Sustainable Choices – Wood Products in Industrial Applications

DOVETAIL PARTNERS INC.

February 2020, Kathryn Fernholz

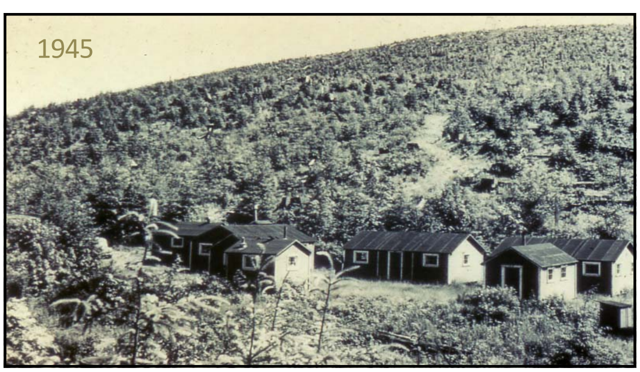
Course Description

This presentation for industrial product and system designers, packaging professionals, purchasing and facilities managers will outline what makes North American sourced wood a green building material and clear up misconceptions on the environmental impacts of harvesting wood. There are many types of materials that can be used as components of products or systems and the environmental impact of using several of those will be evaluated.

Learning Objectives

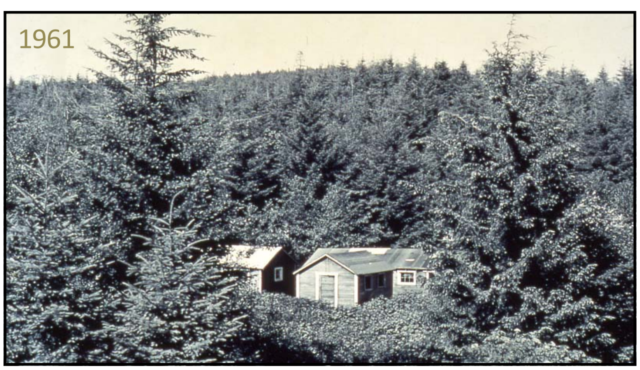
1. Describe the abundant ecological capacity of North America to support a wide distribution of forests and forest types.
2. Understand how the symbiotic relationship between forests and the people of North America have evolved over the past centuries.
3. Discuss how the use of a variety of forest products can economically support sustainable management of forest lands.
4. Describe how to quantify environmental choices in the selection of materials through the use of LCA and carbon accounting.
5. Understand the ecological value of North American wood fiber and the importance of certification standards.
6. There are many viable types of materials used in applications and systems in manufacturing, this session will discuss the economical impacts of various products.


1940


1945


1950


1955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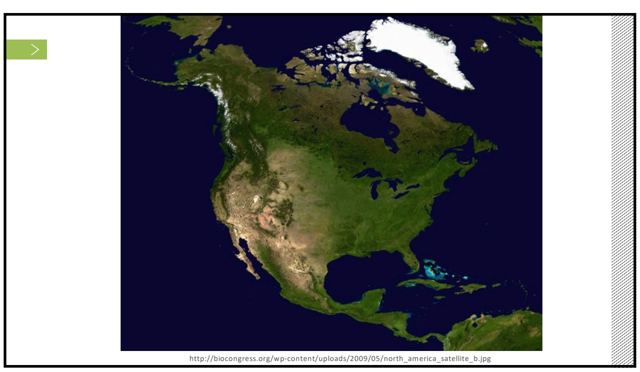
1971


1974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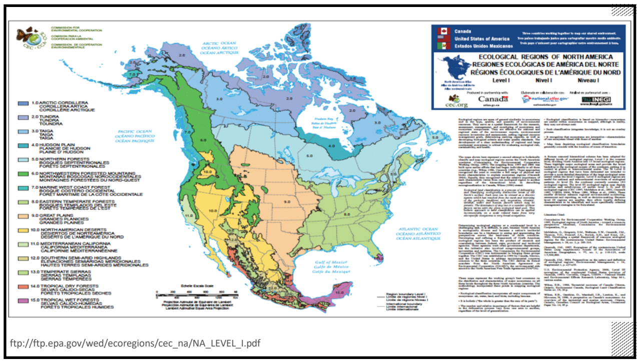
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REGIONES ECOLÓGICAS DE AMÉRICA DEL NORTE
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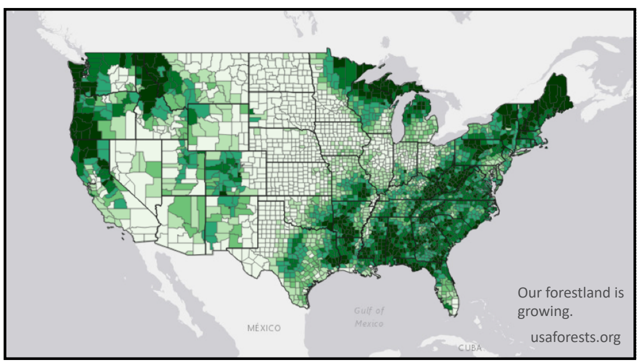
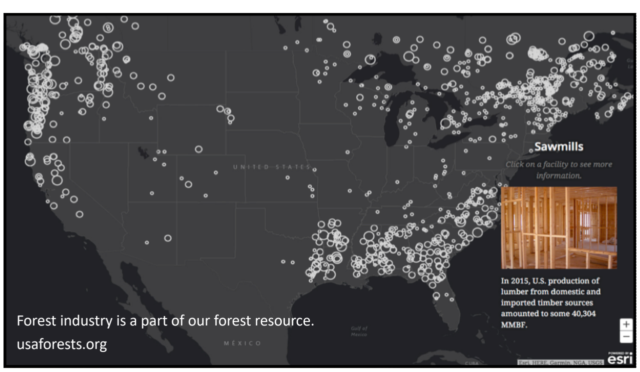
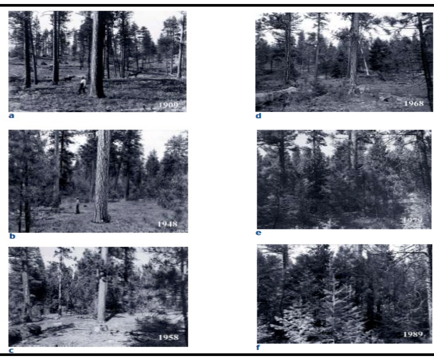

Our forestland is growing.
usaforests.org
MÉXICO
Gulf of Mexico
CUBA


Sawmills
Click on a facility to see more information.
In 2015, U.S. production of lumber from domestic and imported timber sources amounted to some 40,304 MMBF.
Forest industry is a part of our forest resource.
usaforests.org
esri

Across New England, areas like the Swift River Valley (above, left, in the 1880s and in 2010) in Petersham have seen their forests, once cut down and cleared for farmland, replenished in the 21st century.



Source: Understanding Eastside Forests http://oregonforests.org/sites/default/files/publications/pdf/Unst_East_Forests.pdf

World Growth in Consumption of Principal Raw Materials, 1961-2017

(Population growth during this period 2.45x)

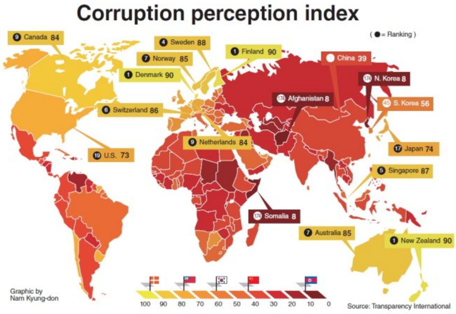
Steel	Cement	Aluminum	Plastics	Wood
4.9x	12.7x	12.7x	25.8x	1.6x

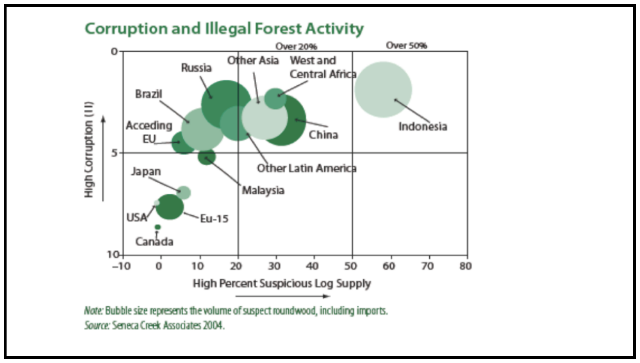
Source: Data for wood from FAO (2018); for cement, steel, and aluminum from the U.S. Geological Survey (2018); and for plastics from the Association of Plastics Manufacturers in Europe (2018). Wood and plastics data are for 2016.

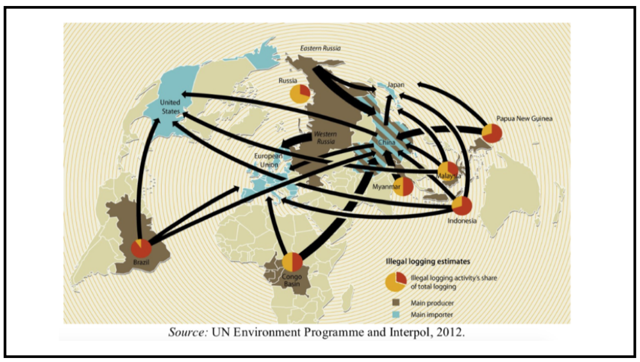
US steel imports

The United States is the world's largest steel importer

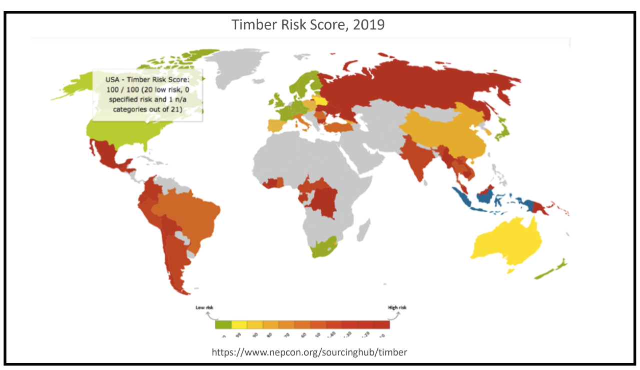
Corruption perception index

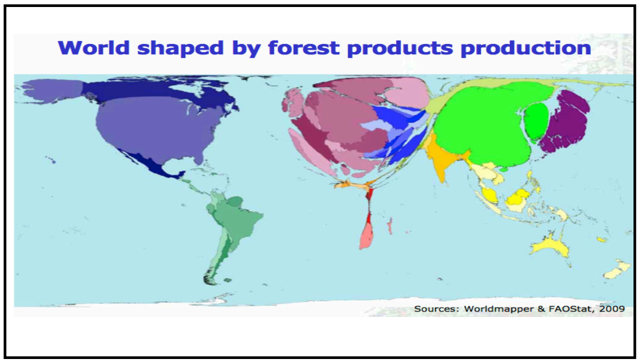


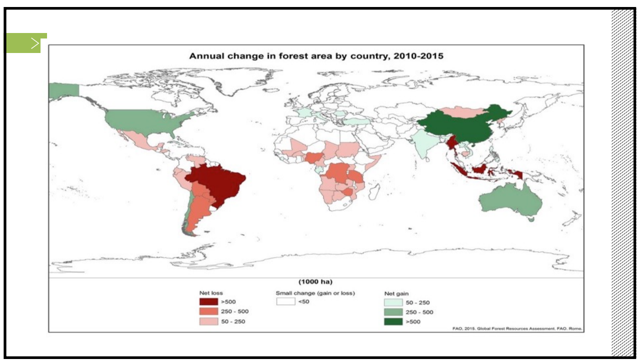


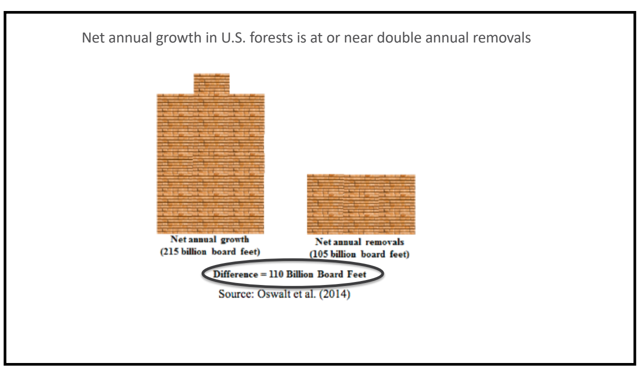


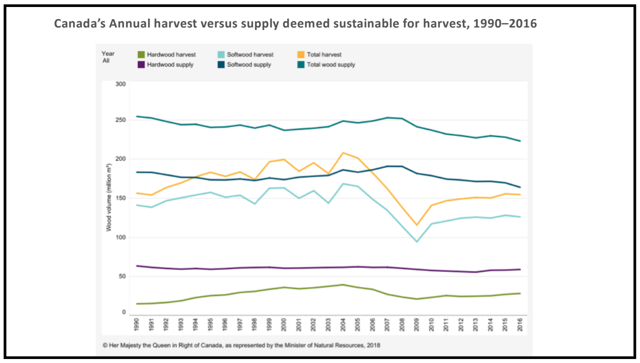
Source: UN Environment Programme and Interpol, 2012.

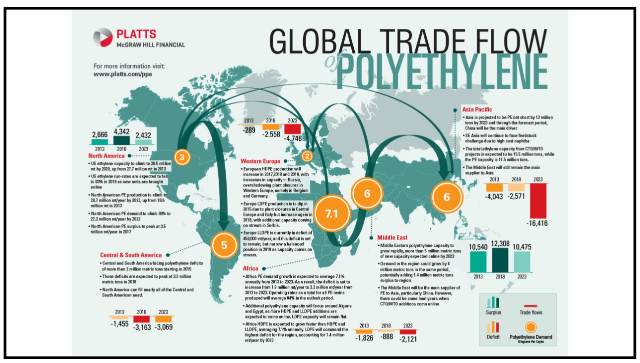



World shaped by forest products production
Sources: Worldmapper & FAOStat, 2009


Annual change in forest area by country, 2010-2015
(1000 ha)
Net loss
>500
250 - 500
50 - 250
Small change (gain or loss)
<50
Net gain
50 - 250
250 - 500
>500
FAO, 2015. Global Forest Resources Assessment. FAO, Rome.


Net annual growth in U.S. forests is at or near double annual removals
Net annual growth
(215 billion board feet)
Net annual removals
(105 billion board feet)
Difference = 110 Billion Board Feet
Source: Oswalt et al. (2014)


Canada's Annual harvest versus supply deemed sustainable for harvest, 1990–2016
Year
All
Hardwood harvest
Hardwood supply
Softwood harvest
Softwood supply
Total harvest
Total wood supply
Wood volume (million m³)
300
250
200
150
100
50
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016
© Her Majesty the Queen in Right of Canada, as represented by the Minister of Natural Resources, 2018


PLATTS
McGRAW HILL FINANCIAL
GLOBAL TRADE FLOW of POLYETHYLENE
For more information visit:
www.platts.com/ppa
North America
Western Europe
Asia Pacific
Middle East
Africa
Central & South America
2,666
4,342
2,432
-289
-2,558
-4,748
-4,043
-2,571
-16,416
10,540
12,308
10,475
-1,455
-3,163
-3,069
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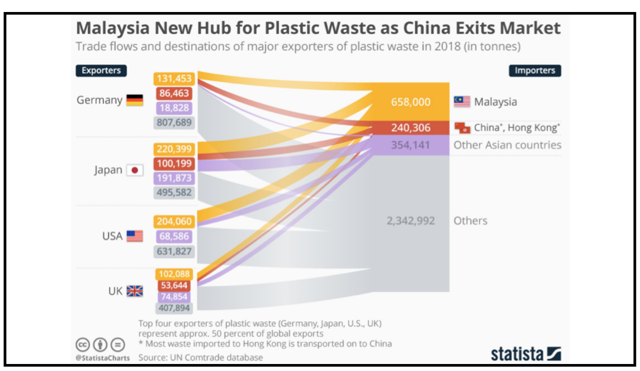
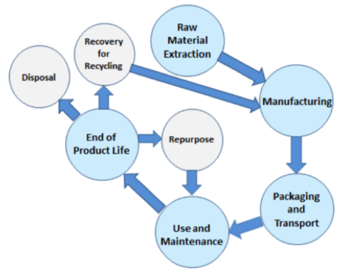
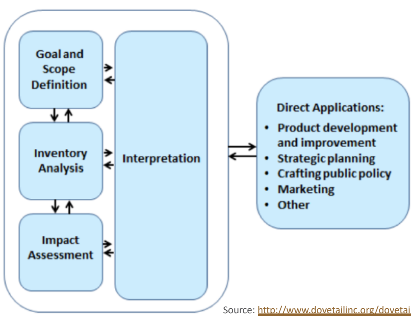

Malaysia New Hub for Plastic Waste as China Exits Market
Trade flows and destinations of major exporters of plastic waste in 2018 (in tonnes)
Exporters
Importers
Germany
131,453
86,463
18,828
807,689
Japan
220,399
100,199
191,873
495,582
USA
204,060
68,586
631,827
UK
102,088
53,644
74,854
407,894
658,000
Malaysia
240,306
China*, Hong Kong*
354,141
Other Asian countries
2,342,992
Others
Top four exporters of plastic waste (Germany, Japan, U.S., UK)
represent approx. 50 percent of global exports
* Most waste imported to Hong Kong is transported on to China
@StatistaCharts
Source: UN Comtrade database
statista

Depiction of "Cradle to Grave" LCA



Source: http://www.dovetailinc.org/dovetaillcatools0217.pdf

The Four Stages of an LCA



Source: http://www.dovetailinc.org/dovetaillcatools0217.pdf

Comparative Effluents in Manufacturing Steel vs. Wood-Framed Interior Wall[2,3]

Emission/Effluent	Wood Wall	Steel Wall	Difference
CO_2 (kg)	305	965	3.2x
CO (g)	2,450	11,800	4.8x
SO_X (g)	400	3,700	9.3x
NO_X (g)	1,150	1,800	1.6x
Particulates (g)	100	335	3.4x
VOCs (g)	390	1,800	4.6x
Methane (g)	4	45	11.1x
Suspended solids (g)	12,180	495,640	41.0x
Non-ferrous metals (mg)	62	2,532	41.0x
Cyanide (mg)	99	4,051	41.0x
Phenols (mg)	17,715	725,994	41.0x
Ammonia (mg)	1,310	53,665	41.0x
Halogenated organics (mg)	507	20,758	41.0x
Oil and grease (mg)	1,421	58,222	41.0x
Sulfides (mg)	13	507	39.0x

[2] The walls examined here are 3 meters (10 feet) x 30 meters (100 feet), and are framed in non-structural steel studs (galvanized) and wood studs, both of nominal 2 x 4 cross-section.

[3] Source: Meil, J. (1994).

http://www.dovetailinc.org/report_pdfs/2007/dovetailmatselfram0407bl.pdf

Environmental Performance Indices for Above-Grade Wall Designs and for Floor and Roof Assemblies for a Home Built to Minneapolis Code Standards[4]

Environmental Performance Index	Above-Grade Exterior Walls[5]			Floor[8] and Roof Assemblies		
	Wood[6]	Steel[7]	Diff.	Wood	Steel	Diff.
Embodied Energy (Gj)	250	296	18%	109	182	67%
Global warming potential (kg CO_2)	13,009	17,262	33%	3,763	9,650	157%
Air emission index (index scale)	3,820	4,222	11%	981	1,813	85%
Water emission index (index scale)	3	29	867%	17	70	312%
Solid waste (kg)	3,496	3,181	- 9%	13,766	13,641	-0.9%

[4] Source: Perez-Garcia et al. (2005).
5 All walls with $^7/_{16}$-inch plywood sheathing and vinyl siding.
[6] 2 x 6 kiln-dried SPF
[7] 20-gauge, 2x6, galvanized studs containing average recycled content for steel framing produced in North America.
[8] Floor joists are 2x10 for both steel and wood, with the steel of 18-gauge.

http://www.dovetailinc.org/report_pdfs/2007/dovetailmatselfram0407bl.pdf

Iron and Steel Old Scrap Recovery (OSR), Recycled Content (RC) and End-of-LIfe Recycling Rates (EOL-RR) as Determined in Various Studies (UNEP 2011)

OSR (%)	RC (%)	EOL-RR (%)
54 [1/]	52 [2/]	52 [3/]
52 [2/]	41 [3/]	67 [4/]
66 [3/]	28 [4/]	78 [5/]
65 [4/]		90 [6/]

Note: References are reproduced from UNEP (2011) to show the origins and dates of various estimates. Full citations for these sources do not appear in the literature cited section of this report.

[1/] UNEP working group consensus (2011)
[2/] Worldsteel (2009)
[3/] USGS (2004); estimates for 1998.
[4/] Wang et al. (2007)
[5/] Birat (2001)
[6/] Steel Recycling Institute (2007)

http://www.dovetailinc.org/report_pdfs/2015/dovetailsteelrecycling0315.pdf

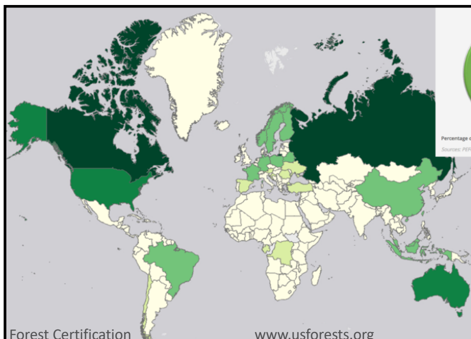
Lowest Impact Single-use Bags as Determined in Various Studies*
(shading indicates types of bags included in evaluation)

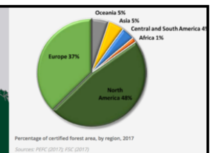
	Study Lead Author, Year of Study, and Country in Which Conducted							
Bag Type	Kimmel et al. (2014) USA	Recyc-Québec (2017) Canada	Ministry of Env. & Fd (2018) Denmark	James and Grant (2004) Australia	Sevitz et al. (2003) S. Africa	Env. Agency (2011) England/ Wales	Ecoblian (2004) France***	Mercado et al. (2016) Sweden
HDPE thin plastic	x, y	x, y			x, y	x, y	x, y	x, y
HDPE thin plastic (degradable)								
Starch-polyester (degradable)				x, y**				
LDPE thick plastic			x, y					
Paper – unbleached Kraft			y					

* x = lowest overall impact across multiple impact measures; y = lowest climate change potential
** This study also examined several types of degradable plastic bags not included in this Table – starch-PBS/A and starch-PBAT, both of which had lower impacts than starch polyester.
*** In this study LDPE thick plastic bags were found to be the lowest impact option across all indicators if used 4 times or more and assuming no reuse of HDPE thin plastic bags.

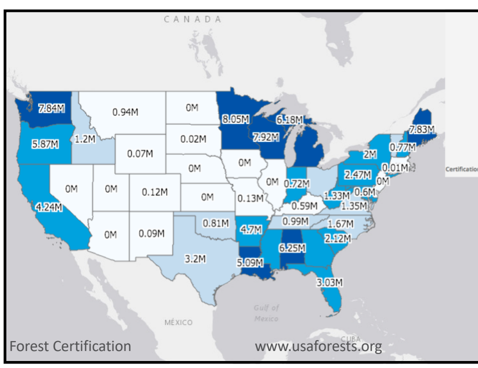
Although environmental impacts linked to lightweight plastic bags are generally lower than alternatives, as determined through life cycle assessment, there are three major problems with lightweight plastic that are not captured through LCA.

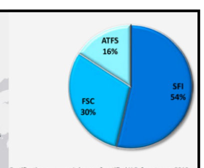
- Degradation upon disposal can require decades or even centuries.
- When degradation does occur, it leaves behind plastic residues in the form of microplastics that appear to persist in the environment for very long periods.
- Light plastic films are prone to windborne transport into water bodies where they can pose significant problems for marine life.



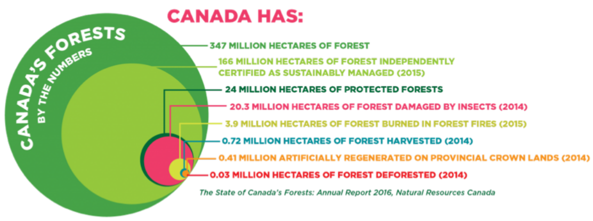


The United States accounts for 9 percent of the world's certified forestland, after Canada (40 percent) and the Russian Federation (11 percent).

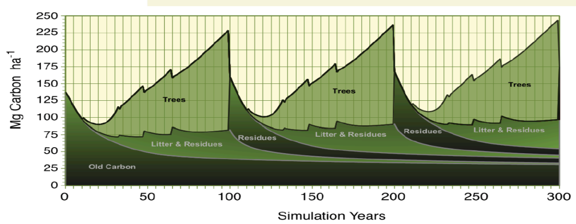




Almost 20% of timberland area in the U.S. is certified for sustainable, responsible forest management.



Forest Carbon flows on a stand-level



Source: Eliasson et al. 2011

"In the long-term, a sustainable forest management strategy aimed at maintaining or increasing forest carbon stocks, while producing an annual sustained yield of timber, fiber, or energy from the forest, will generate the largest sustained mitigation benefit."

- Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report

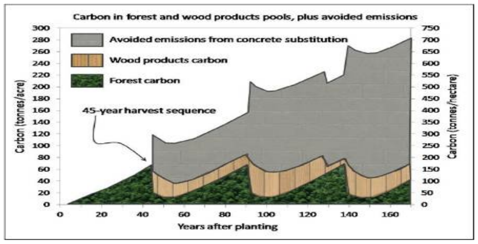


Figure 1. Carbon storage over time under a no-harvest scenario compared to a sequence of 45-year rotation harvest, illustrating additional carbon storage from making and using wood products that substitute for concrete walls in residential housing construction. Diagram courtesy of Jay O'Laughlin, University of Idaho as part of the 2008 Policy Analysis Group on Carbon Sequestration Strategies in the Forest Sector.

Net Carbon Emissions in Producing a Ton of: [1/ 4/]

Material	Net Carbon Emissions (kg C/metric ton)
Softwood lumber	33
Recycled steel (100% from scrap)	220
Concrete	265
Concrete block[3/]	291
Steel (virgin)	694

[1/] Values are based on life cycle assessment and include gathering and processing of raw materials, primary and secondary processing, and transportation.
[2/] Source: USEPA (2006).
[3/] Based on the EPA concrete value and information about energy requirements in block-making.

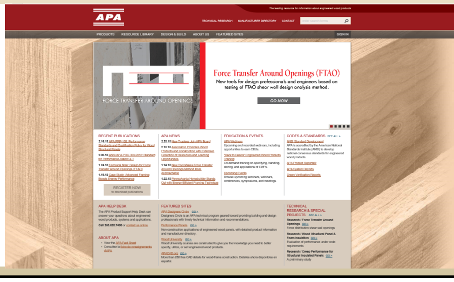
"Wood products are manufactured from renewable raw material; they are reusable and biodegradable, and they continue to store carbon throughout their lifetime. These characteristics make wood an excellent alternative to many of the materials that are now widely used in construction and consumer goods, which leave a much larger 'carbon footprint' and include concrete, steel, aluminum and plastic. Increasing production and consumption of wood products will therefore be part of a sustainable future."

- State of the World's Forests
United Nations Food and Agriculture Organization

Conclusions

- North America's ecology provides for incredible forest resources
- Risks exist in global supply chains
- LCA quantifies impacts and allows for material comparisons
- Certification is an additional assurance tool available for forest products and should be demanded for other materials
- Carbon benefits are provided by forests, forest products, and through substitution
- Bottom line – using forest products from responsible sources supports forest growth and makes wood a sustainable material

APA Update Newsletter
(www.apawood.org)



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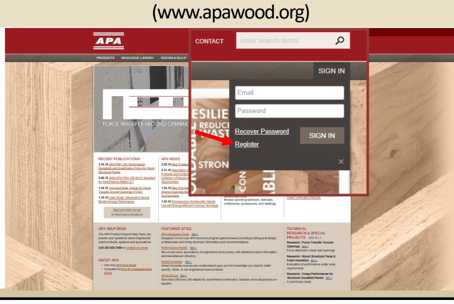
APA Update Newsletter
(www.apawood.org)



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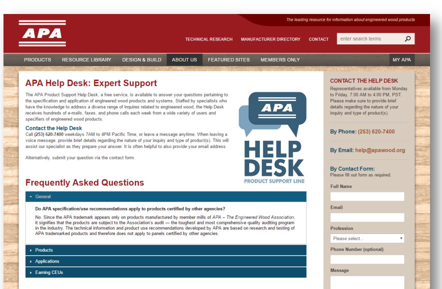

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