

**Environment and Natural Resources Trust Fund  
2012-2013 Request for Proposals (RFP)**

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**Project Title:**

**ENRTF ID: 028-B**

Strengthening Minnesotas Forest Health Using Thermal Modification Technology

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**Topic Area:** B. Forestry/Agriculture/Minerals

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**Total Project Budget:** \$ 310,965

**Proposed Project Time Period for the Funding Requested:** 3 yrs, July 2013 - June 2016

**Other Non-State Funds:** \$ 0

**Summary:**

The UMD NRRI proposes to strengthen Minnesotas forest health and productivity by using thermal modification, a chemical-free technology for improving the durability, dimensional stability, and decay resistance of underutilized wood.

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**Location**

**Region:** Statewide

**County Name:** Statewide

**City / Township:**

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<input type="checkbox"/>	Funding Priorities	<input type="checkbox"/>	Multiple Benefits	<input type="checkbox"/>	Outcomes	<input type="checkbox"/>	Knowledge Base
<input type="checkbox"/>	Extent of Impact	<input type="checkbox"/>	Innovation	<input type="checkbox"/>	Scientific/Tech Basis	<input type="checkbox"/>	Urgency
<input type="checkbox"/>	Capacity Readiness	<input type="checkbox"/>	Leverage	<input type="checkbox"/>	Employment	<input type="checkbox"/>	TOTAL <input type="checkbox"/> %



# Environment and Natural Resources Trust Fund (ENRTF) 2012-2013 Main Proposal

## PROJECT TITLE: Strengthening Minnesota’s Forest Health Using Thermal Modification Technology

### I. PROJECT STATEMENT

As shown below, 2008 harvest levels of aspen, black ash, paper birch, and red pine in MN were well below long-term sustainable levels. These low harvest levels threaten forest health and productivity, slow optimal growth, and reduce age-class balance.

Species	2008 Harvest Level (cords/year)	Long-Term Sustainable Harvest Level (cords/year)	Percent Below Long-Term Sustainable Harvest Level
Aspen	1.45 million	2.36 million	38.6%
Black ash	73,400	352,900	79.2%
Paper birch	171,700	370,100	53.8%
Red pine	177,000	345,000	48.7%

Also, since 2006, MN has lost four oriented strandboard (OSB) plants and many sawmills; this eliminated over 1,500 jobs and a combined \$644 million in industrial output, added value, and tax payments. Thus, a major opportunity exists to address low harvest levels, while simultaneously bolstering the economic competitiveness of MN’s forest products industry. The proposed project seizes this opportunity by using thermal modification, a chemical-free technology, to produce high-value wood products with greater dimensional stability, resistance to rot, extended service-life, and fewer environmental impacts. This fledgling technology, successful in Europe for solid wood, has not taken hold in MN due to lack of data in regard to its use for non-solid wood. The goals of this proposed project are to:

1. Strengthen the health, productivity, and optimal growth of MN’s forests by increasing harvest levels of aspen, black ash, paper birch, and red pine toward long-term sustainable levels.
2. Accelerate economic returns from MN’s forest lands by using thermal modification technology to increase the market value of Minnesota’s aspen, black ash, paper birch, and red pine.

Goals will be achieved by **(1)** defining performance benchmarks for wood window and door components, OSB, and plywood; **(2)** manufacturing pilot-scale thermally-modified window and door components, OSB, and plywood from MN aspen, black ash, paper birch, and red pine; **(3)** conducting performance testing; and **(4)** disseminating results/impacts. The direct outcomes are to **(1)** prove the technical feasibility of producing the new products, and **(2)** disseminate project results and impacts to statewide stakeholders. The ancillary long-term outcome is to create jobs and improve the economic competitiveness of MN’s forest products industry. This project also meets several LCCMR Six-Year Strategic Plan priorities.

### II. DESCRIPTION OF PROJECT ACTIVITIES

**Activity 1:** Identify industry-required performance benchmarks for wood window/door components, OSB, and plywood **Budget:** \$21,500

Benchmarks from industry agencies will enable assessment of future project impacts and performance improvements made during the project. Metrics include bending strength/stiffness, plywood shear strength, screw- and nail-holding strength, adhesive bond strength, water absorption/thickness swell, dimensional stability when exposed to humid air, thermal testing, and resistance to biological decay.

Outcome for Activity 1	Completion Date
1. Identify performance benchmarks for wood window and door components, OSB, and plywood.	October 2013

**Activity 2:** Manufacture thermally-modified window/door components, OSB, and plywood from MN aspen, black ash, paper birch, and red pine. Conduct performance testing. **Budget:** \$250,500  
 We will manufacture window/door components, OSB, and plywood prototypes from each MN species. We will also fabricate up to four prototype windows. All prototypes will then be thermally modified in the UMD NRRI's new Pilot Plant (installation complete in summer 2012). Pilot Plant feasibility was established using State of WI funds, and the major equipment was purchased by the private non-profit WI Bus. Inn. Corp. (WBIC). (UMD NRRI has a lease-to-buy agreement with WBIC.) Mechanical, physical, and biological performance testing will be conducted using the metrics/benchmarks listed in Activity 1.

Outcomes for Activity 2	Completion Date
1. Manufacture window/door components, OSB, and plywood products.	May 2014
2. Thermally modify the window/door components, OSB, and plywood products.	February 2015
3. Complete performance testing of all the new thermally-modified products.	December 2015

**Activity 3:** Partner with Arrowhead Reg. Dev. Comm. (ARDC) to develop, facilitate, document, and execute plan to disseminate project results/impacts to stakeholders statewide **Budget:** \$38,965  
 We will work with ARDC from project start to disseminate results/impacts. This includes providing quarterly updates to representatives from all seven NE MN counties, cities and townships, public and private landowners, loggers, forest products manufacturers, and tribal representatives. ARDC will also assist in providing results/impacts to all of MN's RDCs, the Iron Range Economic Alliance, Arrowhead Growth Alliance, Northern Counties Land Use Coordinating Board, North Shore Management Board, and other groups. ARDC will also provide a web site portal to make project information publicly available.

Outcomes for Activity 3	Completion Date
1. Develop structured dissemination plan targeting stakeholders statewide.	March 2016
2. Execute structured dissemination plan and submit final report.	June 2016

### III. PROJECT STRATEGY

#### A. Project Team/Partners

Project Team (all will use LCCMR funding)

UMD NRRI: Patrick Donahue (PI), Matthew Aro (Co-PI), Scott Johnson (Scientist), and Sue French and Robert Vatalaro (technicians). UM-Twin Cities: John Carmody/Pat Huelman (performance testing/life-cycle analyses). ARDC: Pat Henderson (executing project results/impacts dissemination plan).

Project Partners (will provide in-kind support by disseminating project results/impacts to constituents)  
 Headwaters (\$2,500), East Central (\$2,000), Mid-Minnesota (\$1,000), and Region Five (\$375) RDCs.

#### B. Timeline Requirements

The project duration is three years. Activity 1: 4 months, Activity 2: 26 months, Activity 3: 6 months.

#### C. Long-Term Strategy and Future Funding Needs

The proposed project accelerates and complements a larger strategy to improve MN forest health and productivity by transferring thermal modification technology to industry to provide new incentives to increase harvest levels, while simultaneously providing economic development and job creation opportunities. UMD NRRI is now completing USDA- and industry-funded work to advance this strategy. An NSF proposal was also submitted in March 2012 (decision pending). UMD NRRI will also pursue other foundation resources to support the proposed project, if funded.

**2012-2013 Detailed Project Budget**

**Strengthening Minnesota's Forest Health Using Thermal Modification Technology**

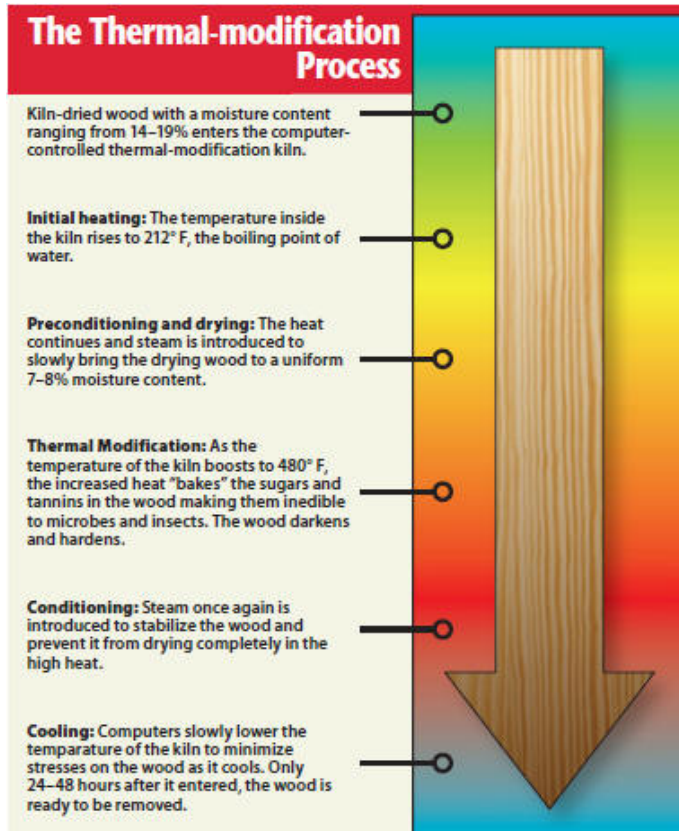
**IV. TOTAL ENRTF REQUEST BUDGET: Three years**

<b>BUDGET ITEM</b>	<b>AMOUNT</b>
<b>Personnel (all from UMD NRRI):</b>	
Patrick Donahue (PI; project manager); 36 mo.; 15% FTE, (74% salary, 26% fringe)	\$ 47,265
Matthew Aro (Co-PI; project design/analyze data); 36 mo.; 20% FTE, (74% salary, 26% fringe)	\$ 42,578
Scott Johnson (Scientist; kiln operation/performance testing); 36 mo.; 25% FTE, (71% salary, 29% fringe)	\$ 40,154
Sue French (Researcher; kiln operation/performance testing); 36 mo.; 50% FTE, (91% salary, 9% fringe)	\$ 25,750
Robert Vatalaro (Research foreman; kiln operation); 36 mo.; 15% FTE, (71% salary, 29% fringe)	\$ 25,073
Undergraduate students (2) (data collection, performance testing); 24 mo.; academic year: 50% FTE; summer: 100% FTE, (96% salary, 4% fringe) (minimal fringe rate charged during summer when academics are not in session)	\$ 32,786
<b>Contracts:</b>	
(Contractor selected through competitive bidding process): air infiltration, water penetration, load deflection, thermal- and weather-cycle testing of wood windows	\$ 19,500
UM - Twin Cities, Minneapolis/St. Paul, MN: hygrothermal performance testing of thermally-modified wood window and door components, OSB, and plywood when incorporated into building envelope systems; life-cycle and sustainability analyses	\$ 10,000
Mississippi State University (MSU), Starkville, MS: biological durability testing of thermally-modified wood window and door components, OSB, and plywood. (MSU is the U.S. expert in the field; U of MN facilities not able to provide insect-resistance testing)	\$ 5,000
Arrowhead Regional Development Commission (ARDC), Duluth, MN: ARDC will lead the preparation and execution of the plan to disseminate project results and impacts. This includes providing quarterly updates to representatives from all seven NE MN counties, cities and townships, public and private landowners, loggers, forest products manufacturers, and tribal representatives. ARDC will also assist in providing results/impacts to all of MN's RDCs and other stakeholders. ARDC will also provide a web site portal to make project information publicly available.	\$ 15,000
<b>Equipment/Tools/Supplies:</b>	
Wood shop supplies, including saw blades, panel sander belts, and adhesives	\$ 3,000
Thermal-modification kiln supplies, including kiln filters, gaskets, and nitrogen	\$ 4,000
Engineered wood materials to be used as control specimens	\$ 2,250
<b>Travel:</b>	
18 round trips for PI and Co-PI from Duluth to outstate Minnesota (5 trips in year one, 5 trips in year two, 8 trips in year three) to share project results/impacts and data, gather feedback on thermally-modified wood prototypes, and meet with landowners and potential commercialization partners. (500 miles round trip x \$0.555/mile) + \$123/person/day per diem (includes lodging and meals)	\$ 9,424
4 round trips for PI from Duluth to UM-Twin Cities (Minneapolis, MN) (3 trips in year two, 1 trip in year three) to oversee thermally-modified wood product performance testing. (300 miles round trip x \$0.555/mile) + \$192/day per diem (includes lodging and meals)	\$ 1,435
<b>Additional Budget Items:</b>	
Publication and printing for semi-annual/final reports and related documentation used for sharing results/impacts with statewide stakeholders. Includes establishing NRRI web presence and initiating and maintaining digital availability.	\$ 2,500
Shipping of thermally-modified wood prototypes to performance testing partners, potential commercialization partners, and other statewide stakeholders	\$ 1,500
UMD NRRI thermal-modification kiln use charge (\$791.67 per kiln charge: 5 kiln charges in year one (\$3,958), 25 kiln charges in year two (\$19,792))	\$ 23,750
<b>TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =</b>	
	<b>\$ 310,965</b>

**V. OTHER FUNDS**

<b>SOURCE OF FUNDS</b>	<b>AMOUNT</b>	<b>Status</b>
<b>In-kind Services During Project Period:</b>		
Dr. Neil Nelson (UMD NRRI) will play an active role by attending quarterly meetings, coordinating the valuable relationships described in this proposal, and working to build long-term cooperative relationships focused on the goals of the proposed project. He will also provide advice and mentoring, with an emphasis on assisting with the innovation capacity-development aspects of the project.	\$ 12,000	secured
Headwaters (\$2,500), East Central (\$2,000), Mid-Minnesota (\$1,000), and Region Five Regional Development Commissions (\$375). Services include: (1) preparing emails/newsletters for each Commission's cities, counties, staff, and local elected officials; (2) placing project web links on each Commission's website; (3) providing project links and information on each Commission's Facebook page; and (4) sharing results/impacts with landowners and economic development practitioners by providing speaking opportunities for the PI and Co-PI.	\$ 5,875	secured
<b>Funding History:</b>		
U.S. Department of Agriculture Wood Education and Resource Center (\$57,654) and UMD NRRI Product Development Fund (\$34,947). This work established baseline physical and mechanical performance data on thermally-modified solid wood (yellow poplar and basswood) for the window and door industry.	\$ 92,601	

## Thermal-Modification Process Overview



Source: [www.junctionwood.com](http://www.junctionwood.com)

### Increasing harvest levels by 30% would provide these benefits:

1. Healthier and more productive forests
2. Increase in optimal forest growth
3. Improved forest age-class balance
4. **\$43.9 million economic output and 379 jobs created, statewide**
  - Increased aspen harvest: **\$32.6 million, 281 jobs**
  - Increased black ash harvest: **\$1.7 million, 15 jobs**
  - Increased paper birch harvest: **\$3.9 million, 34 jobs**
  - Increased red pine harvest: **\$5.7 million, 49 jobs**

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Assumptions: 1) Stumpage prices from MN DNR ([files.dnr.state.mn.us/forestry/um/forestresourcesreport\\_10.pdf](http://files.dnr.state.mn.us/forestry/um/forestresourcesreport_10.pdf)). 2) Thermal-modification process: \$850 estimated added value per thousand-board-feet. 3) Sawmilling: \$200 estimated added value per thousand-board-feet. 4) Dry kiln: \$100 estimated added value per thousand-board-feet for aspen, black ash, and paper birch; \$50 estimated added value per thousand-board-feet for red pine. 5) All wood collected from the increased harvest is manufactured into thermally-modified lumber. 6) Job creation figures are estimates calculated from MN DNR ([files.dnr.state.mn.us/forestry/um/economiccontributionMNforestproductsindustry2011.pdf](http://files.dnr.state.mn.us/forestry/um/economiccontributionMNforestproductsindustry2011.pdf)).

## **Strengthening Minnesota's Forest Health Using Thermal Modification Technology**

### **Project Manager Qualifications**

Project Manager Patrick Donahue is the Program Director of the Market-Oriented Wood Technology Program at the University of Minnesota Duluth Natural Resources Research Institute (UMD NRRI). Prior to becoming Program Director in 2001, he was an Assistant Scientist, Scientist, Senior Scientist, and Program Coordinator. In 1981, he received his B.S. in Wood Science from the University of Minnesota – Twin Cities and is currently pursuing an M.S. in Engineering Management from UMD.

Pat provides quantitative and qualitative research and feedback, identifies market opportunities, and forecasts market and environmental impacts, per a broad blend of global wood science education, R&D knowledge, sales and marketing experience, and strategic industry contacts. He also transfers and applies knowledge and solutions from industry-to-industry or continent-to-continent, for a “better way.” Pat also directs Institute staff and manages all aspects of client projects, including defining product, process, and market requirements; writing proposals; developing work plans; and delivering positive outcomes.

### Synergistic Activities

Since 2000, Pat has been engaged in the development of technology to thermally modify lumber using Finnish methods. The work began with a contract grant from the Finnish government, which led to a series of contracts to research market potential. More recently, he received U.S. Department of Agriculture funding to further develop this technology for the fenestration (window, door, and building envelope components) market. Most recently, he received a contract to assist a team of top regional lumber producers in developing a major facility to thermally modify red pine lumber for external cladding. This will greatly reduce the need for importation of wood species from outside the region, and will lead to another core tenant in an eco-industrial park. Pat has also developed and executed a Wood Science lecture series for UMD's Civil Engineering Materials Science curriculum (2010-present) and is Chairman of the Forest Products Society, Upper Mississippi Valley Chapter (2011-present).

### Relevant Publications

Donahue, P., Aro, M., French-Coda, S., and Chen, W. 2011. Thermally-modified Eastern hardwoods as high-tech fenestration and exterior shuttering. USDA Wood Education and Resource Center Project no. 09-DG-090. Final Accomplishment Report. September 22. Online. Accessed on February 20, 2012. Url: [http://spfnic.fs.fed.us/werc/finalrpts/09-DG-090\\_2.pdf](http://spfnic.fs.fed.us/werc/finalrpts/09-DG-090_2.pdf).

Donahue, P. and Aro, M. 2010. HEATReeT Wood Technology Enterprise. Wisconsin Department of Agriculture, Trade and Consumer Protection project no. 25048. Subcontractors, final report submitted to Wisconsin Business Innovation Corporation.

### **Organization Description**

The UMD NRRI was founded in 1985 with a mission to foster economic development of Minnesota's natural resources in an environmentally sound manner to promote private sector employment. UMD NRRI program directors, scientists, and research staff have extensive experience in managing large, interdisciplinary projects whose objectives include the development of technologies and tools for environmental assessment, resource management, and positive economic development. For more information, please visit [www.nrri.umn.edu](http://www.nrri.umn.edu).