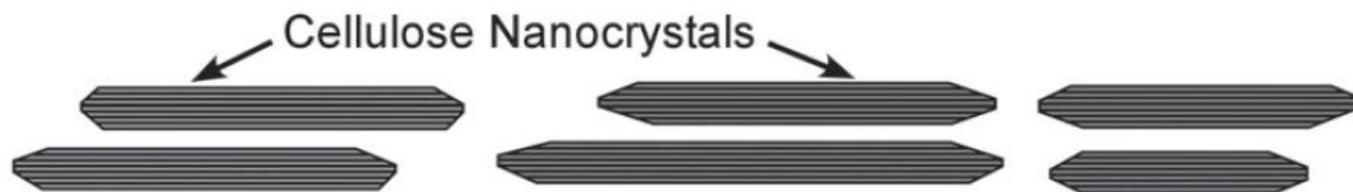




a)

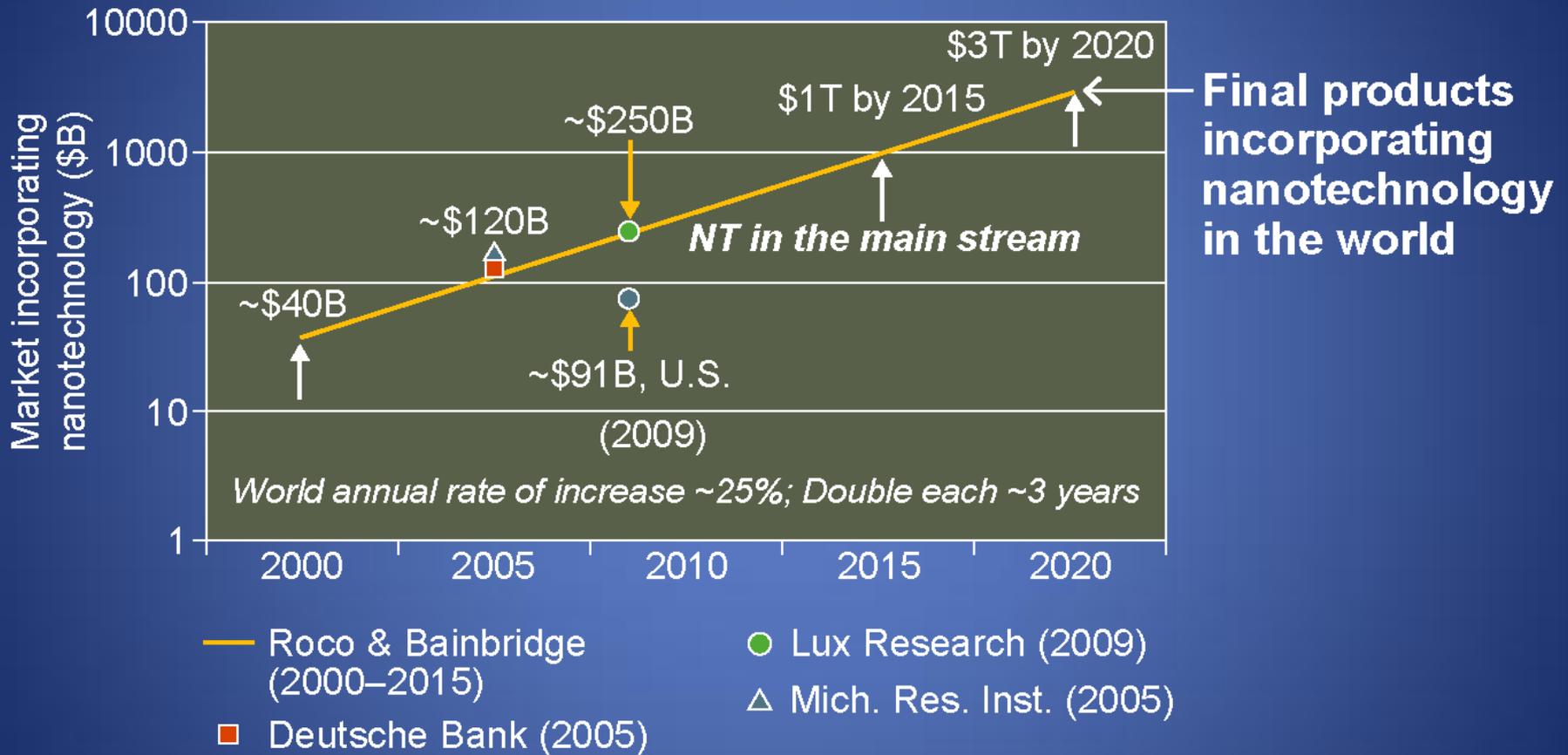


b)



c)

Nanomaterials Opportunity



Cellulosic Nanomaterials

EHS Standards Work Items

1. Develop a compilation of existing international standards and assess their relevance for cellulose nanomaterials

	characterization	toxicity	exposure
occupational			
environmental			
consumer			

2. Develop sample preparation and dosimetry methods for CNC and CNF to use with OECD test guidelines for occupational and environmental assessment
3. Develop consumer/commercial product testing guidelines

Thank You

Ted Wegner

E-mail: twegner@fs.fed.us

Telephone: 608-231-9434

**USDA Forest Service
Forest Products Laboratory
One Gifford Pinchot Drive
Madison, WI 53726
Telephone: 608-231-9200**

FAX: 608-231-9567

Website: www.fpl.fs.fed.us



U.S. DEPARTMENT OF
ENERGY | Energy Efficiency &
Renewable Energy

Sustainable Nanomaterials Workshop