National Hardwood Lumber Association

1st Annual Report on the North American Thermally Modified Wood Market—2025

NHLA

Report funded by **Jartek**

Preface

Thermally modified wood is gaining momentum in North America — but the market is still writing its rulebook.

Demand is rising for materials that last longer, perform better, and meet higher sustainability expectations. Thermally modified wood directly responds to these demands, offering enhanced durability and stability without the use of chemicals. Yet thermal modification remains unevenly understood terminology varies, performance claims differ, and reliable market data has been scarce. Clarity is needed before scale can follow.

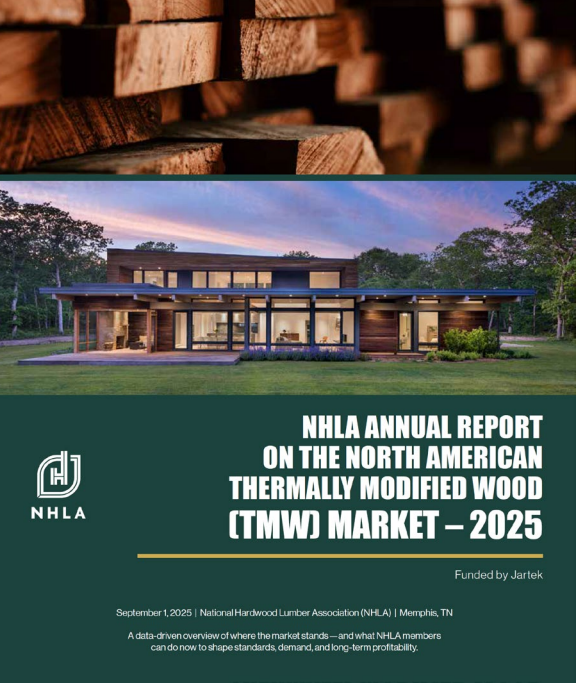
This report was created to bring that clarity.

Funded by Jartek and independently produced by the National Hardwood Lumber Association, it offers an objective snapshot of the North American thermal modification market — where it stands today, and where it may be headed.

Jartek designs and delivers industrial technology that enables producers to manufacture thermally modified wood with consistent, high-end quality. Supporting this report reflects a simple belief: heat alone does not define thermal modification — control, knowledge, and standards do.

Markets are not built by machines alone. They are built by shared understanding, transparent data, and trust across the value chain. We hope this report helps move the conversation forward and supports the responsible growth of thermally modified wood in North America.

JARTEK



NHLA Staff Experience With TMW

Dallin Brooks

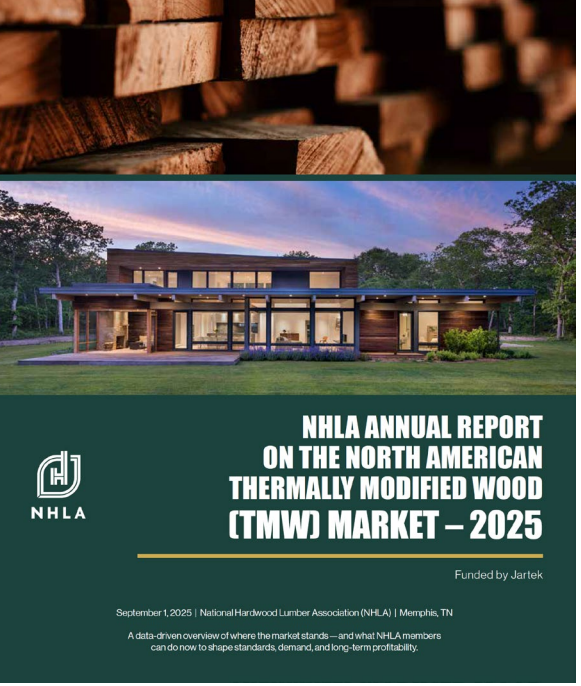
1. Studied TMW as Undergraduate Student at UBC Wood Products Processing.
2. Worked for SMI International and did TMW Market Report
3. Worked for and with FPInnovations on multiple reports on TMW
4. Worked for Jartek as North American Technical Director
5. Masters in TMW: Value-Added Commodity Supporting Rural Communities
6. Operated 2,120 bf TMW facility in BC under name of SeasonWood
7. Past Chair of AWPA P-9 Committee on Non-biocidal wood protection

Natalie Thelen

1. As her Master's thesis, Natalie interviewed individuals throughout the forest products industry regarding potential applications for thermally modified wood, as well as advantages and barriers to commercialization.

Sailesh Adkikari

1. Collaborated to develop thermally modified hardwood CLTs and produced the final report for a USDA Wood Innovation Grant on decay resistance.



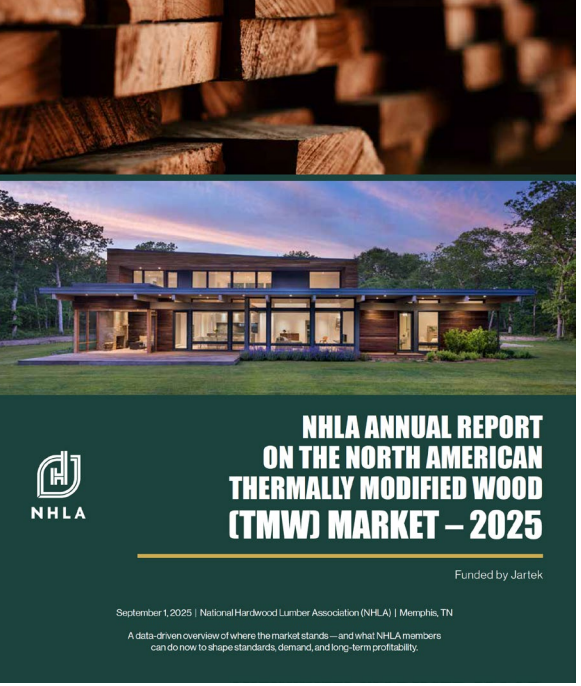
Wood Modification Overview

1st Chemical Impregnation is not Modification

- Pressure treating wood with preservatives or fire-retardants does not change the wood cell structure
- Preserved wood (CCA, Creosote, DCOI, MCA, EL2)
- FRTW (D-Blaze, Dricon, FlamePro, PyroGuard, SaferWood Thermex)

Pressure Treating Processes

- Force chemical combinations into the wood and fix them into the cells by bonding them together.



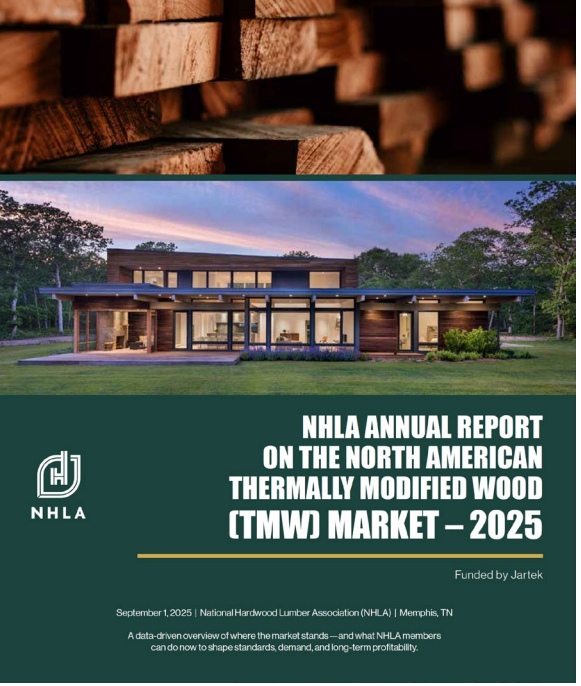
Wood Modification Overview

Modification means Changing the Wood Cell Structure

There are many different ways to change that cell structure.

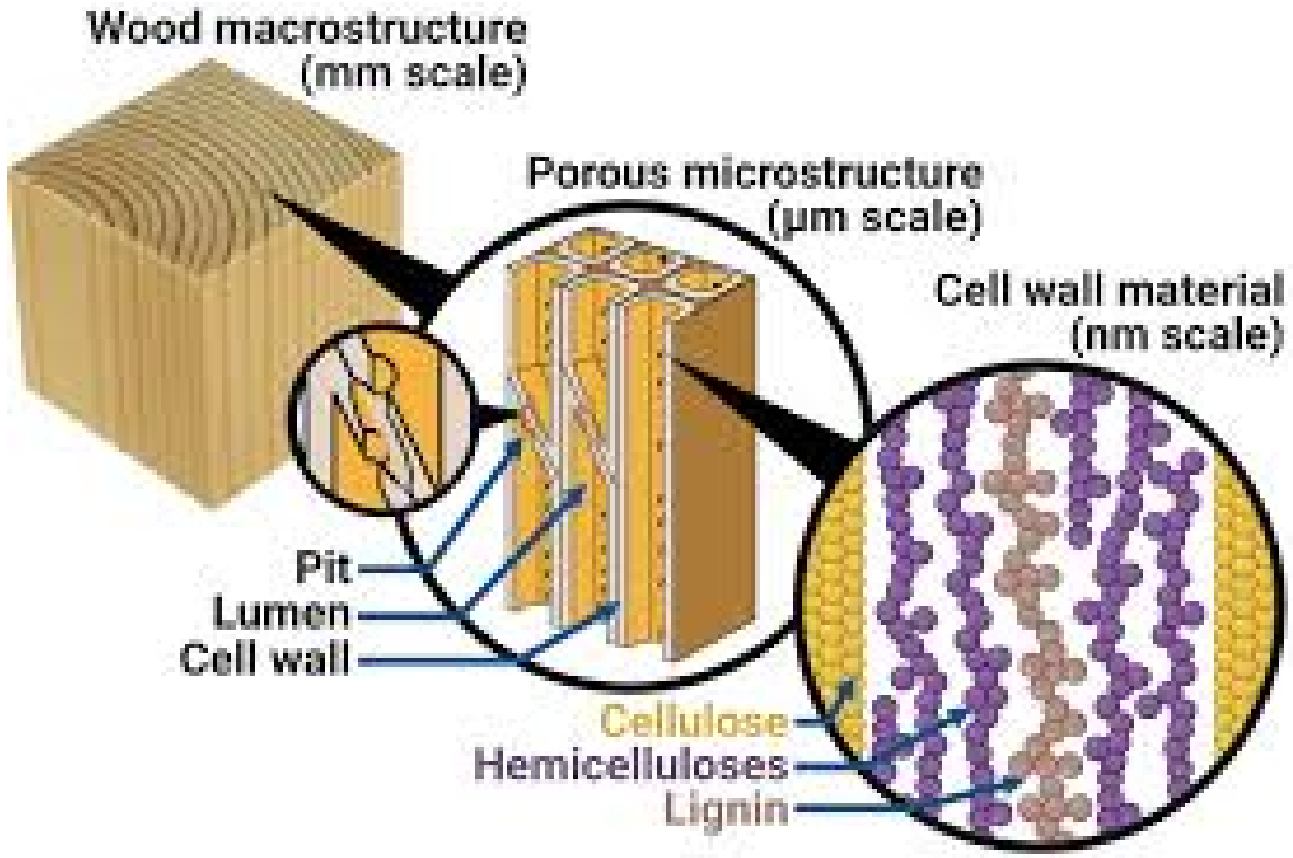
Modification Processes

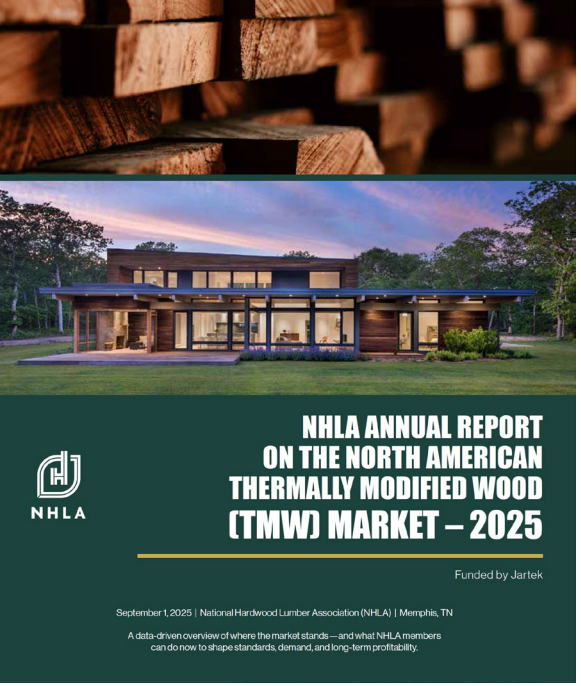
- Acetylation (Vinegar)
- Furfurylation (Alcohol)
- Enzymatic Treatments (Polymers)
- Thermal (Heat)



Background on Wood Modification

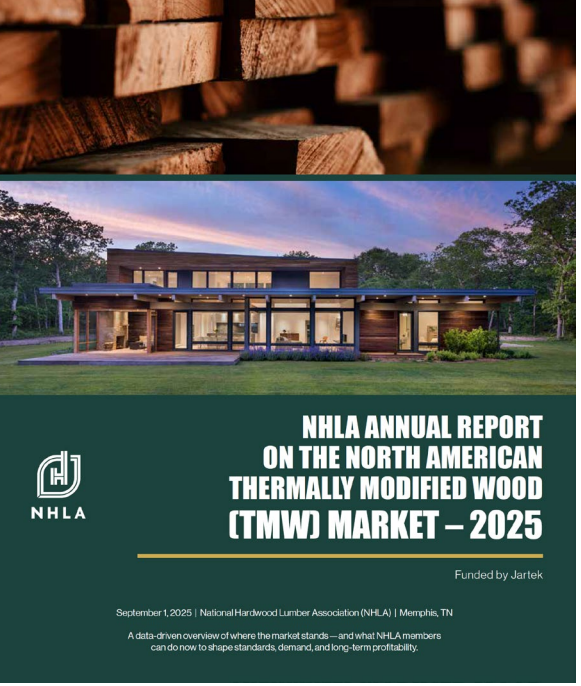
1. Wood Modification Overview
2. Thermal Modification Overview





Comparison Overview

Product Type	Durability (Above Ground)	Dimensional Stability	Chemical Use	Structural Use	Aesthetic Appeal	Sustainability Profile
Thermally Modified Wood	High (Class 1–2)	Excellent	None	Limited	Rich, natural	Excellent
Pressure-Treated Lumber	High (all uses)	Poor	Yes	Yes	Industrial look	Moderate (toxins)
Acetylated Wood (e.g., Accoya®)	Very High (Class 1)	Exceptional	Yes modified	Yes	Uniform, premium	Excellent
Furfurylated Wood (e.g., Kebony®)	Very High	Good	Yes (resin)	Yes	Dark, glossy	Good (non-toxic resin)
Wood-Plastic Composites	High	Excellent	Synthetic	Yes	Consistent, artificial	Poor (non-renewable)
Tropical Hardwoods (e.g., Ipe)	Very High	Good	None	Yes	Premium, exotic	Poor (deforestation)

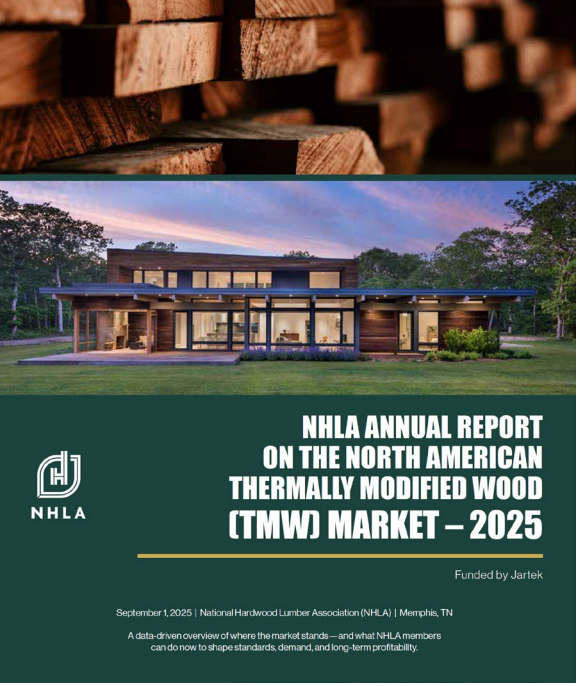


Thermal Modification Overview

Definition of Thermal Modification has not been properly determined.

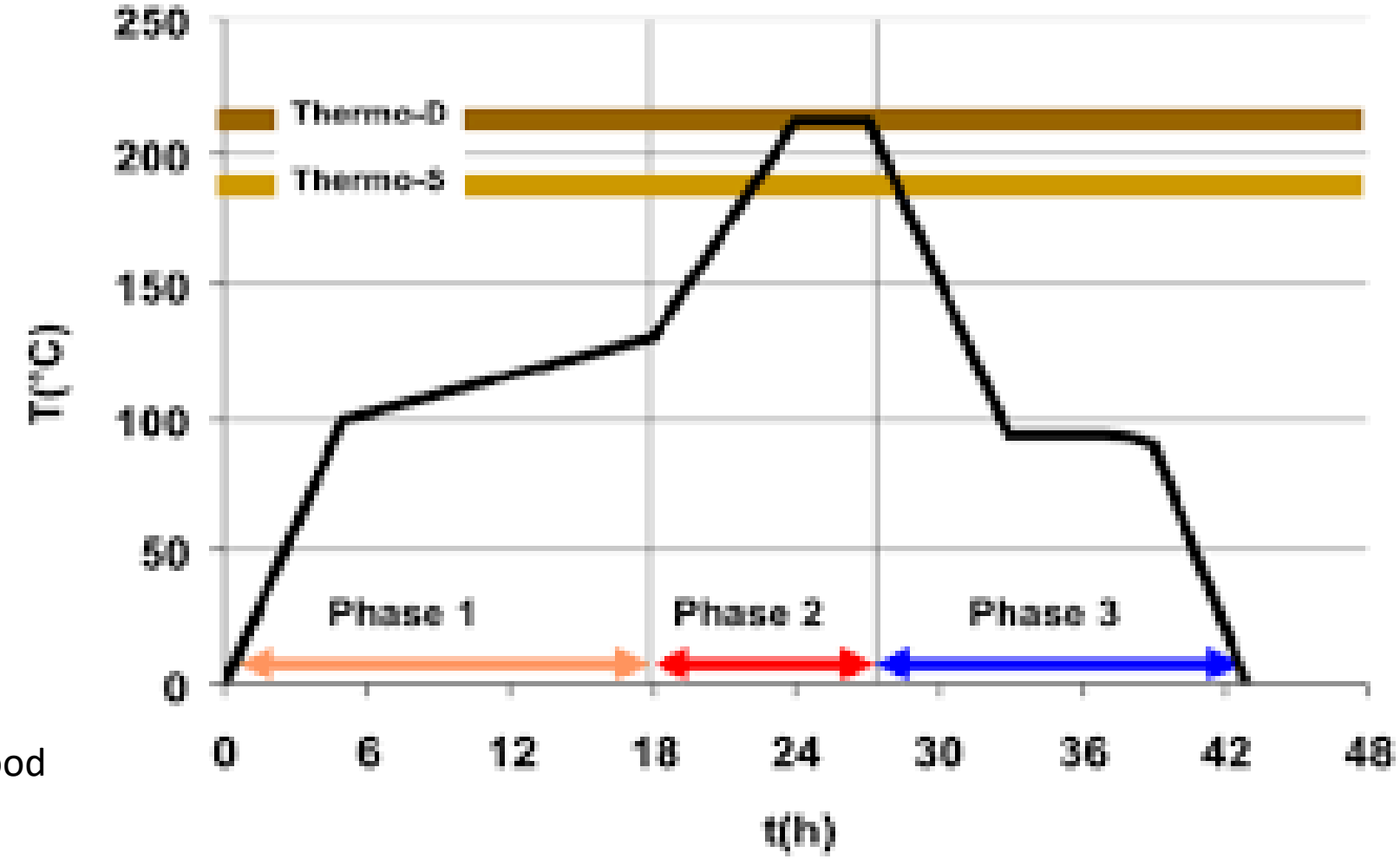
- **High Temperature Leads to Crystalized Hemi-Cellulose**

If you raise the temperature high enough wood will burn and turn to charcoal.



Thermal Modification Overview

Process



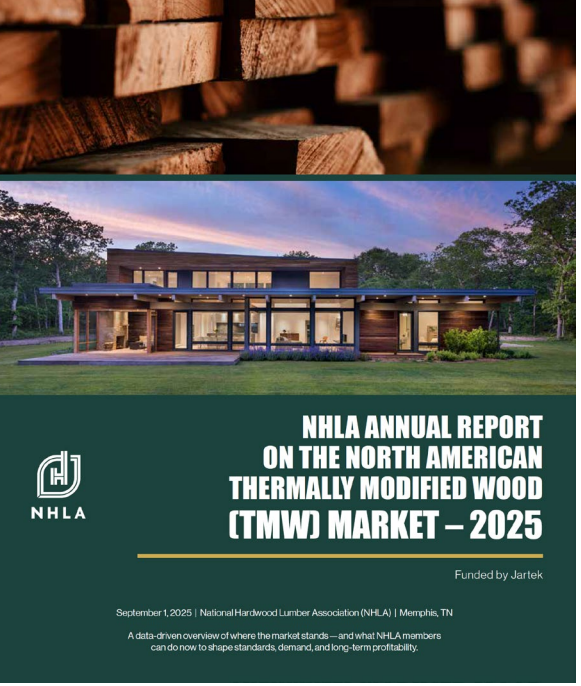
Open Process

Phase 1 Dry Wood to 0% MC

Phase 2 Modify wood

Phase 3 Cool and Remoisturize Wood

Image from Thermowood Handbook



Thermal Modification Overview

Process Variants
Several different industrial thermal modification systems are used. These include:

Steam-Based (Conventional Kiln): Uses superheated steam at atmospheric pressure.

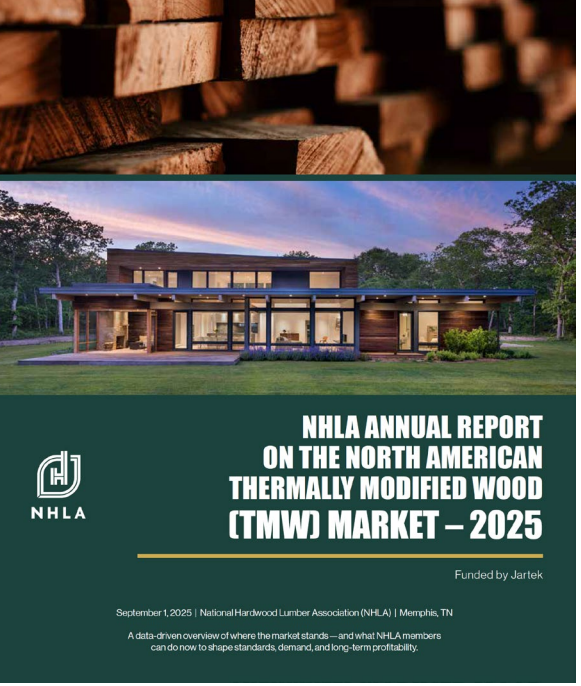
Nitrogen-Based (Inert Gas): Heats wood in a closed reactor with nitrogen.

Oil Heat Treatment (OHT): Submerges wood in heated vegetable oil.

Vacuum/Pressurized Systems: Use vacuum or pressure to improve heat transfer.

Hybrid and Proprietary Methods: Combine elements of the above (e.g., steam + oil, pressurized steam + dry curing) to optimize performance.

Process Type	Energy Efficiency	Strength Retention
Steam-Based	Moderate	Moderate
Nitrogen-Based	High	Lower
Oil Heat Treatment	High	High
Vacuum Systems	Very High	Moderate



Each method is tailored to specific wood species, product goals, and operational constraints.

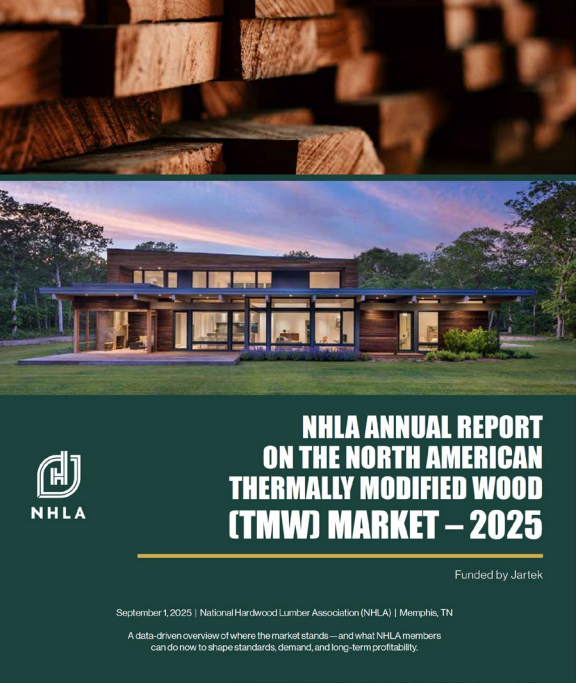
Thermal Modification Overview

Standards and Certifications Europe

International ThermoWood® Association (ITWA): Provides process and performance guidelines for Thermo-S and Thermo-D classifications. Members must meet defined treatment parameters and undergo audits.

European Standards: CEN/TS 15679 defines thermally modified timber and test methods. EN 350 and EN 113 are used to assess durability.

Definition of TMT: Wood with altered cell-wall composition and improved properties due to heat treatment.



NHLA Working on Creating a certification for TMW manufacturers.

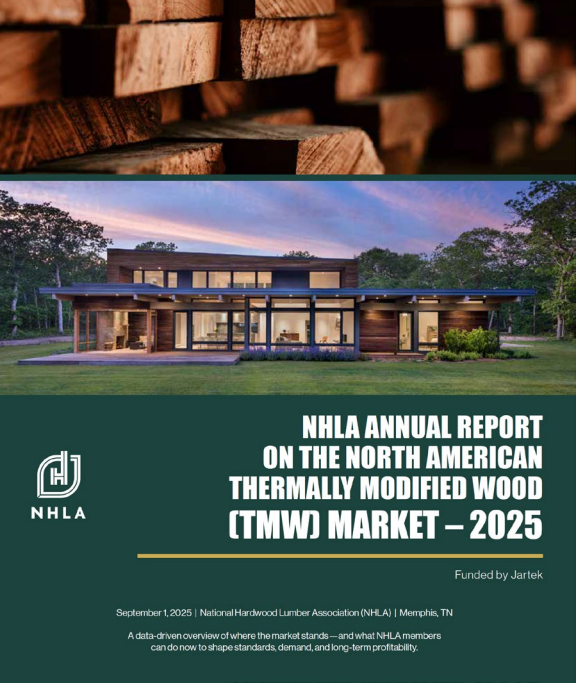
Thermal Modification Overview

Standards and Certifications North America

AWPA Guidance Document N outlines data requirements for TMW inclusion in standards.

ASTM test methods (e.g., D5664 for decay resistance) are used in research.

ICC-ES Evaluation Reports are pursued by some producers for code recognition.



There is an unlimited range of parameters and that is why we need standards across process variants.

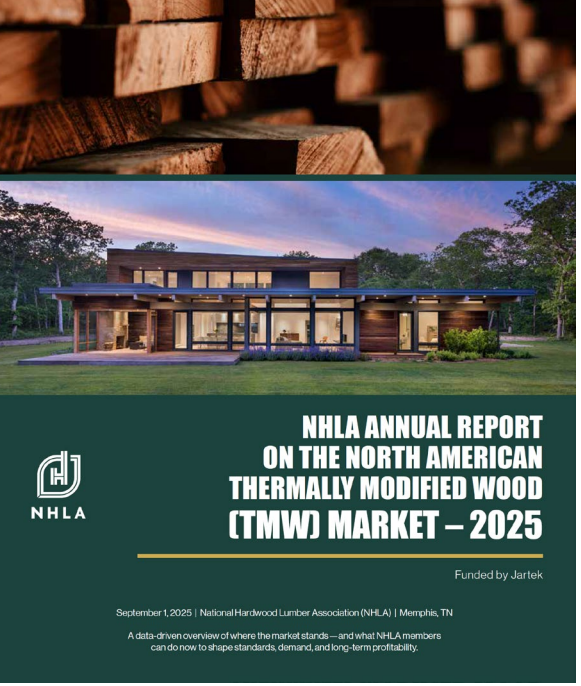
Thermal Modification Overview

Key Process Parameters

Temperature: Higher temperatures (~220°C) yield greater durability and darker color but increase strength loss. Lower temperatures (~180°C) prioritize dimensional stability.

Duration: Wood is held at peak temperature for 2–4 hours, with total cycle times ranging from 15 hours to 3 days.

Atmosphere and Moisture Control: Oxygen is excluded using steam, nitrogen, vacuum, or oil. Moisture content is reduced close to zero percentage during treatment, then reconditioned to ~4–7% for usability.



SeasonWood Chamber Built by Jartek

Report funded by **Jartek**

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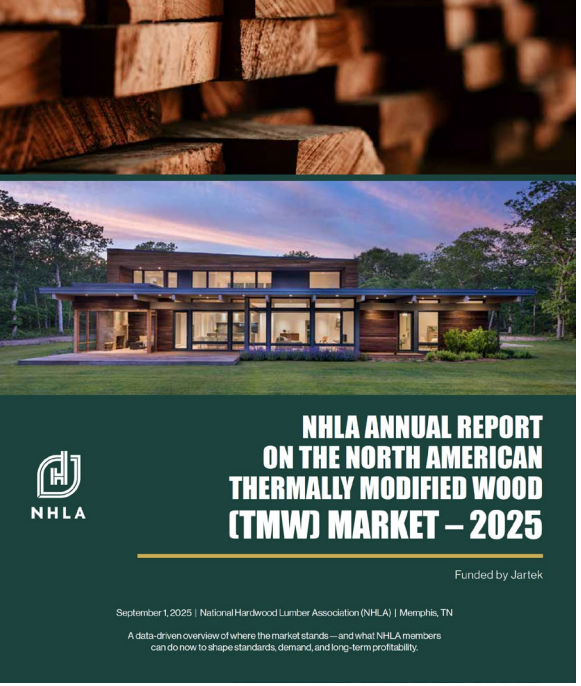

Therma Wood Tech Cylinder Built by WTT

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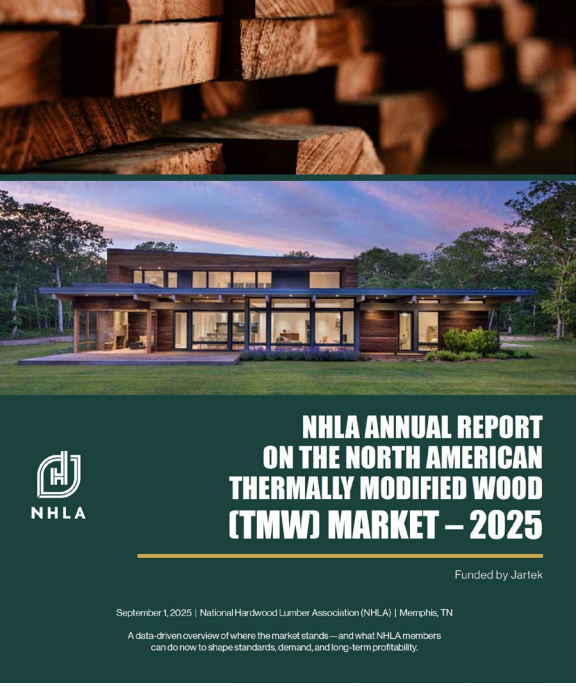

Thermal Modification Overview

Impacts

Image courtesy of Jartek

Properties of Thermally Modified Wood

- Permanently 30-50 % lower EMC
- Reduced shrinking and swelling = dimensional stability
- Improved resistance against weather and decay
- Consistent and attractive color
- Slightly reduced mechanical properties

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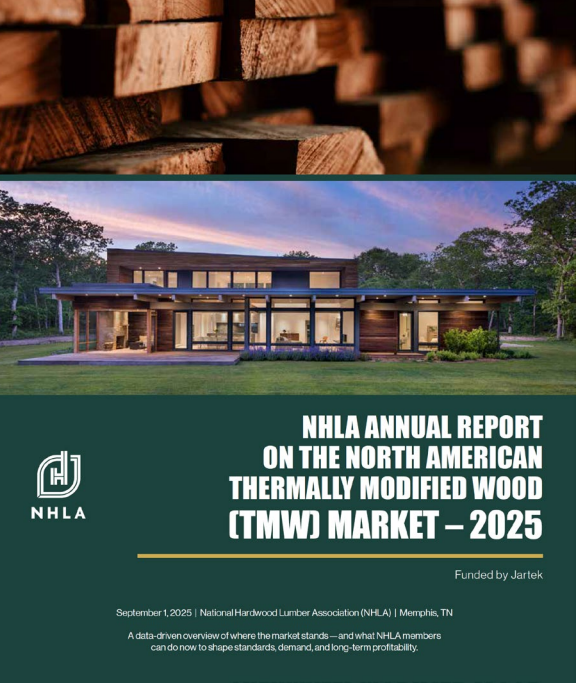


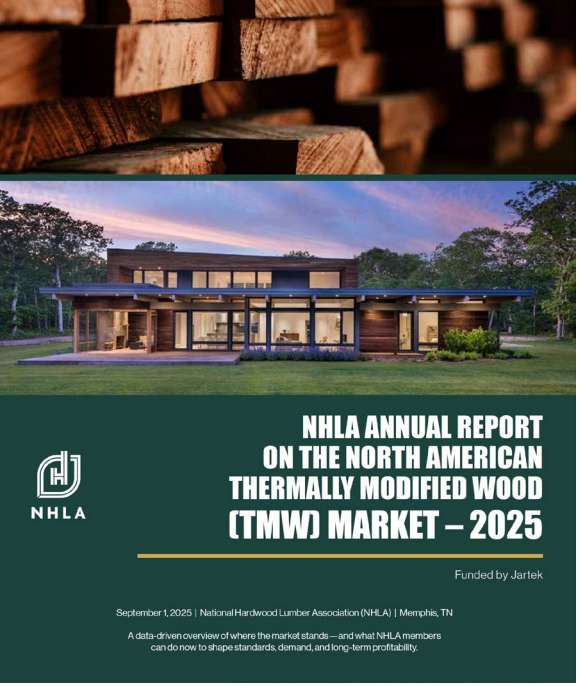
Thermal Modification Overview

Products

Image courtesy of Jartek

Thermally Modified Wood Uses

- Siding
- Decking
- Flooring
- Saunas & Outdoor Furniture
- Molding & Millwork
- Windows & Doors



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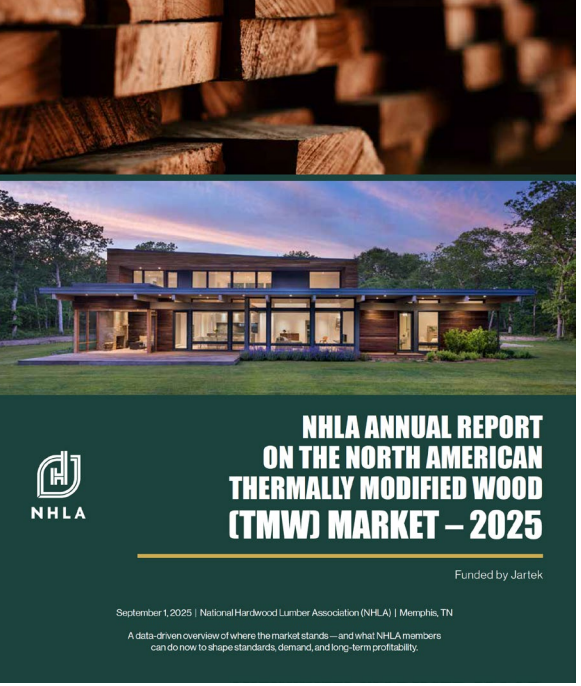

Report Guided by the NHLA TMW Task Force

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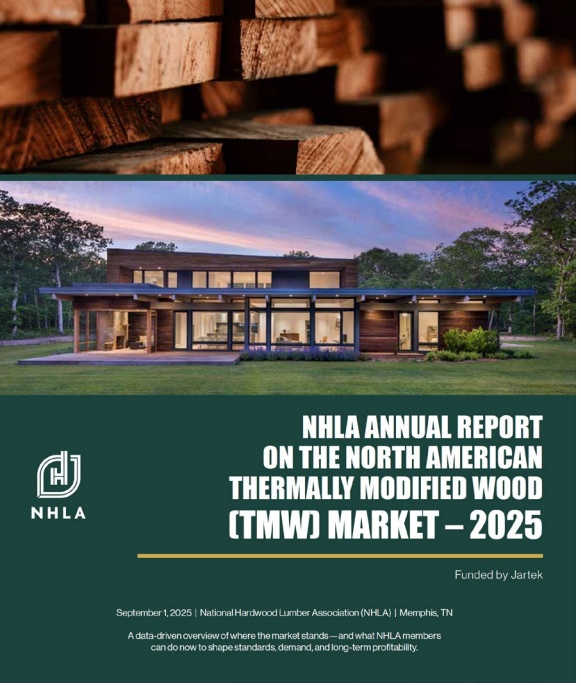


Key Findings of Report

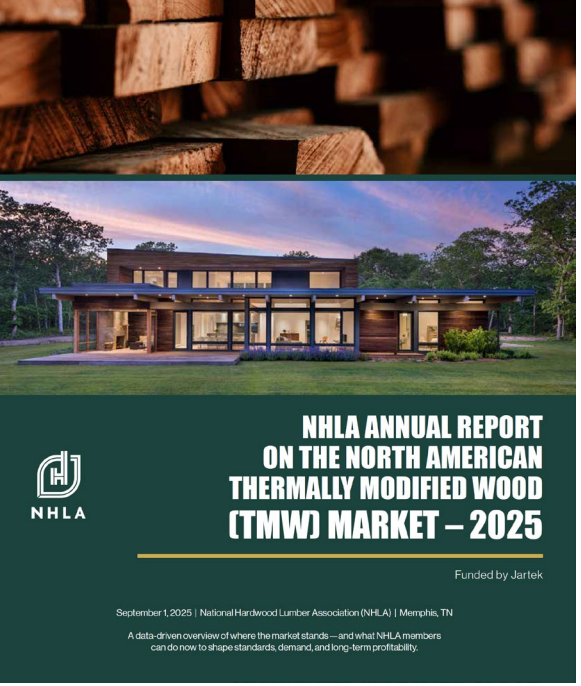
Market Growth

North American TMW production capacity has doubled since 2020, with approximately 10–12 TMW producers with a combined estimated annual output of 20,000–30,000 m³. Most producers operate one or two kilns, with batch sizes ranging from 5 to 20 m³.

Europe TMW production, was over 121Mmbf in 2024.

Annual output remains modest (tens of thousands of cubic meters) but is forecasted to reach ~100,000 m³; by 2030 under current trends.

Globally, the TMW market was valued at ~$1.3 billion in 2024 and is projected to grow at ~5% annually, reaching ~$1.8 billion by 2030.



Key Findings of Report

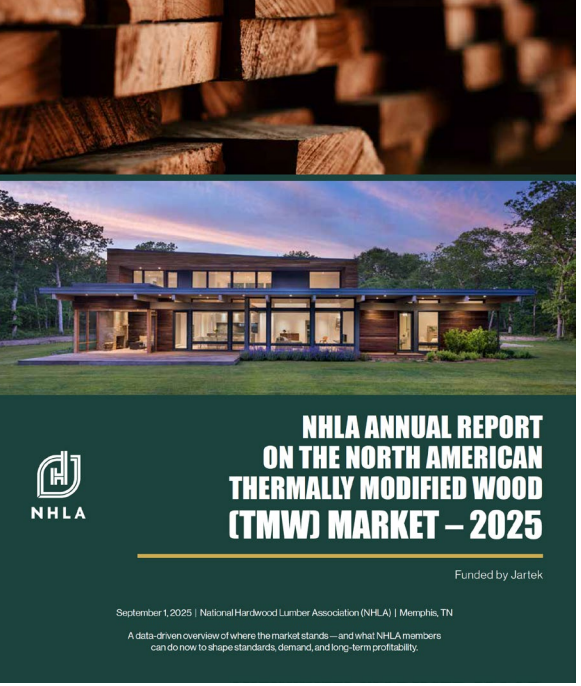
Performance and Sustainability

TMW offers enhanced decay resistance and dimensional stability, rivaling tropical hardwoods, without added chemicals.

Thermally modified wood last 20+ years in above-ground applications, with equilibrium moisture content reduced by ~50%, minimizing warping and cupping.

However, strength is reduced by ~10–30%, limiting structural applications. TMW remains recyclable and contributes to LEED credits for low-VOC materials.

Ground-contact applications are not recommended due to moisture exposure and decay risk.



Key Findings of Report

Market Drivers

Rising demand for sustainable building materials is accelerating adoption.

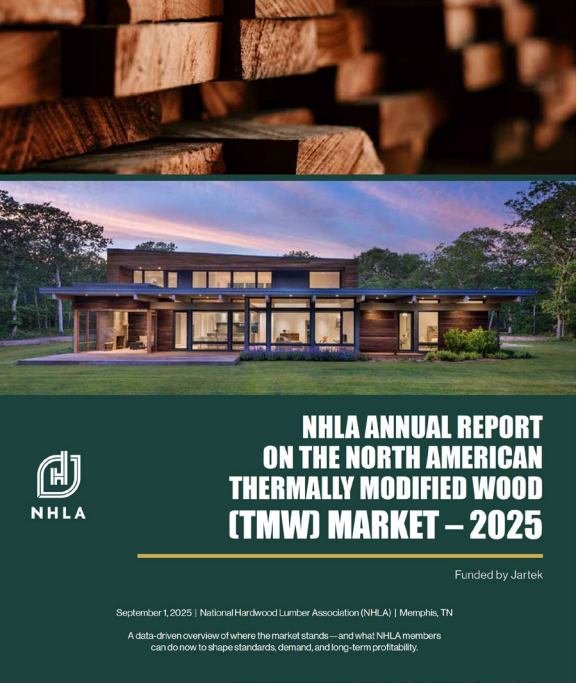
TMW enables domestic species (e.g., ash, oak, pine) to replace imported tropical lumber and chemically treated wood.

The technology adds value to lower-grade or infested lumber, such as ash affected by emerald ash borers.

High-profile architectural projects have increased awareness and credibility.

Most TMW is done for custom orders.

That means you can't walk into many distributors or lumber yards and find it.



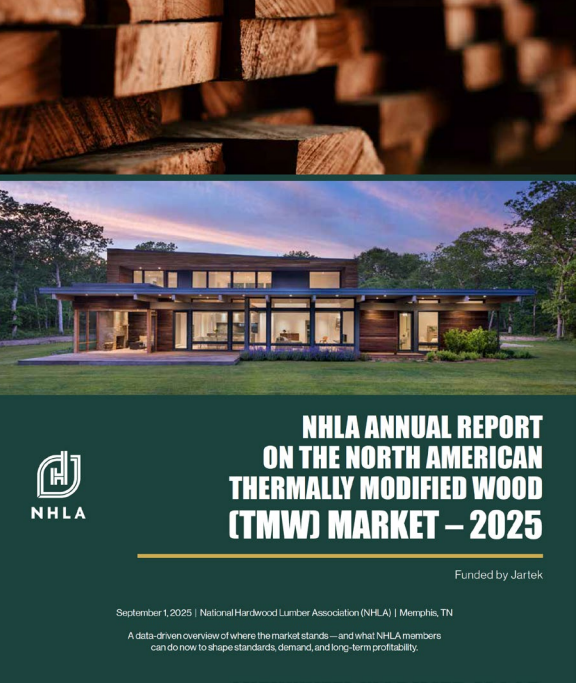
Key Findings of Report

Market Pricing

Thermally modified hardwoods command a premium over untreated lumber due to the added processing, improved performance, and aesthetic appeal.

Pricing varies by grade, species, finish, and distribution channel.

- TMW ash decking: $4.00–$5.50 per board foot (vs. $2.50–$3.00 for untreated ash)
- TMW poplar siding: $3.00–$4.00 per board foot (vs. $1.50–$2.00 untreated)
- TMW oak flooring: $5.00–$7.00 per board foot (premium architectural grade)



Key Findings of Report

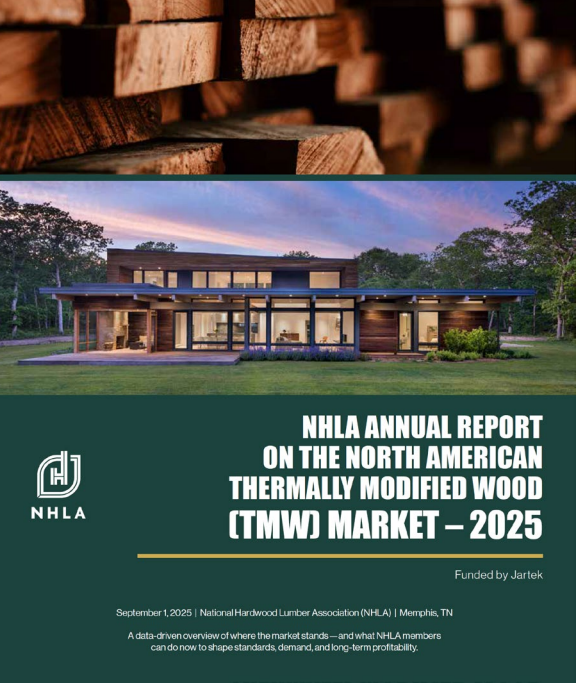
Key Applications

TMW is primarily used in above-ground exterior applications: decking, siding, cladding, pergolas, and outdoor furniture.

Interior uses include flooring, cabinetry, and millwork, especially where moisture resistance and dimensional stability are critical.

TMW softwoods (especially pine) are gaining traction in fencing, playsets, and garden structures as non-toxic alternatives to pressure-treated wood.

While volumes remain modest, demand is growing in high-end residential, commercial, and institutional markets.



Key Findings of Report

Challenges

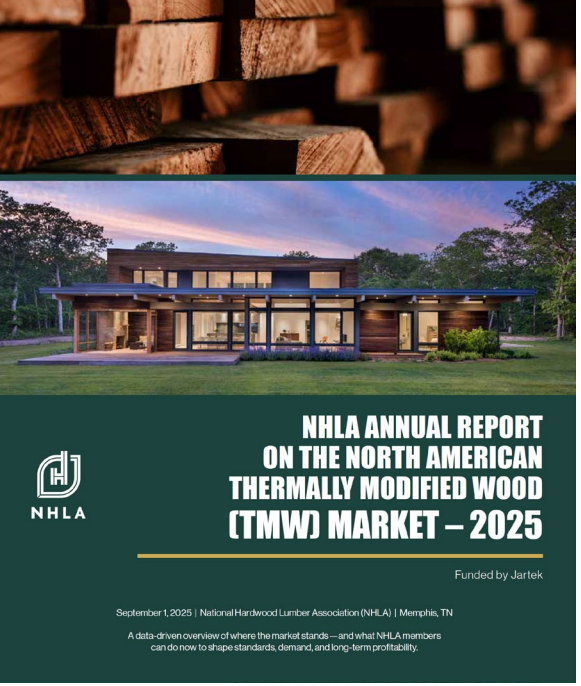
Lack of unified standards and building code recognition in North America.

Limited market awareness and persistent misconceptions.
High initial costs: TMW products typically cost 1.5–2.5× more than untreated lumber.

Raw material supply constraints in some regions, especially for ash.
Performance limitations in ground-contact and structural applications.

Competition from pressure-treated wood, acetylated wood and wood-plastic composites.

Manufacturers that have over promised and underdelivered on quality and performance have hurt the TMW market.



Strategic Recommendations

Establish Standards and Certification

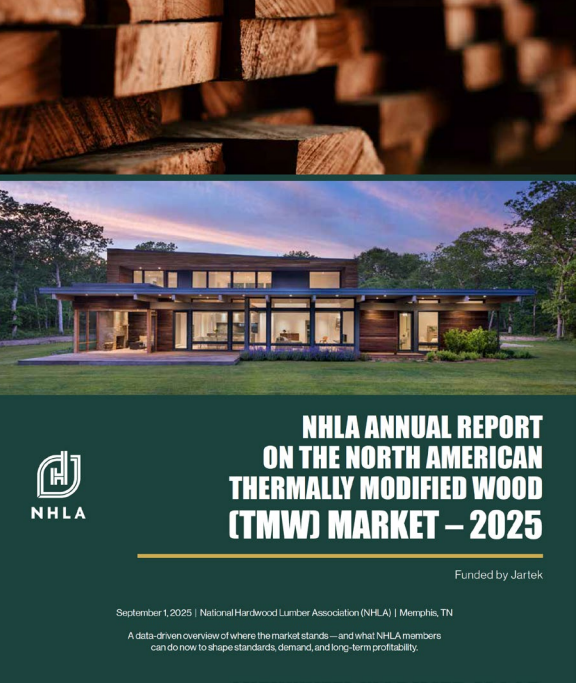
Accelerate development of a North American TMW standard through NHLA, AWPA, and ASTM.

Launch a certification program to build specifier and consumer confidence.

Industry Collaboration and Branding

Form a dedicated North American TMW Council to coordinate promotion, R&D, and branding.

Develop a unified identity and terminology (e.g., “TMW”) across the industry.



Strategic Recommendations

Outreach to Specifiers and Consumers

Invest in technical guides, CEU seminars, and marketing campaigns targeting architects, builders, and homeowners.

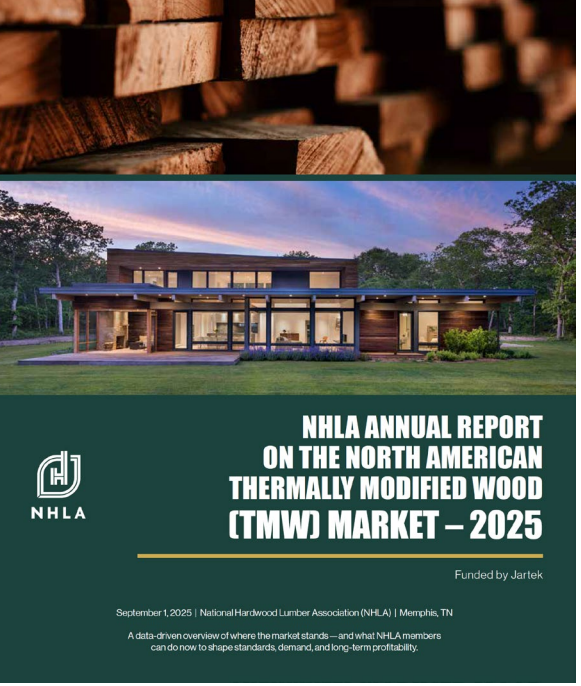
Train distributor and lumberyard sales teams to promote TMW effectively.

Enhance Technical Data and Warranty

Expand long-term field testing and publish design values.

Foster Innovation and Investment

Support R&D for process improvements and new product development. Leverage grants and partnerships to attract investment and scale production.



Key Players

Key Players

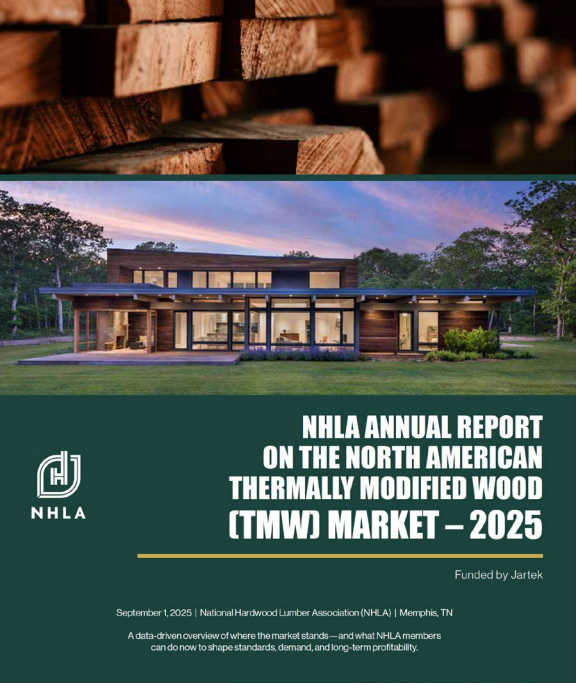
As of 2025, there are approximately 10–12 active hardwood TMW producers in North America, with a combined estimated annual output of 13Mmbf.

Most producers operate one or two kilns, with batch sizes ranging from 5 to 20 m^3.

Production is expected to grow steadily as more sawmills and secondary manufacturers invest in thermal modification systems. Several producers have announced plans to expand capacity or add new species to their product lines.

Midwest & Northeast TM ash and oak

Southern TM poplar and maple



Equipment Manufacturers

Major Equipment Suppliers

Several international and domestic companies supply thermal modification systems to North American producers. Key players include:

Jartek (Finland)

WDE Maspell (Italy)

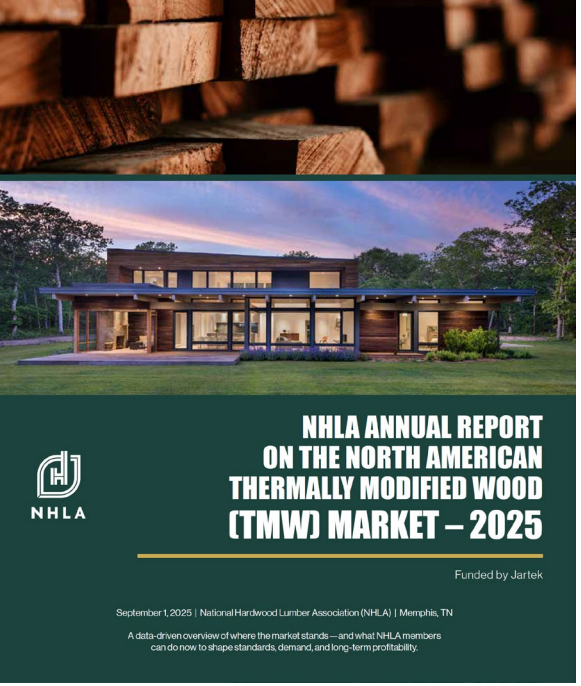
Valutec (Sweden): Not present in the market, but some manufacturers still use its technology.

IWT Moldrup (Denmark)

WTT (Germany)

Big On Dry (Italy)

Self-Installed Systems: Some producers have developed proprietary or retrofitted systems using modified kilns and control units.



Many wood product associations are hosting webinars on TMW all the time.

TMW Major Industry Events

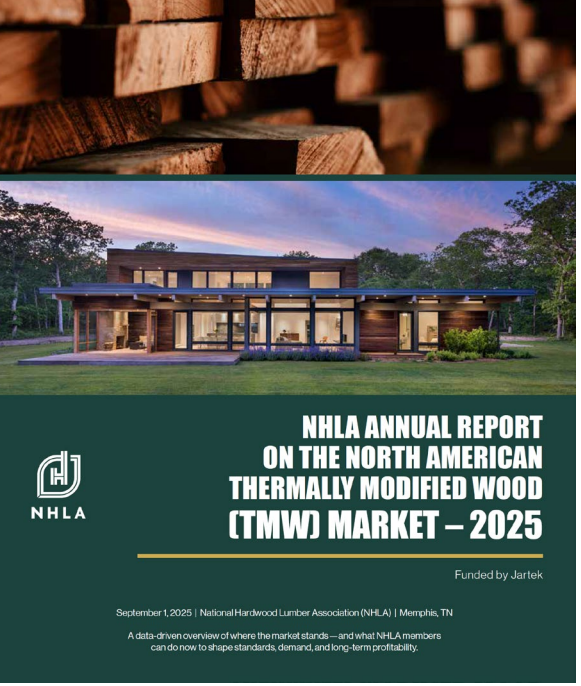
NHLA Annual Convention: Held each fall, this event includes TMW-focused panels, supplier exhibits, and networking opportunities.

AWPA Annual Meeting: A technical forum for wood protection professionals, including researchers and standards developers.

International Woodworking Fair (IWF): One of the largest wood industry expos in North America. TMW producers and equipment suppliers exhibit products and technologies.

Greenbuild International Conference & Expo: A key venue for promoting TMW to architects, builders, and sustainability professionals

Building Materials Shows: Events such as the NAWLA Traders Market and the NAHB International Builders' Show offer opportunities to introduce TMW to new audiences.



Current R&D Landscape

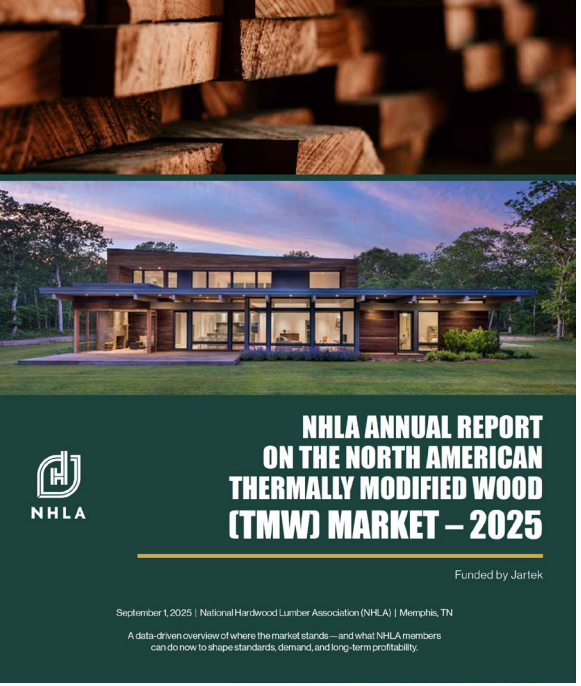
Several organizations are actively engaged in TMW-related research:

USDA Forest Service – Forest Products Laboratory (FPL): Conducts durability testing, process optimization studies, and comparative analysis of modified wood treatments.

University Research Centers: Institutions such as Oregon State University, Mississippi State University Virginia Tech, Michigan Technological University and more have published studies on thermal modification, wood chemistry, and performance metrics.

NHLA TMW Task Force: Facilitates data collection and coordinates research priorities among member companies and technical advisors.

AWPA and ASTM Committees: Provide frameworks for testing protocols and data submission for standardization.



Priority Research Areas

To support industry growth, R&D partnerships should focus on:

Durability and Field Performance: Long-term outdoor testing of North American species in various climates and applications.

Mechanical Properties: Quantifying strength retention and developing design values for structural and semi-structural use.

Process Optimization: Reducing energy consumption, shortening cycle times, and improving consistency across species and kiln types.

Species Expansion: Evaluating underutilized and pest-affected species for thermal modification suitability.

Coating Compatibility: Studying interactions between TMW and stains, sealants, and adhesives to improve finish durability.

Environmental Impact: Conducting lifecycle assessments (LCAs) and carbon footprint analyses to support sustainability claims.

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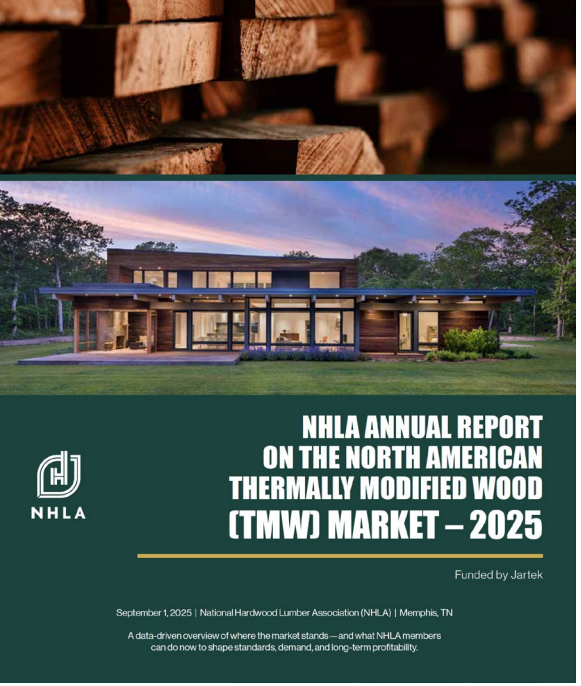


Facilities Types and Scale

TMW manufacturing facilities in North America range from small batch operations to mid-sized integrated plants. Common facility types:

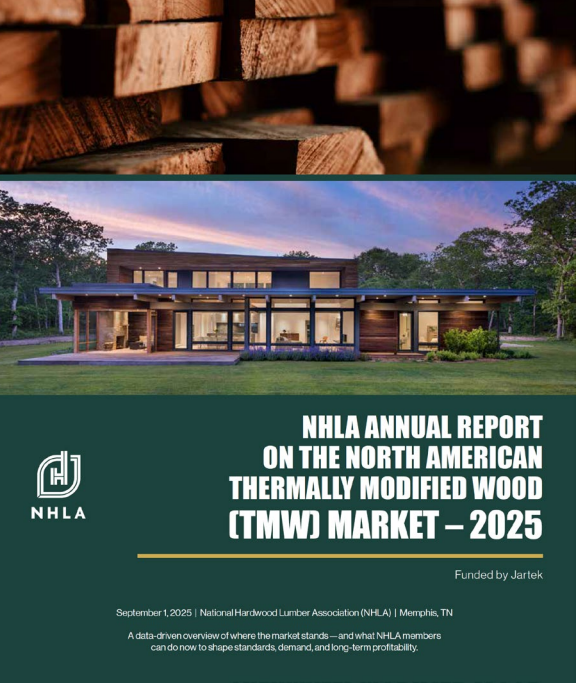
Sawmill-Integrated Kilns: Many hardwood producers have added thermal modification kilns adjacent to existing sawmill operations. This allows for direct processing of rough lumber and efficient use of byproducts (e.g., biomass for heating).

Dedicated TMW Plants: Some companies operate standalone facilities focused exclusively on thermal modification. These plants often serve multiple species and offer branded product lines.

Secondary Manufacturers: A growing number of flooring, siding, and millwork producers are incorporating TMW into their product offerings by outsourcing modification or installing in-house kilns.

Most facilities operate on a batch basis, though continuous kilns are being explored for high-volume softwood production.

Batch sizes typically range from 2,000bf to 8,500bf, with cycle times of 24–72 hours depending on species and system type.



Facilities Types and Scale

Proximity to raw material sources and distribution hubs influences facility location. Transportation costs and regional species availability are key considerations.

Regional Distribution

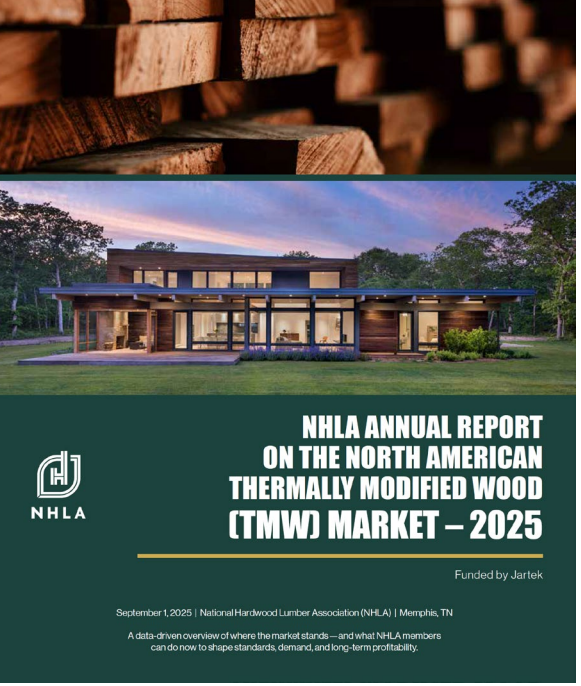
TMW manufacturing is concentrated in regions with strong hardwood and softwood supply chains:

Midwest (e.g., Ohio, Indiana, Michigan): Focus on ash, oak, and maple. Several producers are modifying EAB-killed ash to recover value.

Northeast (e.g., Pennsylvania, New York): Poplar and beech are common. Facilities often serve architectural and millwork markets.

Southeast (e.g., North Carolina, Georgia): Southern Yellow Pine modification is growing, targeting cladding, and fencing applications.

Pacific Northwest: Limited activity, but potential for Douglas fir and western softwoods.



Facilities Types and Scale

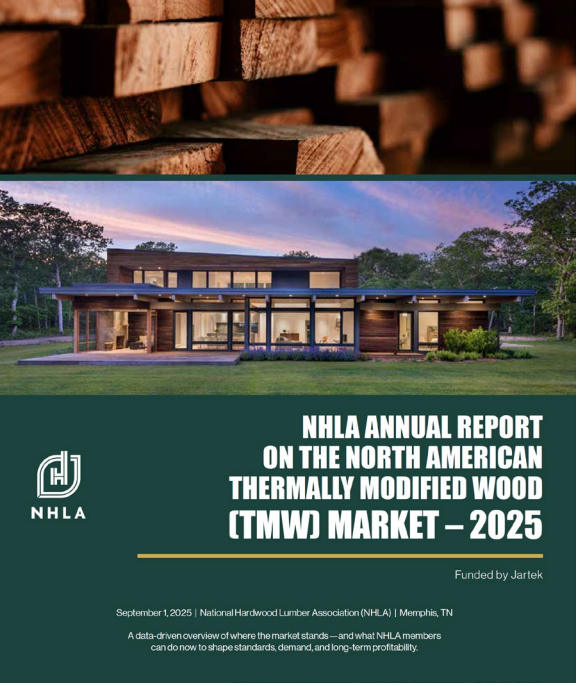
Operational Trends
Several trends are shaping the manufacturing landscape:

Species Diversification: Producers are expanding beyond ash and poplar to include oak, maple, pine, and specialty woods.

Pre-Finishing Integration: Many facilities now offer staining, sealing, and profiling services to deliver ready-to-install products.

Automation and Monitoring: Advanced control systems enable precise temperature and moisture management, improving consistency and throughput.

Quality Assurance:
Producers are investing in testing equipment (e.g., moisture meters, strength testers) to validate product performance and support certification efforts.



Global Market Outlook

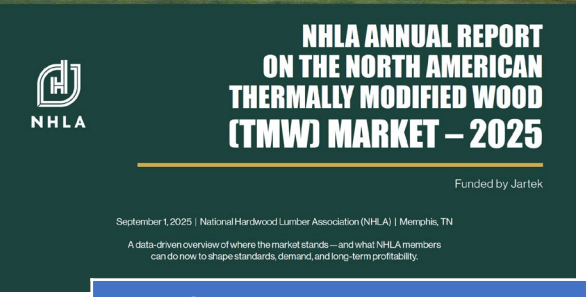
As of 2024, the global TMW market was valued at approximately $1.3 billion.

Forecasts project annual growth of ~5%, reaching ~$1.8 billion by 2030.

Europe accounts for most of the global production, with over 285,000 m^3 ($1m^3$ = 424 board feet) produced annually by ITWA member companies alone.

North America's output remains modest (~30,000–40,000 m^3) but is expected to grow significantly as infrastructure and market awareness improve.

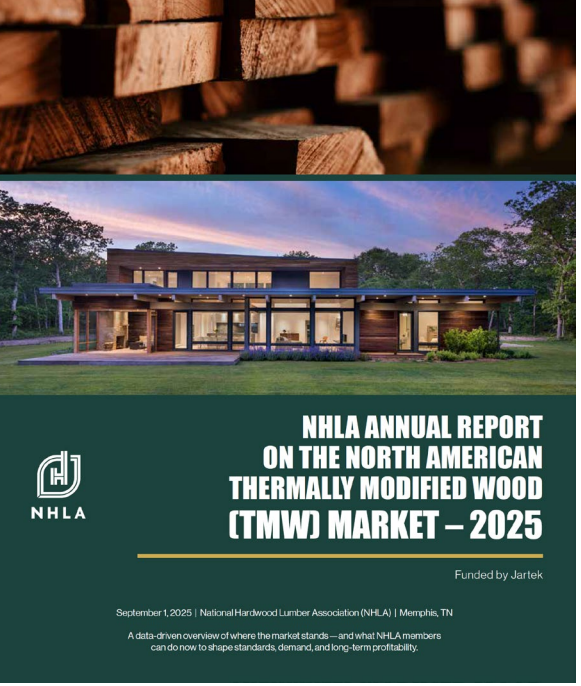
Asia and the Middle East are emerging markets, with increasing interest in sustainable building materials and non-toxic wood treatments.



Current Pricing Overview

Material Type	Typical Price Range	Notes
Pressure-Treated Lumber	$1.50 – $2.50/BF	Lower cost, chemically treated
Tropical Hardwoods	$5.00 – $8.00/BF	Premium, imported, sustainability concerns
Wood-Plastic Composites	$3.50 – $5.50/BF	Consistent appearance, synthetic materials
Acetylated Wood Accoya	$6.00 – $9.00/BF	High performance, chemically modified

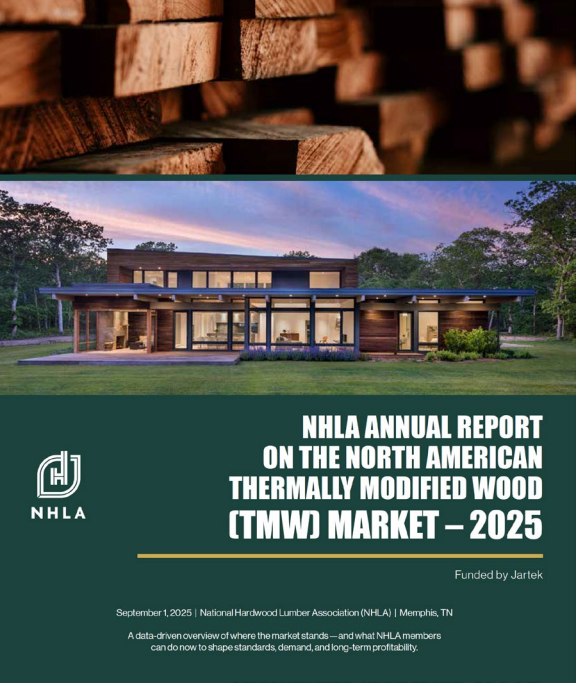
Product Type	Common Species	Price Range (USD/Board Foot)	Notes
Decking	Ash, oak	$4.00 – $5.50	Premium outdoor use, high durability
Siding & Cladding	Poplar, pine	$2.50 – $4.00	Pre-finished options priced higher
Flooring	Oak, maple	$5.00 – $7.00	Architectural grade, interior use
Fencing & Garden Structures	Pine, spruce	$2.00 – $3.50	Competes with pressure-treated lumber
Interior Paneling	Fir, spruce	$3.00 – $4.50	Low-VOC, warm tones



Market Growth Projections

Based on current trends, industry surveys, and global benchmarks, the North American TMW market is expected to grow significantly over the next five years.

Year	Estimated Annual Output (North America)	Growth Drivers
2025	~30,000–40,000 m^3	Existing producers, rising demand
2027	~60,000–70,000 m^3	New kiln installations, expanded applications
2030	~100,000 m^3+ (1m^3 = 424 board feet)	Standardization, certification, export growth

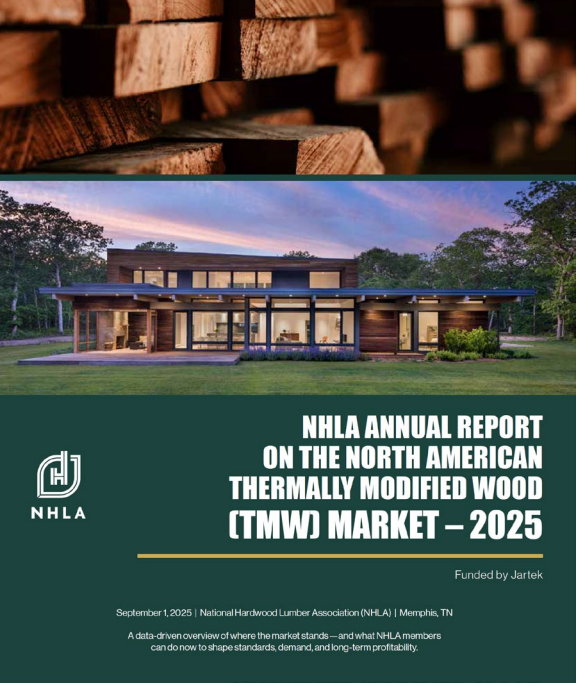


TMW European Market Experience

Use High Quality Wood

- Product Markets
  - Hardwood Flooring
  - Siding and Cladding
  - Decking
  - Sauna's and Wall Paneling
  - Furniture and Specialties
- Production Capacity
  - Past Production Temperature Too High
  - Presently Operating Around 100% Full
  - Future Production to be Expanded

- Customer Profiles
  - Large Corporate Sawmills (StoraEnso, FinnForest, CHH)
  - Flooring Manufacturers (Tulipuu, Volunta Parket, Majur)
  - Service Providers (Ruskapuu,SWM)
  - Midsized Value-added Manufacturers (TreTimber, Isku)
  - Start ups that have been successful (LunaWood, Novawood)



TMW Evaluation of Opportunities

North America: Same Markets Cheaper Products

Problems for North American Consumers

Cedar / Redwood / Tropical Species Concerns
- High Price
- Low Quality from 2nd Growth
- Less Stable Supply from imports

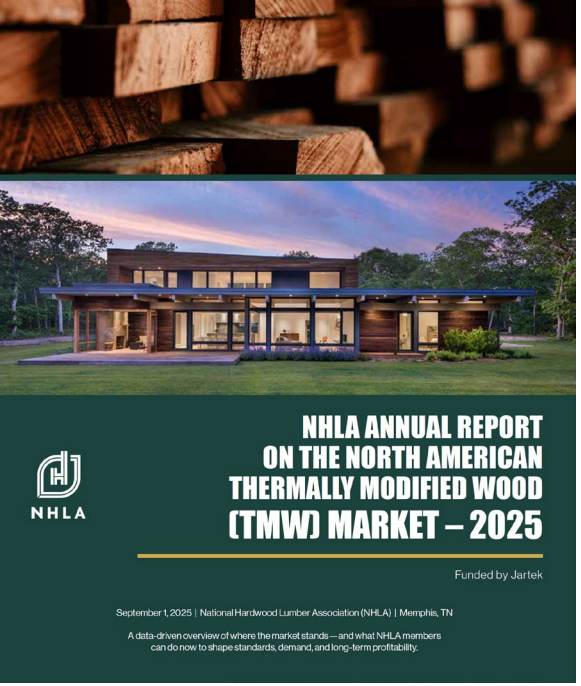
Environmentally Conscious Consumer
- Carbon Emissions, Product Life Cycle
- Concern for Chemicals in Residential Applications

Wood Properties
- Maintenance of Wood Applications
- Cupping, Warping, Bending, Bow, Twist

Wood Products Life Time
- Termite and Other Insects
- Fungi and Rot

Increased Competition From Foreign TMW Imports

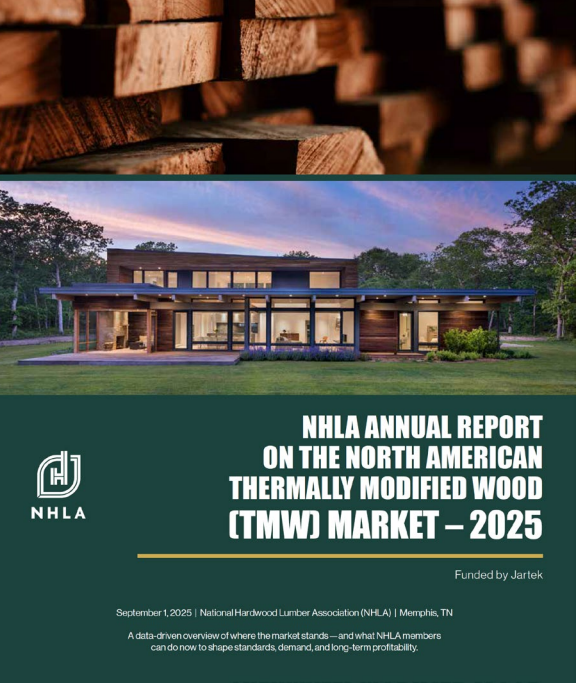
Image courtesy of Jartek



TMW Evaluation of N. A. Barriers

Mind Set of Producers and Consumers

- Equipment Barriers
  - High Capital Costs
    - Economies of Scale Hard to Reach
- High Operating Costs
  - Stickers
  - Load Handling
  - Pre-Drying
- Increased Energy Costs
  - 25% More Energy than Conventional Kilns
- Manufacturing Barriers
  - Knots
  - Tear out, Chipping, Checking
  - Need N.A. Standard Testing
- Wood Barriers
  - Still Wood
    - UV Light
    - Decay
    - Insects

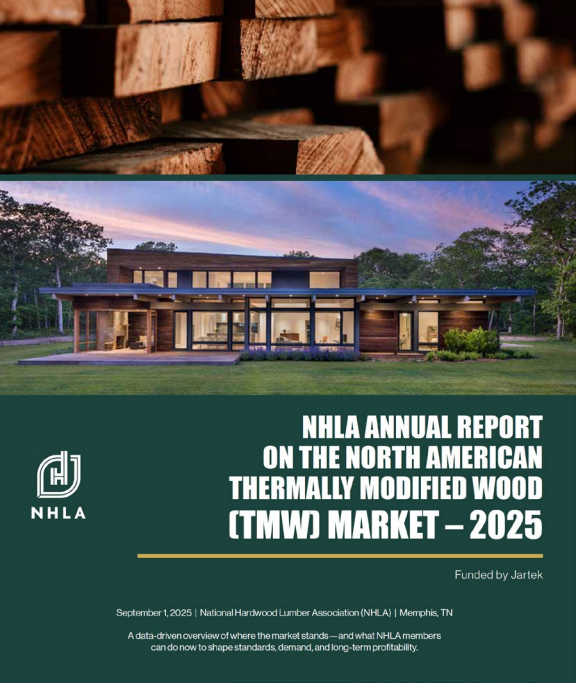


TMW Evaluation of N. A. Fit

Substitute for High Value Species

Hardwoods

- Solid and Engineered Flooring
  - Color Change
  - Increased Stability
- Furniture,
  - Substitute for Wenge, Black Walnut etc.
  - Color Change
- Siding and Cladding
  - Substitute for Cedar and Redwoods
  - Durability Improvements
  - No Resin Bleed
- Decking
  - Cedar / Redwood / Tropical Substitute
  - Large Market with no Clear Leaders
- Other, Window, Door, Moldings
  - Stability
  - Increased Durability

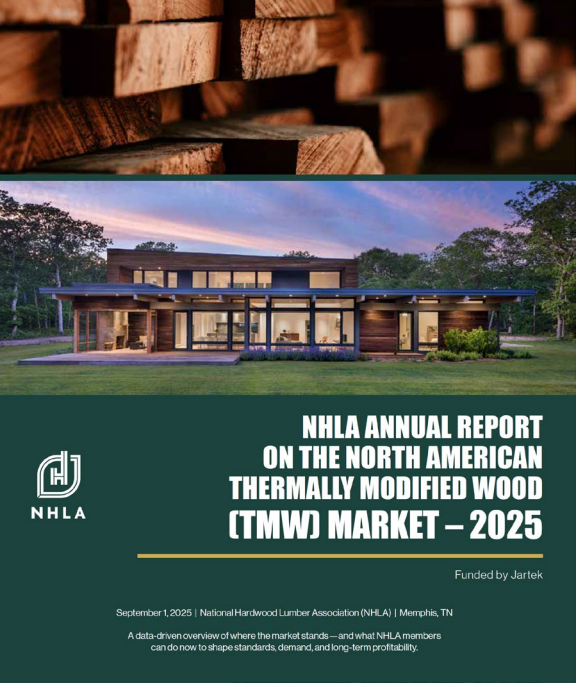


NHLA Commitment to TMW

- Thermal Modification Task Group Created
  - Chair Chris Rider
- Director of Research and Development
  - Sailesh Adhikari
    - 50% of his time is committed to thermal modification
    - 25% of his time is committed to product development
      - Exterior use of hardwoods
        - Decking
        - Siding
        - Fencing
        - Guardrail posts
    - 25% of his time is committed to structural grade development

Report funded by **Jartek**

nhla.com/news/nhla-annual-report-on-the-north-american-thermally-modified-wood-tmw-market-2025



NHLA Thermal Modification Goal:

1st Year 2026

- Publish Annual State of the TMW Industry Report
- Create N.A. Process Standards
  - NHLA TMW Process Certification
  - Equipment / Process Neutral
- Market Promotion to Design Professionals

2nd Year 2027

- TMW Grading Rules

3rd Year 2028

- Create N.A. Product Standards
  - AWPA Wood Durability Standards

Report funded by Jartek

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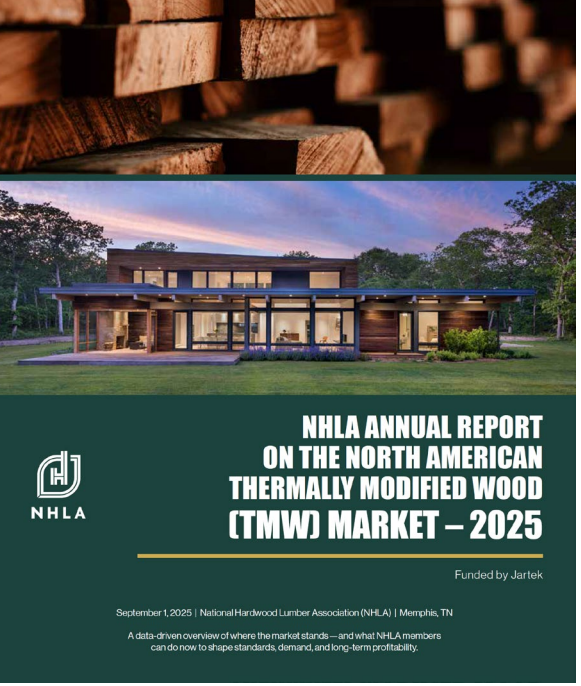
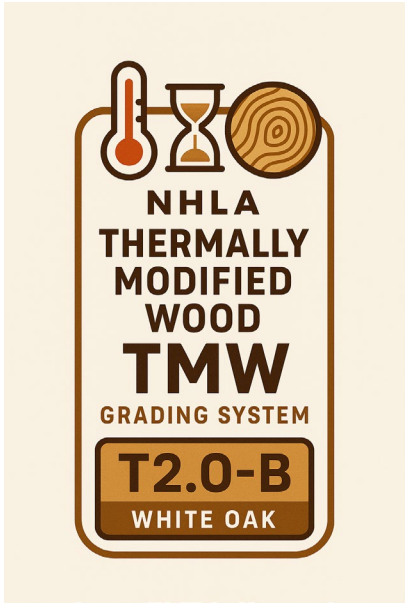
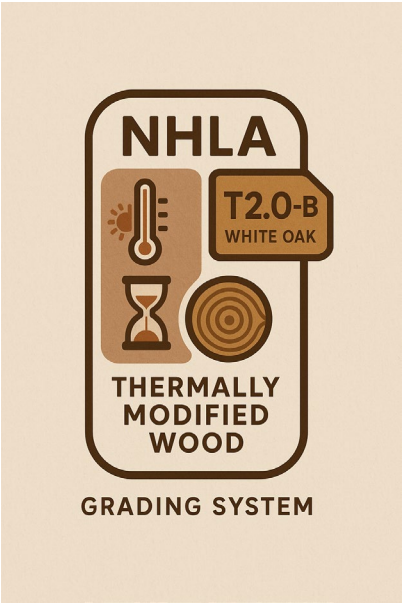
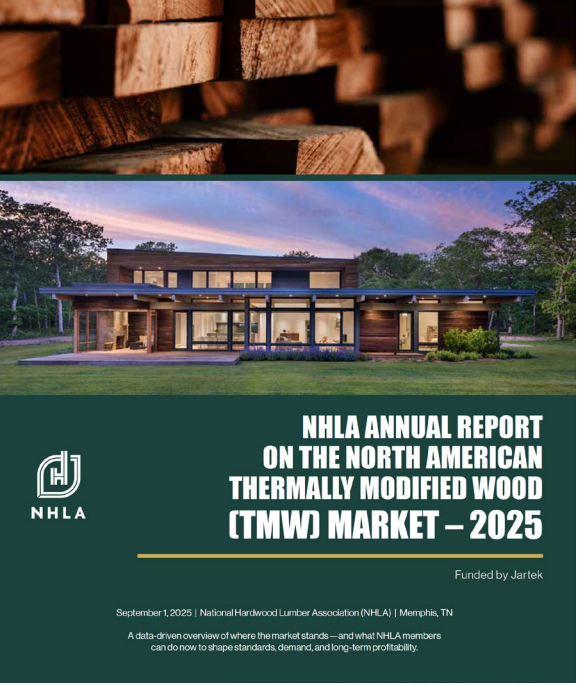


Draft Process Standards Idea

2. To mark thermally modified wood the bundle must indicate the temperature class (T?.?), date, batch number, wood dimensions, grade, and the NHLA TMW Logo (To be created)



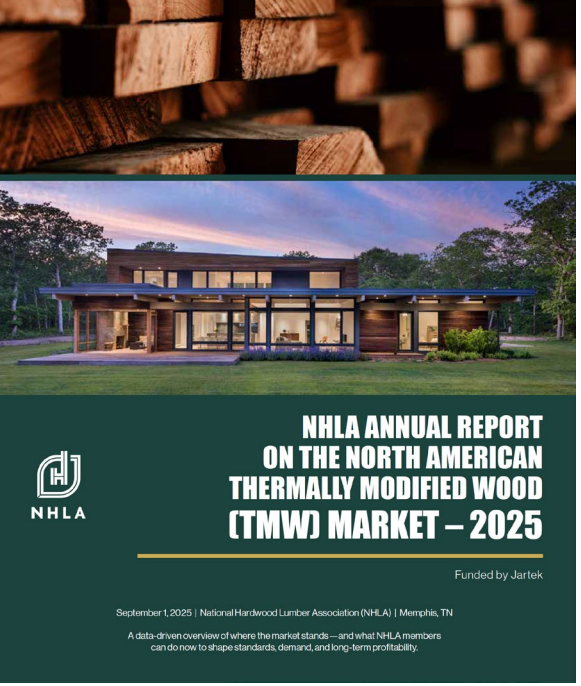




TMW Promotion to Design Professionals

- Real American Hardwood
  - .pro website
  - .com website
  - Tradeshow booths
- Hardwood & Design Publication
  - Starting August 2025
    - Quarterly publication
    - Distribution to 6,000 in NHLA database and potentially 40,000 in partner database.
- CEU and other Content
- Source of Supply Publication

REAL AMERICAN HARDWOOD



Grading Rules for TMW

If you put knotty, waney wood into the chamber you get knot holes and waney wood out.

The quality of thermally modified lumber depends on five things:

1. **Quality of the wood going in.**
2. **Consistency of the wood going in.**
3. The pre drying stress, done before or in process.
4. The thermal modification process
5. Post thermal modification process controls**.**

Grading Rules voted on by NHLA Active Members.

(Sawmills, concentration yards and distributors with headquarters in the USA and Canada.)

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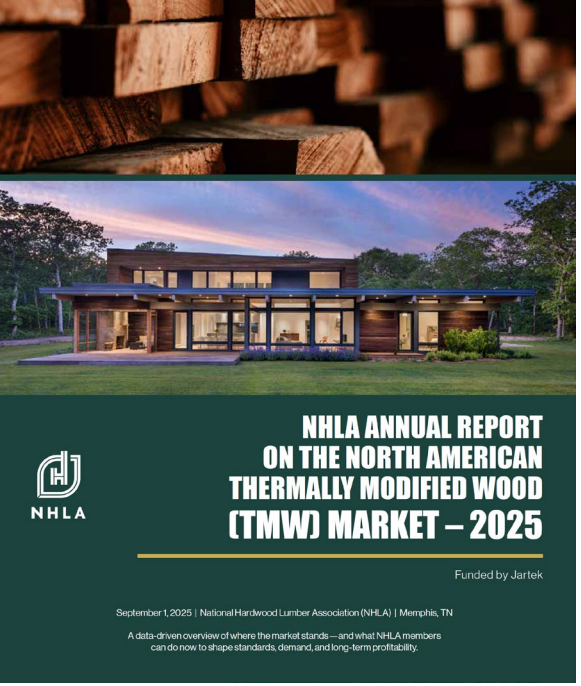


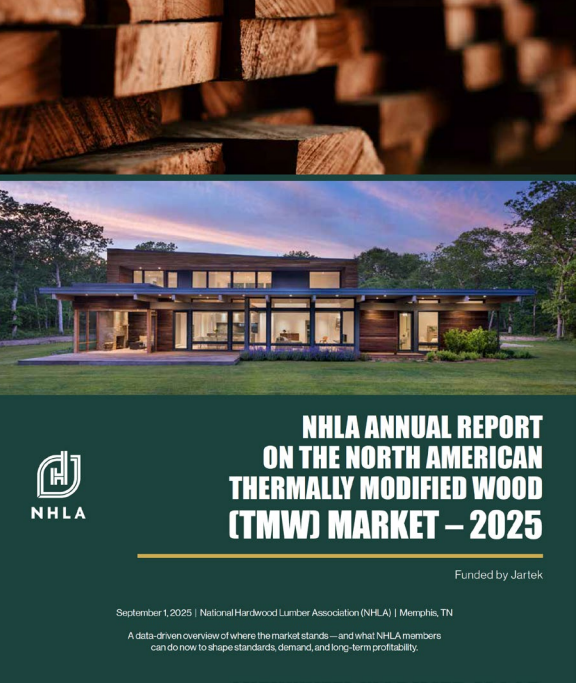
Product Standards for TMW

American Wood Protection Association (AWPA)

- Requires Termite resistance for all Use Categories (U1)
- No natural durability standards
- Need to Modify U1
  - Resistance from cedar, redwood and tropical producers for a natural durability standard
  - Resistance from chemical wood preservers to create a lower standard without termite protection.
- Need Process standards to base durability standards off of.
- Need durability testing to verify durability standards and equivalency
  - Multiple species
  - Multiple temperatures
- Industry Consensus Standard
  - When it comes time to vote you have to be a member on the committee to vote.
  - Join the AWPA

P-9 Committee Non-Biocidal Wood Protection

Currently has a TMW Guidance Document



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Thermally Modified Wood Handling

Fine Dust Particles: Can clog machines and more combustible.

Internal stress increased: Limit need to cut or profile to surface areas.

Increased Brittleness: Cupping in process can be planned out but be gentle.

Knots mean problems: Quality in, quality out, limit knots and watch.

Expect 20% fall down

Report funded by **Jartek**

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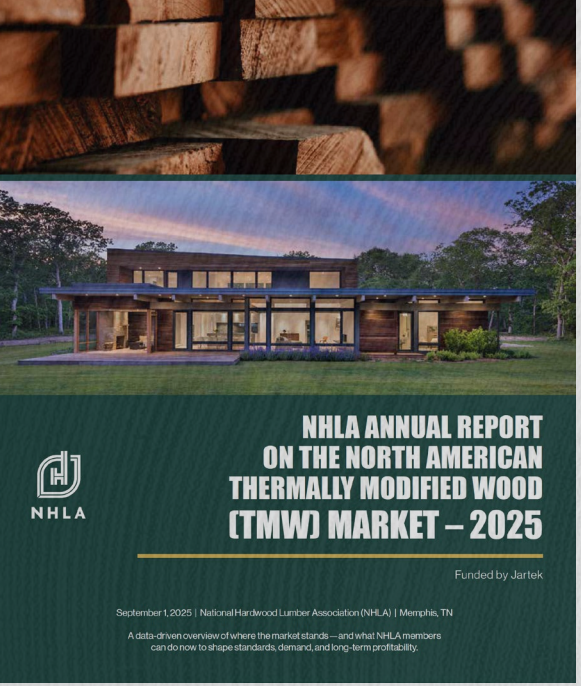

National Hardwood Lumber Association

Thermal Modification Conclusions

NHLA Set to Support TMW Industry

- Hardwood Producers
- Softwood Producers

Sailesh dedicates 50% of his time to TMW

NHLA Report on the North American Thermal Modification Market Funded by Jartek just the start.

Process Standards and Certification

NHLA Grading Rules for TMW

Products and Durability Standards with AWPA

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Questions?

Thanks to our Funder **Jartek**