



New Markets for Hardwoods

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Virginia Tech

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NHLA Convention

About the speaker

- Native from Costa Rica. Grew up farming coffee, cattle, and trees
- BS in Industrial Engineering. Graduate degrees from Purdue University in Indiana.
- Henry has been with Virginia Tech since 2008. His efforts focus on research in new products and markets for wood products
- Recently selected as VP of the Society of Wood Science and Technology
- Associate Director of the Center for Forest Products Business



Agenda

- The hardwood industry: current challenges
- Mass timber markets for hardwood lumber
- Access mats
- Thermally modified wood
- Export markets for hardwood
- Bioenergy
- Others
- Moving forward



The hardwood industry

- 2020 production: 7.26 billion BF¹
 - Current markets: Pallets (42%), exports (17%), railway ties (11%), flooring (9%), cabinets (6%), millwork (6%), furniture (5%) and board road/mat timbers (4%)¹.
- Current challenges:
 - Labor
 - Logistics
 - Production volumes
 - Prices
 - Sustainability
 - Carbon markets
 - Competition from substitutes products



¹Harwood Market Report 2021

Why Mass Timber?

- Advantages
 - Renewable materials
 - Reduction of greenhouse gas emissions
 - Substitution for concrete or steel
 - Carbon sequestration: zero emissions
 - Construction times
 - Aesthetics
- Preferred to low to mid-rise buildings
- Challenges
 - Manufacturing and logistical limitations
 - Current capacity
 - Limited species
 - Land use and impacts
 - Building codes



Mass timber structure at the University of Massachusetts Amherst, USA

Global Mass Timber Market

- Global market in 2018 was about US\$660 million. Expected to grow 13% between 2020-2025
- Europe accounts for 60% of global mass timber market
- By 2025, mass timber is expected to be US\$1.4 billion of the US\$14 trillion World construction industry



CLT structure in Austria

Mass Timber Market in the USA

- Softwood species primarily dominate structural lumber markets, but some hardwood species were used in the past
- In the US, 38.41 billion board feet (bf) of softwood lumber were consumed in 2017. But only 24.4 billion bf of softwood lumber was produced in the same period
- It is estimated that the CLT industries will consume more than 17% of the total lumber production volume of 2017 by 2025
- In 2017, 7.87 billion bf of hardwood lumber was consumed in the US, and 8.32 billion bf of hardwood lumber was produced



Apex Clean Energy building in Charlottesville, VA

Mass Timber Products



Glue-laminated beam at Zip-o-Log in Oregon, USA

- Glue-laminated beams
- Mass plywood
- Cross-laminated timber (CLT)
- Engineered lumber
 - LVL, OSL, PSL
- Preference is to use softwood lumber (conifers)
 - Pine, Spruce, Doug Fir and other conifers
 - Lower production cost
 - Focus on higher production volumes than hardwoods
 - **Structural grades might be available only for softwood lumber**
 - Easier to bond

Structural grade hardwood lumber

TABLE 2 DIMENSION LUMBER BASE VALUES — HARDWOODS 2" to 4" THICK by 2" and WIDER USE WITH ADJUSTMENT TABLES A THROUGH G Design Values in Pounds Per Square Inch Grades Described in para.10.0-12.4 Also Stress Rated Boards, See para. 17.0							
Species or Group	Grade	Extreme Fiber Stress in Bending "Fb" Single Member	Tension Parallel to Grain "Ft"	Horizontal Shear "Fv"	Compression		Modulus Elasticity "E"
					Perpendicular "Fc⊥"	Parallel to Grain "Fc//"	
RED MAPLE	Sel. Str.	1300	750	210	615	1100	1,700,000
	No. 1	925	550	210	615	900	1,600,000
	No. 2	900	525	210	615	700	1,500,000
	No. 3	525	300	210	615	400	1,300,000
	Construction	1050	600	210	615	925	1,400,000
	Standard	575	325	210	615	725	1,300,000
	Utility	275	150	210	615	475	1,200,000
	Stud	700	425	210	615	450	1,300,000

- NHLA oversees appearance grades for hardwood lumber
- NELMA, SPIB and WWPA.
 - Have developed structural grading rules for most commercial hardwood species
- Why the market does not offer structural graded hardwood lumber?
 - Cost
 - Availability
 - Culture of using softwood lumber for structural applications

NDS. American Wood Council. NELMA oversees grading rules for Red Maple

Mass timber research at Virginia Tech

- Poplar lumber. Why?
 - One of the top commercial hardwood species in the USA
 - Used in the past for structural applications
- Log yield studies
 - Virginia-Carolina
 - Allegany Wood Products
- Grade comparison
 - Blue Ridge Lumber
- Custom certification for yellow poplar CLT panels
 - Smartlam
 - APA
- Hybrid and hardwood veneered-CLT panels
 - Texas CLT
 - Danzer Veneer
 - AWP



Structurally graded Yellow Poplar at Smartlam

NHLA vs structural grade comparison

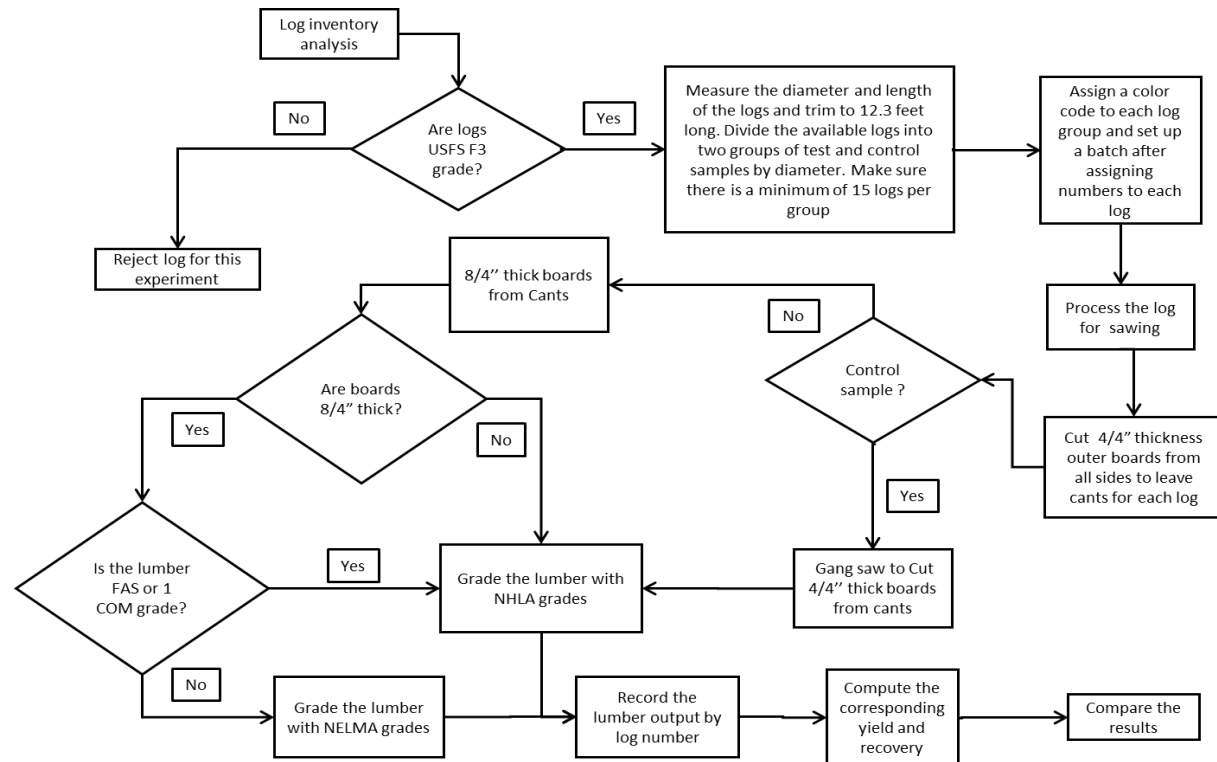
- Goal: study low-grade hardwood logs potential to produce a mixed grade: NHLA grade and NELMA grade (SGHL)
- Methods
 - Species selection: yellow poplar (SG=0.43, MOR=10150 lbf/in² and MOE=1.58 lb/in²x10⁶)
 - Log yield study. Include two sawmills (pilot study and complete study) in the eastern US
 - F3 US Forest Service grade logs
 - 12, 13, 14, and 15 inches diameter logs. Total of 126 logs in two samples
 - Samples
 - Control: NHLA grade
 - Test: NHLA + NELMA



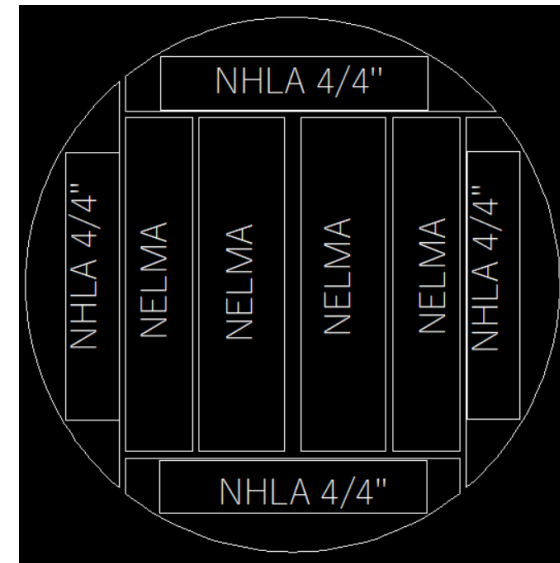
Yellow Poplar logs used for log yield study in AWP

NHLA vs structural grade comparison

- Methods:



Test log sawing method



NHLA vs structural grade comparison

- Grade comparison

NHLA grade results (only 8/4)

Lumber Grade	Lumber (Count)	Measured (bf)	Yield (percentage)
FAS	8	120	2.54%
1 common	41	581	13.02%
2A common	53	772	16.83%
2B common	162	2415	51.43%
3A common	4	52	1.27%
3B common	41	626	13.02%
BG	6	89	1.90%
Total	315	4655	100.00%

Lumber grade using NELMA rules (only 8/4)

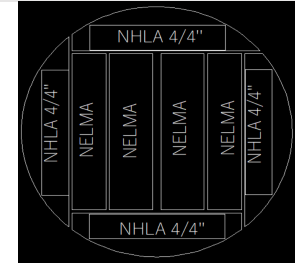
Lumber Grade	lumber Count	Measured bf	Yield Percentage
S. SELECTS	62	881	19.64%
Number 1	54	765	17.06%
Number 2	111	1612	35.94%
Number 3	76	1047	23.34%
economy	12	180	4.01%
Total	315	4485	100.00%

NHLA vs structural grade comparison

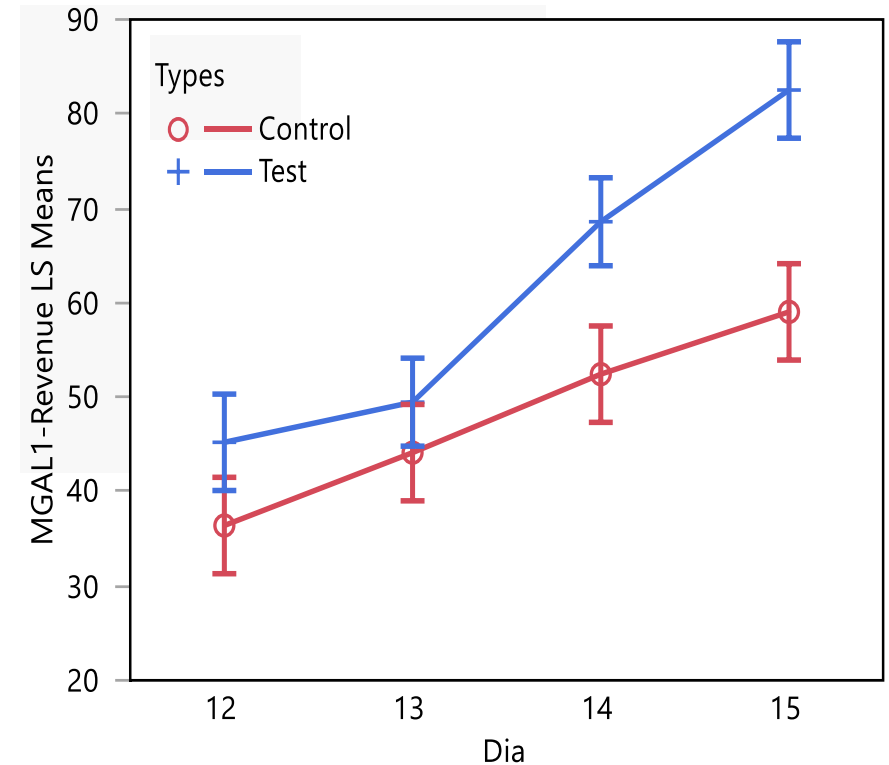
- Economic analysis results:

- Control vs test sample

- Control: only NHLA grade (all 4/4)
- Test: [(all 4/4) + (8/4>1 Common)+ NELMA (8/4)]



Diameter	Control			Test			Recovery Difference	p-value (Two-way ANOVA)
	N	Average Recovery	SD	N	Average Recovery	SD		
12	15	\$36.40	\$5.35	15	\$45.21	\$5.44	\$8.81	0.0172
13	15	\$44.12	\$8.69	18	\$49.46	\$8.56	\$5.34	0.1283
14	15	\$52.43	\$7.25	18	\$68.57	\$14.86	\$16.14	<0.0001
15	15	\$59.03	\$11.98	15	\$82.53	\$12.39	\$23.50	<0.0001



Structural grading workshop

- Training on structural grades for hardwood lumber
 - October 13, 2021. Buckhannon, WV



AHMI 2021 Fall Conference

October 11-13 • The Stonewall Resort
Roanoke, WV

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Current capacity of hardwood sawmills to produce SGHL

- Are sawmills (HW only or HW+SW) ready to produce structural grade hardwood lumber (SGHL)?
 - VT Surveyed 124 hardwood sawmills on:
 - Current capacity
 - Awareness
 - Collaborations
 - Required resources
 - Only 10% are ready
 - 60% of mills would produce SGHL if price was 5% higher than NHLA grade
 - 50% of mills would produce SGHL if demand was at least 5 MMBF

Hardwood CLT production and testing

- Yellow poplar as raw material for Cross-Laminated Timber (CLT)
 - First yellow poplar CLT study was conducted by Virginia Tech in 2012
 - Custom certification with Smartlam
 - Panels produced between Sept 15-16, 2021
 - Test with APA dates to be TBD
 - Industry involvement:
 - Donors: AWP, Blueridge Lumber Co., Turman Lumber Co., Northwest Hardwoods, Meherrin River Forest Products, NELMA
 - Leadership: AHMI, NHLA and HMA
- National hardwood industry effort to create a custom certification and include a hardwood CLT grade into the CLT standard



Yellow poplar CLT panels produced in Smartlam. Dothan, AL

Other options for hardwoods into Mass Timber

- Texas CLT and Danzer Veneer
- Softwood CLT core with hardwood veneers
 - Does not require structural grade hardwood
- Hybrid CLT
 - Preliminary work conducted by IKD, Conversation Plinth in Indianapolis, IN
 - Exploring possibilities with yellow poplar, red oak, and southern yellow pine



TEXAS CLT



DANZER
Hardwood Excellence.

Non-structural CLT market



- Access roads mats are a requirement to avoid erosion, soil and water damage
 - Energy projects
 - Construction
- Traditional access mats have been made using hardwood lumber (bolted mats)
 - CLT access road mats do not require structural grading rules
- Southern Yellow Pine CLT mats
 - At least three CLT mills produce these mats
 - Substitute to bolted mats
 - Business model: pooled mats
 - Over 300 million bf per year
- Energy projects (natural gas) have been suspended/canceled

Non-structural CLT market

- VT is partnering with Mississippi State University to test durability of hardwood CLT access mats
- US Forest Service/Wood Innovations Grant
 - Control: bolted CLT mats and SYP CLT mats
 - Test: Yellow poplar and Red Oak CLT access mats
- Industrial partner: Sterling Lumber and Superior Mat Company



Thermally modified wood (TMW)

- TMW performance tests at Virginia Tech
 - ASTM D143: static bending, hardness, shrinkage
 - ASTM D4442: MC measurements
 - AWP A E10: for decay resistance
 - Opportunity for hardwood species
 - Poplar, Ash, Red Oak, Maple
- Test applied on Ash, Yellow Poplar, and Red Maple samples from three TMW east coast manufacturers
- Work funded through an USDA/Wood Innovations Grant



Thermally modified wood (TMW)

- TMW performance results implications
 - Siding or shingles: excellent materials
 - Dimensional stability: excellent choices
 - Flooring: hardness
 - Decking: MOE and MOR
 - Outdoor furniture: good potential but more test needed

Test (compared to published literature)	Ash	Yellow Poplar	Red Maple
MOE (change)	-8%	+15%	+20%
Hardness (change)	-47%	+13%	+4%
MOR (change)	-66%	+7%	-14%
Equ. MC (%)	5.46	5.22	5.40
Shrinkage (change)	-83%	-85%	-82%
Decay resistance (% weight loss) to G. trabeum and T. versicolor	1.14% and 0.74%	2.08% and 1.77%	1.6% and 1.06%

Thermally modified wood (TMW)

- Marketing study. Knowledge of architects and customers on Technical aspects of TMW
 - Bending strength, MOE, hardness, shrinkage, and visual aspects
 - 146 responses were obtained
 - Only 22 respondents indicated have worked with TMW

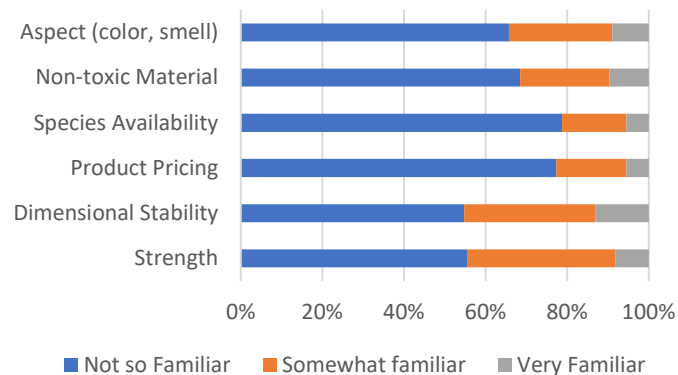


Architect and Photographer (HAUS |
Architecture For Modern Lifestyles)

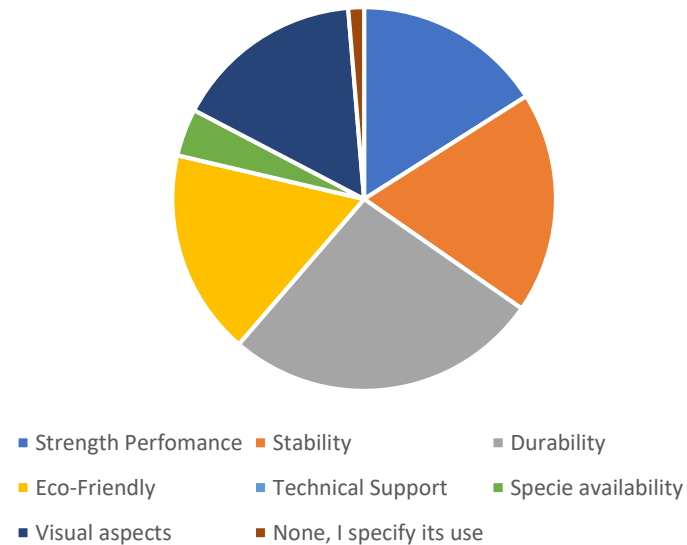
Thermally modified wood (TMW)

- Marketing study results

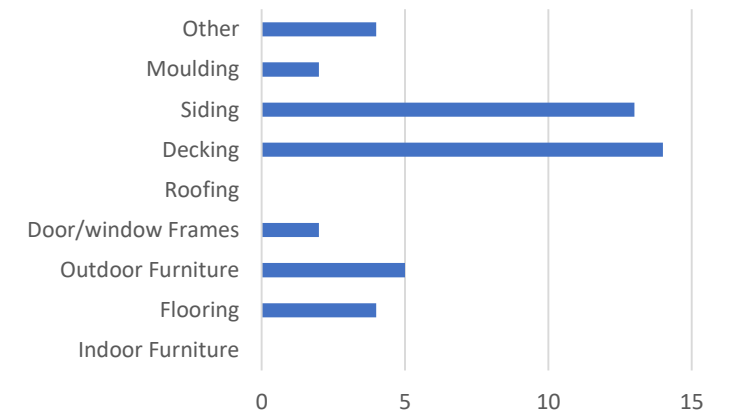
Architect's familiarity on technical aspects of TMW



Customer's interest on technical aspects



Customer's intended applications



Thermally modified wood (TMW)

- As result, Virginia Tech is offering training to architects on TMW
 - At least 4 workshops in the east and west coast
 - Partnering with the American Institute of Architects, University of Minnesota, TWM industry, and Grid Architects
- Training funded through an USDA/Wood Innovations Grant

Thermally Modified Wood: A sustainable solution



When: Thursday, October 28, 2021

Where: Cambria Hotel and Suites

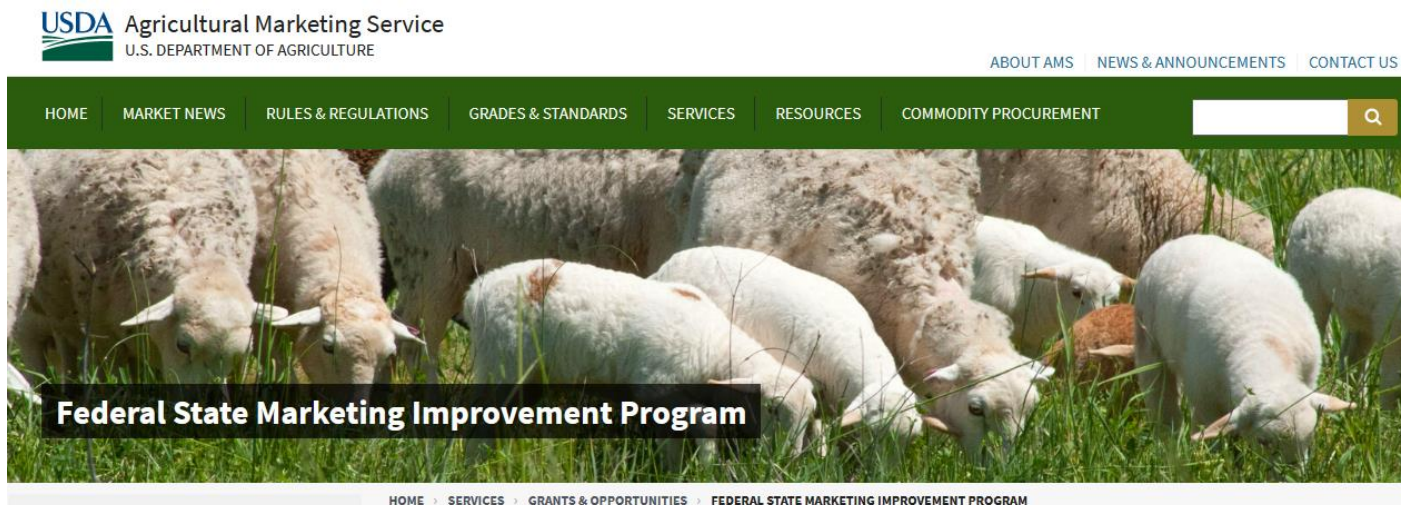
1 Helen Heneghan Way, Rockville, MD 20850

Parking is free for participants

Cost: \$50

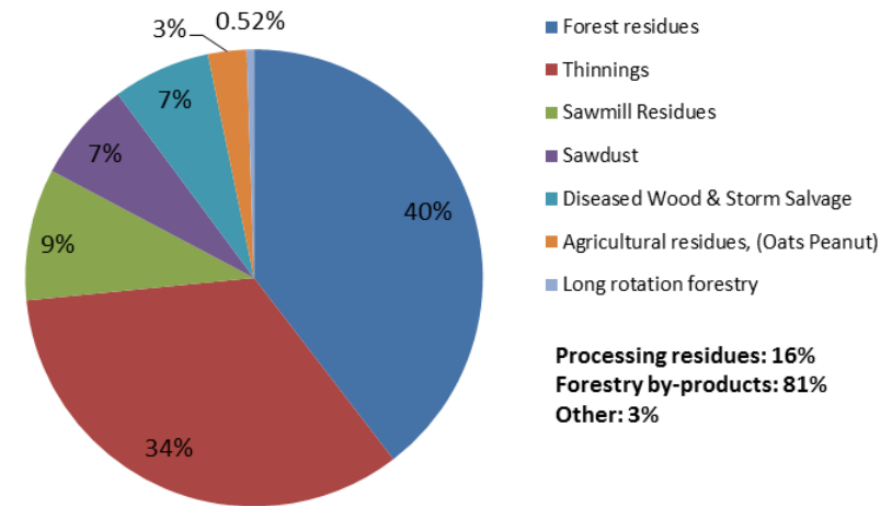
Export markets for hardwood

- International market research at Virginia Tech since 2010
 - Potential of US hardwood lumber in Central America, 2010-2012
 - South East Asia and Western Europe, 2012-2013
 - Social housing in South America, 2014-2016
 - Eastern European markets for US hardwood lumber, 2017-2019
 - Methyl bromide transition to vacuum and steam treatment technology, 2021-2024
- Projects funded through USDA/FSMIP



Bioenergy

- European Union (EU)+UK markets still hot for pellets
 - 29 million metric tons in 2018, 30.8 in 2020
 - USA supplies 24% of that market. Potential to supply 65%
 - Hardwoods are preferred
 - USA continues to be the biggest pellet exporter to the EU
- Issues
 - Competition from solar panels and carbon credits
 - Subsidies for biomass are fading out in some states



Typical feedstock sourcing portfolio in the US Southeast (Idaho National Laboratory 2017)

Others

- Niche markets
 - Live-edge boards
 - Urban wood
 - Logistics is challenging
- Low value hardwood timber
 - Basswood, Sycamore, Beech, Blackgum, Sweetgum
 - Potential for CLT



<https://www.etsy.com/C>

Moving forward

- Make sure we don't lose our current markets
 - Grade, industrial, and export markets
- Look beyond appearance grades
 - Add structural grading
 - Re-evaluate product mix: ROI
- Continue to innovate
 - New product development
 - Process improvements
- Alternative international markets



McAfee Knob. Catawba, VA.

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Thank you!

