Amanda Brazee

From: Amanda Brazee
Sent: Friday, December 05, 2014 9:27 AM
Subject: Report on the Competitiveness of Minnesota's Primary Forest Products Industry
Attachments: Competitiveness Report - Final 11.26.14.pdf

Dear Council members:

Attached please find a copy of the Minnesota Forest Resources Council's (MFRC) "Report on the Competitiveness of Minnesota's Primary Forest Products Industry."

The report mentions LSOHC within recommendation #6 which simply state, "**Employ additional tools, such as the purchase of permanent conservation easements, to ensure the protection of high value forest lands and associated timber supply (Legislature, DNR, LSOHC).**

With the breadth of Council member interests and the reach of past, current and potential OHF appropriations, I thought this report may be of interest to at least a few Council members.

On a separate note, thanks to an alert by Representative Hansen, yesterday I was privileged to attend a Minnesota Environmental Initiative "Policy Forum" regarding pollinators. It was an extremely interesting event with far too many take-away points for me to mention them all. However, here are just a few tidbits for your consideration.

- Each year, from cumulative causes, an estimate 25-30% of commercial bee hives perish.
- Honey bees will travel up to 5 miles in search of food. Native bees may spend their entire life within 1 mile from their nesting site.
- California almond farmers rented commercial bee hives for pollination in the mid-1990s at a rate of approximately $35/hive. Today, that rate is reportedly $150-200/hive.
- Commercial blueberry fields in Michigan experience an increased yield of approximately 500 lbs. when adjacent corridors and roadsides are laden with blooming pollinator habitat. Canola growers in Canada have similarly experienced an increase in profits by planting up to 30% of otherwise canola crop land to pollinator habitat.
- Bees, although a primary pollinator species, are joined by moths, butterflies, and a host of other insect species as pollinators.

Have a great weekend.

Mark

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Report on the Competitiveness of Minnesota's Primary Forest Products Industry

December 2014

Submitted by the Minnesota Forest Resources Council

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Cover photos (left to right): Eli Sagor, University of Minnesota (UMN) — tree removal selection; Amanda Kueper, DNR — Hedstrom Lumber Company mill yard; Eli Sagor, UMN — red pine regeneration following seed tree harvest.

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Executive Summary

Minnesota's primary forest products industry is vital to state's economy and to the health of the state's forests. The economic downturn that started in 2008 hurt the competitive position of Minnesota's primary forest products industry, and concern about the competitiveness of the industry lingers**.** To address this concern, the DNR Commissioner asked the Minnesota Forest Resources Council to assess Minnesota's forest-based economy and compare it with other states and countries. The Commissioner asked the Council to specifically look at permitting and environmental review, vehicle weight limits, taxation, energy costs and other metrics.

In general, Minnesota's forests are aging and declining rapidly in terms of growth and quality. Harvesting has declined steadily over the past decade, despite development opportunities cultivated from new forest-based products. The result is diminished forest health, productivity and wildlife habitat, compounded by environmental review processes that have slowed new investment. Uncertainties related to climate change, invasive species and threats to summer harvest increase these challenges. All put a strain on the competitiveness of Minnesota's primary forest products industry.

This report offers numerous recommendations to help improve the competitiveness of Minnesota's primary forest products industry. No single recommendation on its own will make a significant difference. It is the combination of recommendations, which are aimed at improving forest health, increasing the availability of quality wood and improving the business environment in which the industry and all its affiliated constituents operate, that will start bending the curve toward a more competitive position.

Table 1 provides a summary of the competitive position of Minnesota's forest products industry relative to other states and countries across several key factors. The recommendations in the report are listed following the table. Each of the factors, and the related recommendations, are explained in more detail in the report.

Table 1. Comparison of all factors - Minnesota versus other locations.

	Wood Fiber Availability and Cost	Cost of Energy	Workforce Development	Environmental Review and Permitting	Taxation	Transporation
Wisconsin	B	W	W	S	B	S
Michigan	B	W	W		W	B
Mississippi	B	W	W		B	
Louisiana	B	B	W		B	B
Georgia	B	B	W	B	B	W
North Carolina	B	Mixed	W	S	B	
Washington		W	W	S	B	B
United States						
Germany						
Finland						
Canada						

Legend

B	= Better than Minnesota
S	= About the Same as Minnesota
W	= Worse than Minnesota
Mixed	= Mixed
	= Missing Data

Recommendations*

Wood Fiber Availability and Cost

1. **Increase availability of wood on the market (USDA Forest Service — Superior and Chippewa National Forests, Department of Natural Resources [DNR], counties).**

2. **Increase outreach to family forest landowners by professional foresters, with particular focus on pursuing financial incentive payments to help develop and implement forest management plans and promoting more timber harvests to attain landowner goals (NRCS, USDA Forest Service – State and Private Forestry, DNR, forest industry, consulting foresters, UMN Extension, MFA).**

3. **Develop a comprehensive plan for identifying and accessing sites that can be made available for summer harvesting where site conditions and management objectives support non-frozen ground operations (USDA Forest Service – Chippewa and Superior National Forests, DNR, counties, forest industry, consulting foresters).**

4. **Increase revenue for public and private forest landowners by encouraging them to conduct larger volume sales (i.e., more volume per sale) (USDA Forest Service – Chippewa and Superior National Forests, DNR, counties, forest industry, consulting foresters).**

5. **Conduct pine thinnings year-round (USDA Forest Service – Chippewa and Superior National Forests, DNR, counties, consulting foresters).**

6. **Employ additional tools, such as the purchase of permanent conservation easements, to ensure the protection of high value forest lands and associated timber supply (Legislature, DNR, LSOHC).**

7. **Enhance the effectiveness of the Sustainable Forestry Incentive Act (SFIA) at providing a multitude of benefits including increased timber supply, slowed parcelization, maintenance of water quality and maintenance of public recreational access (Legislature, DNR, Department of Revenue).**

    a. **Clarify the goals of the SFIA program, providing more specificity regarding the benefits of the program and identifying the different benefits from small and large forestland owners. (Legislature).**

    b. **Identify SFIA as an incentive program rather than as a tax program. This would allow a shift in much of the administration and funding of SFIA from the Department of Revenue to DNR (Legislature, Department of Revenue, DNR).**

    c. **Implement a two-tiered payment, with a higher payment for all forest landowners who provide public recreational public access on their lands and a lower payment for those who do not allow public recreational access (Legislature).**

    d. **Private landowner forest management plans should be registered with the DNR (Legislature, DNR).**

    e. **Contingent upon funding, DNR should be charged with periodically reviewing landowner compliance by program participants for their conformance with SFIA program requirements (Legislature, DNR).**

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* Recommendations are **not** listed in priority order. Entities listed in parentheses are those to whom the recommendation is directed.

f. **Penalties should be increased, with stronger penalties for forest land converted to non-forest uses (e.g. gravel pits or clearing for agricultural purposes, versus constructing a structure on a small part of the tax parcel) (Legislature).**

g. **Clarify penalty requirements relative to ownership changes - i.e., clarify who incurs payment responsibilities and identify who receives payment when land ownership is transferred (Legislature).**

h. **Repeal the 60,000 easement acre limit for current and future landowners eligible for SFIA (Legislature).**

i. **Maintain a strong tax incentive for future voluntary donations of conservation easements to prevent development, expanded mixed ownership patterns and creation of more roads required by new owners to access their properties (Legislature, DNR).**

8. **A delegation led by DNR should work collaboratively with the SFI, FSC and ATFS certification systems to establish recognition of the Minnesota Master Logger Certification program as a credible third-party certification program (DNR, MLEP, MFI).**

Cost of Energy

1. **The state should provide utilities and their customers with the authority to offer a special tariff to those energy intensive customers who are exposed to global competition and able to move production to other locations outside Minnesota (Governor, Legislature).**

2. **The state should require that industrial electric rates be based upon cost of service (Governor, Legislature).**

3. **The state should continue to exempt vehicles used for off-road activities from the biodiesel mandate and from fuel taxes for logging vehicles and equipment (Legislature, Department of Revenue).**

4. **Direct the Department of Commerce to evaluate and report on alternatives to diesel fuel for the logging industry, including compressed natural gas (with fueling stations at paper mill sites) and other bio-based alternatives (Legislature, Department of Commerce).**

Workforce Development

1. **Improve the targeting, timing and availability of job training models and programs for logging businesses and the forest industry sector, especially for skilled electrical and mechanical maintenance craftsmen and the building trades (MNSCU, UMN).**

2. **Develop new apprenticeship and training programs for entry level logging business employees, enhance continuing education offerings to increase the capacity and capability of existing logging business employees and expand efforts to recruit students into these programs, including truck driving (MLEP).**

3. **Urge Minnesota's Congressional delegation to support legislation that would amend the Fair Labor Standards Act of 1938 so that 16 and 17 year olds would be allowed to work on mechanized logging operations under parental supervision (Governor, Congressional delegation).**

4. **Establish at least one high-performance training school in northern Minnesota that will deliver electrical, instrumentation, mechatronics, craft and operating skills that will lead graduates to immediate placement in living wage forest industry jobs close to home (Legislature, MNSCU).**

Environmental Review and Permitting

1. **Exempt wood harvest from the environmental review process until a cumulative harvest threshold quantity of four million cords/year is reached (Legislature, Environmental Quality Board, DNR, MPCA).**

2. **Improve environmental review predictability timelines and efficiency by taking the following actions:**

    a. **Continue to support Minnesota Business First Stop, which provides a helpful service to the Minnesota business community (Governor).**

    b. **Let applicants know what documents are needed and make this information easily accessible at the outset of the environmental review process (DNR, MPCA).**

    c. **Adhere to the rules set at the beginning of the review process so as to avoid 'scope creep' during the later stages of the review process (DNR, MPCA).**

    d. **Provide applicants with *one* contact who handles the required documentation at the outset of the environmental review process (DNR, MPCA).**

    e. **Recognize that electronic communication allows for faster exchange of information, and use that to shorten the length of environmental review by reducing the 'dead time' during the review process (DNR, MPCA).**

Taxation

1. **Assure that the up-front exemption on capital equipment rather than a rebate occurs on July 1, 2015 and consider expanding the definition of capital equipment to include entire projects as well as logging equipment (Legislature).**

2. **Adjust the current 2C rate for forest landowners to make it comparable to the rate for agricultural landowners (Legislature).**

3. **Revise the language that precludes reduced tax assessments by county assessors on conservation easements (Legislature).**

Transportation

1. **Urge Minnesota's Congressional delegation to move federal highway vehicle weight limits at least up to current state limits, 90,000 pounds with 6 axles in the summer and 99,000 pounds with 6 axles in the winter, to ensure a more seamless road network (Governor, Congressional delegation).**

2. **Urge Minnesota's Congressional delegation to change laws that prevent rail competition (Governor, Congressional delegation).**

Recommendations*

3. **Support development of pipelines as an option to increase the availability of rail service for the forest products industry (Governor, Legislature, MN Public Utilities Commission).**

4. **Fund improvements to and maintenance of existing forest roads and bridges in the forested parts of the state (Legislature).**

Bioeconomy

1. **Create biomarkets to use sawmill and forest residuals, with specific initial focus on pellet technology that can replace propane with locally grown and produced renewable fuels in schools and other public buildings (DNR, DEED, IRRRB).**

2. **Request state funding for the UMN targeted specifically at the earlier stages of the bioeconomy research and development continuum (Governor, UMN, Legislature).**

Introduction

Minnesota's primary forest products industry is vital to state's economy and to the health of the state's forests. A 2012 report indicated, "the state's forest products manufacturing and related sectors directly contribute $8.9 billion in industry output and $3 billion value added to the Minnesota economy, employing about 29,700 people directly with a total employment effect of 62,370." [1] In addition, managed forests are at a lower risk for forest pests and wildfire than are unmanaged forests.[2] Timber harvests to meet the demand for forest products are the primary means for managing forests. Timber harvesting is also an important wildlife habitat management tool and creates conditions suitable for diverse recreational opportunities.

The economic downturn that started in 2008 hurt the competitive position of Minnesota's primary forest products industry, and concern about the competitiveness of the industry continues leading into 2015**.** In general, Minnesota's forests are aging and declining rapidly in terms of growth and quality. Harvesting, the principal tool for effective forest management, has declined steadily over the past decade, despite development opportunities cultivated from new forest-based products. The result is diminished forest health and productivity compounded by environmental review processes that have slowed new investment. Reductions in harvest levels have led to lower wildlife habitat quality and dramatically increased risk to public safety from very large forest fires and blowdowns. Uncertainties borne from climate change, invasive species and threats to summer harvest compound these concerns.

In summary, Minnesota needs a strong and vibrant forest based industry. This sector represents an essential component of the state's economy and employment levels. Our capacity to sustainably manage our forests for multiple benefits hinges on the health of Minnesota's primary forest products industry.

This report offers numerous recommendations to help improve the competitiveness of Minnesota's primary forest products industry. No single recommendation on its own will make a significant difference. It is the combination of recommendations, which are aimed at improving forest health, increasing the availability of quality wood and improving the business environment in which the industry and all its affiliated constituents operate, that will start bending the curve toward a more competitive position.

Charge and Approach

The primary forest products industry in Minnesota has faced a number of significant issues during the past decade. In response to these issues, DNR Commissioner Tom Landwehr asked the Minnesota Forest Resources Council (MFRC) to assess Minnesota's forest-based economy and compare it with other states and countries. Building on previous MFRC reports in 2003, 2006 and 2007, the Commissioner asked the council to specifically look at permitting and environmental review, vehicle weight limits, taxation, energy costs and other metrics. The Commissioner asked the MFRC to convene a group of stakeholders to advise on this assessment, and to deliver a report by December 1, 2014 so that it could be used to inform decision-makers in the 2015 legislative session.

Bob Stine, Chair of the MFRC, convened a steering committee to oversee the completion of this study. Members of the steering committee were:

Bob Stine, Chair (MFRC)
Pete Aube (Potlatch)
Forrest Boe (DNR-Forestry)

John Fryc (SAPPI, Wood Fiber Employees Joint Legislative Committee, Service Employees International Union Local 32BJ, National Conference of Firemen and Oilers District Chapter 939)
Craig Halla (Molpus Timberland Management)
Judy Haney (Packaging Corporation of America)
Kit Hasbargen (Hasbargen Logging, MN Timber Producers Association)
Joe Maher (UPM Blandin)
Gene Merriam (MFRC Environmental Organization representative)
Heather Rand (Department of Employment and Economic Development)
Mike Schultz (SAPPI)
Jack Wallingford (Norbord MN)

The steering committee, in turn, convened a working group of experts to conduct much of the information gathering and data analysis. This group included:

Andrew Arends (DNR Division of Forestry)
Steve Betzler (MN Power)
Wayne Brandt (MN Forest Industries, MN Timber Producers Association)
Alan Ek (UMN-Forest Resources)
Dave Hart (IRRRB)
Dick Hemmingsen (UMN-Bioproducts and Biosystems Engineering)
Calder Hibbard, Facilitator (MFRC)
Mike Kilgore (UMN-Forest Resources)
Heather Rand (DEED)
Dave Zumeta (MFRC)

The steering committee, with assistance from the working group, identified six key issues determined to be the most significant to address: timber availability and price, cost of energy, workforce development, environmental review\permitting, taxes and transportation. The committee also explored the opportunity to expand development of bio-based products , which is viewed as a likely next development for the forest products industry – *if* the existing industry can become more competitive.

To help create actionable recommendations for the six key issues, it became clear that an understanding of outcomes from past studies and recommendations was needed, as was an understanding of forest resource conditions in the state. These two items provide context for the comparison with other states and countries relative to the key competitiveness issues, and factor heavily into the steering committee's recommendations.

Summary of Past Efforts

The competitiveness of Minnesota's primary forest products industry has been a major concern of industry and state government for nearly four decades. Such concerns have focused on timber supply and availability, development opportunities and costs, environmental impacts of forest management and environmental review processes, among others. Former Governor Pawlenty convened Governor's advisory task forces on the global competitiveness of Minnesota's primary forest products industry in 2003, 2006 and 2007. These successive task forces crafted a number of public policy recommendations. Some were implemented, others remain issues. On the next page is a brief assessment of implementation of previous recommendations.

Forest policy. Funding for the MFRC declined by 26 percent between FY 2008 and FY 2015. A Forestry sub-cabinet was formed as recommended and developed a biomass strategy, but this sub-cabinet no longer exists. The state has implemented Minnesota Business First Stop, a business-friendly economic development initiative that is governed by nine state agency commissioners. First Stop has a much broader purview than forestry, and some forest industries have found the initiative to be helpful.

Research. A number of recommended research projects were funded and completed, including research on silvicultural practices, timber sales methodology, parcelization of forestland and ecological impacts of woody biomass harvesting.

Increase wood and fiber availability. In response to specific situations, public agencies have increased the amount of wood offered (e.g., to address 2006 stumpage price increases and the 2014 summer wood shortage). However, agencies generally continue to lack adequate funds to complete timely forest inventories. In response to legislation (M.S. 127A.31), DNR has focused on maximizing economic returns from trust lands over the past several years, including those from timber harvests. DNR has also revised its Extended Rotation Forest policy to reduce rotation ages, thereby making more timber available from state lands. Not harvesting timber at rotation age remains an issue on other ownerships, and other policy issues also remain unresolved. The 2014 Legislative Auditor's Report on DNR Forest Management documented significant declines in the DNR Division of Forestry's forest management budget from 2008 through 2014.[3]

Productivity. A Forest Management Investment Account was established. Bonding was appropriated for reforestation in a number of years, with $2.5 million appropriated in 2012, and $2.96 million in 2014. These amounts were about half of what was needed to meet the statutory requirement to reforest state lands. Improving productivity would require significantly larger funding allocations from the General Fund. A legislatively mandated MFRC study evaluated the economic feasibility of converting marginal agricultural lands to forest lands, specifically with regards to increasing carbon sequestration from Minnesota forestland.

Maintenance of the forest land base. Through Minnesota Forests for the Future, the Forest Legacy Partnership and other initiatives, the DNR acquired several hundred thousand acres of perpetual conservation easements on industry lands. An MFRC study developed recommendations regarding minimizing the parcelization of forestlands. The legislature passed some language to make land exchanges more efficient, but little has happened to date. The 2014 Legislature passed legislation that precludes county assessors from reducing tax assessments on land that is encumbered by conservation easements after May 30, 2013. This law has resulted in the cessation of activity relative to large acreage forest conservation easements.

Sustainable Forest Incentives Act. In 2013, the Office of the Legislative Auditor issued an evaluation report on the Sustainable Forests Incentive Act (SFIA, M.S. 290C) recommending that the SFIA either be substantially revised or repealed. An SFIA stakeholder group convened in 2014 reached agreement on recommendations to address most concerns raised by the auditor's report and to revise the SFIA. These recommendations are included in this report.

Private forest management. Funding for private land assistance has decreased substantially, especially state funding for the DNR Private Forest Management Program, which has decreased by 75 percent since 2008. Timber supply from family forest owners has substantially decreased over the past number of years, in large part because of relatively low stumpage prices and decreases in available assistance.

Forest certification. Virtually all state land, many counties and large blocks of private land are dual certified. Minnesota leads the nation in the amount of certified forest land.

Energy. The state developed a framework to encourage co-generation opportunities, utilize existing mills and provide capital investments for high-value biomass pilot scale projects. Due to the low price of natural gas and other factors, much of this has yet to come to fruition.

Workforce. Little has been accomplished in this area, and since 2007 there has been a reduction in the logging workforce as well as in the overall forest industry workforce. Forest industry has experienced an increasing skills gap that needs to be addressed. The DNR has recently hired over 30 new field foresters to increase its field complement and replace retiring staff.

Environmental review and permitting. In 2009, an environmental review and permitting bench marking study was completed by the UMN.[4] Over the past few years, the Governor and the legislature have worked on speeding up permitting. A 2011 statute (M.S. 116.03) required the DNR and MPCA to issue or deny permits within 150 days, and these agencies have achieved 99 percent compliance with the statute. Agencies are also required to submit permit efficiency reports and to report within 30 days if a permit is complete enough for processing. Little improvement has occurred with respect to speeding up environmental review, which takes longer to complete in Minnesota than in other competing jurisdictions.

Taxation. Conversion of an exemption to a refund for some capital equipment purchases will go into effect in FY 2016. However, not all capital equipment purchases and no logging equipment purchases are eligible for this exemption. The 2C property tax classification has managed forestland taxed at a lower rate, but not as low the agricultural rate.

Transportation. Truck weight limits were raised at the state level, but not at the federal level. Captive rail remains a major issue for several major forest products industry mills. Substantial bonding funds were dedicated to the maintenance and construction of roads and bridges, but more investments are needed.

Drivers of Forest Health and Productivity

Driver 1. Forest Management

The MFRC has been effective in developing widely used forest management guidelines. These guidelines have been adopted by the Superior and Chippewa National Forests, the DNR, counties and forest industry, and also are followed by most consultants and tribal landowners and many family forest owners. Monitoring by the DNR has documented guideline implementation and usage, leading recently to modest refinements. These guidelines have been recognized by forest certification organizations as meeting standards for certification of practices, and their importance to certification and sustainable forest managed was highlighted in the recent Office of the Legislative Auditor's report on DNR Forest Management.[3]

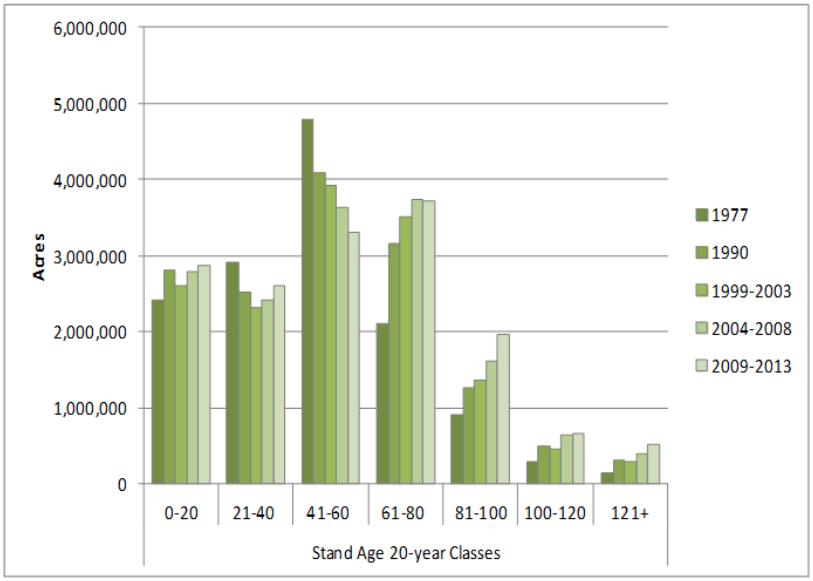
Periodic silvicultural surveys since the 1980s have also described the extent and intensity of silvicultural practices. Together with the potential and actual annual harvest rates and mortality shown in Figure 4 at the end of this section, it is evident that the level of investment in forest management is low compared to most states and countries considered in this report. For example, tree planting acreage (largely conifers) has shrunk by approximately 50 percent in the last several decades. Annual harvests (including residential fuelwood) were approximately 3 million cords per year from the 1930s to 1990s, but then moved up to near 4 million cords during the mid- to late 1990s. Since then harvest levels have retreated due to the economic downturn in 2008, and are now just climbing above historic lows that occurred from 2010-2012.

The increasing focus on environmental concerns over the last several decades, together with only modest investments in management, has led to an accumulation of older forest (aside from old growth reserves) that is now growing slowly, of low quality and difficult to regenerate effectively. Thus, while there is potential to capture mortality and improve overall growth and quality through thinnings and shorter rotations, such investments have not been made on a large scale. While these investments are desirable and possible, public understanding of their positive effect in terms of economic growth, addressing fire risk, improving habitat and addressing climate change remains modest. *The conundrum is that physical timber supply is high, but making it readily available to attract new investment is more complicated*.

Age of the forest

The acreage of the youngest and the three oldest forest age classes on timberland in Minnesota have increased since 1977 (Figure 1). The forests have aged as a result of three major factors. First, forests continue to grow back after harvesting and land conversion that occurred in the late 1800s and early 1900s. Second, annual timber harvests have declined since the mid-1990s, and especially since the start of the 2008 economic recession.[5] Third, public agency policies have largely disregarded harvest at rotation age. Additionally, reduced fire frequency in boreal forests may contribute to an increase in older age classes.[6] Timber quality tends to decline with longer rotation ages, and timber harvest continues to be the key

Figure 1. Age class distribution of Minnesota growing stock trees on timberland from 1977 to 2013.[7]



means for addressing desired age-class distributions. While growing stock volume has increased over the past 10 to 20 years in most states and countries being considered in this report, it has declined in Minnesota (Table 2).

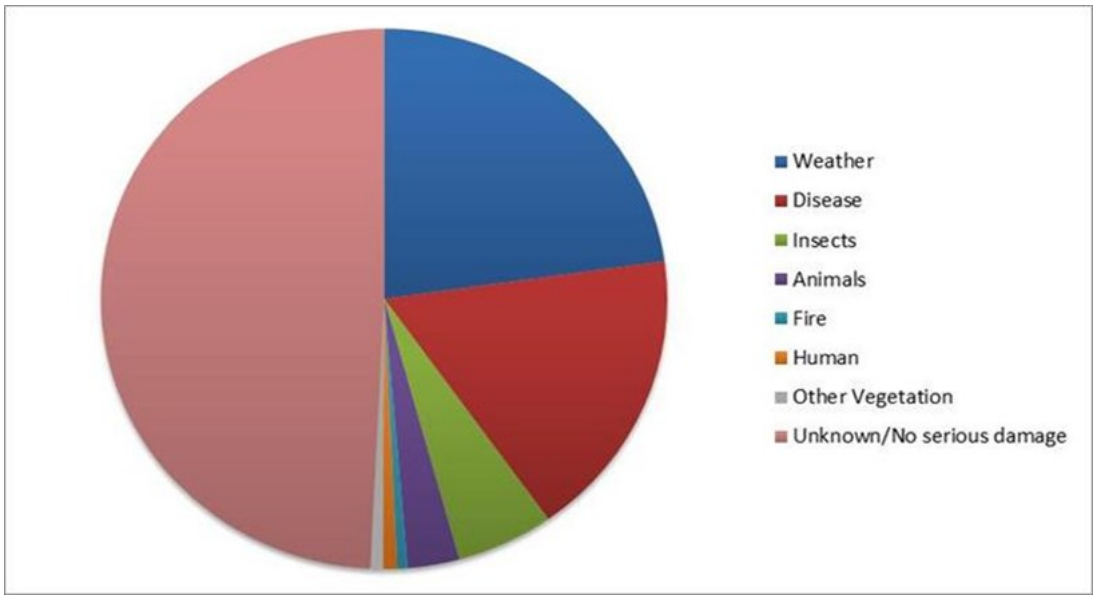
Table 2. Trends in growing stock volume per acre in selected U.S. states (timberland only) and selected countries from 1990 to 2011.[7,8,9,10]

State/Country	Cubic Feet per Acre			
	2010 - 2011 (cds/ac)	2005 - 2008 (cds/ac)	2000 - 2003 (cds/ac)	1990 - 1996 (cds/ac)
Minnesota	11.62	12.43	13.03	13.02
Wisconsin	16.11	16.00	15.76	15.60
Michigan	18.90	18.60	18.43	18.12
Mississippi	17.50	16.66	-	14.04
Lousiana	18.16	18.24	-	17.31
Georgia	18.33	17.48	16.87	16.46
North Carolina	23.38	22.31	21.68	22.15
Washington	47.23	-	-	-
U.S.A	28.04	19.18	24.6	-
Germany	56.98	-	48.48	-
Finland	17.91	17.37	16.1	-
Canada	19.18	20.98	21.71	-
Total World	23.64	23.54	18.09	23.01

Forest tree mortality

Forest tree mortality is an important component of forest health and is closely related to forest age class distribution and species composition of the stand. The average mortality of trees on forest land in Minnesota from 1999-2013 was four million cords[7], roughly two percent of Minnesota's total timberland volume. The identifiable primary causes of non-harvest tree mortality were weather (23 percent), disease (17 percent), insects (six percent), animals (three percent), fire (less than one percent), human-caused damage (less than one percent) and other vegetation (less than one percent) (Figure 2).

Figure 2. Primary, identifiable cause of non-harvest tree mortality on Minnesota timberland from 1999 to 2013.[7]



Silvicultural practices

The intensity of silvicultural practices in Minnesota has decreased since 1996, according to a 2008 survey.[11] The variability of silvicultural approaches applied in Minnesota over time and across ownerships has maintained diverse forest conditions across the state's forested land base. However, current practices will need to adapt further to address the challenges of invasive species, climate change, use of woody residue for energy, budget constraints and increasing herbivory levels on seedlings.[11]

Summer harvesting

There has been a decreasing trend in the percentage of summer harvest since the early 1990s,[12] although more than 70 percent of Minnesota's timberland could be summer accessible (Table 3), depending on soil conditions and annual precipitation patterns. A key limitation to access is the knowledge and tools to predict when these areas are operable without degrading soils and water quality. Limiting the majority of harvests to winter to mitigate site disturbance increases pressure on private lands for summer wood and results in lost public agency revenue. The DNR recently added the wording, "Conduct sale operations on dry/frozen soil conditions only, except with written permission from the State," on most of its harvest permits to allow for the potential for summer harvest. The forest industry may increase wood imports from Canada in poor summer harvest years, but those contracts tend to span multiple years and divert work from local loggers.[13] Also, the soil disturbance that occurs during summer harvest is necessary for the regeneration of many early successional commercial species. More summer harvest opportunities would provide additional recreational benefits that would result from improved access. There is a need to develop a comprehensive plan for identifying and accessing sites that are available for summer harvesting where site conditions and management objectives support non-frozen ground operations.

Table 3. Percentage of Minnesota timberland by physiographic class and Minnesota DNR forest type.[7] Gray highlighting indicates that values represent a percentage of total timberland cover.

	FIA Physiographic Class and Percent of DNR Forest Type Area						
Forest Type MnDNR	Total	Combined Xeric	Flatwoods	Rolling Uplands	Other Mesic	Swamps/ Bogs	Other Hydric
Total	100.00	1.51	33.77	35.69	4.70	24.14	0.20
Jack pine	1.54	16.44	38.66	42.29	1.24	1.38	0.00
Red pine	4.30	10.60	38.32	50.61	0.47	0.00	0.00
Eastern white pine	0.96	4.59	29.67	59.89	4.27	1.57	0.00
Balsam fir	2.49	1.10	27.00	42.06	5.51	24.32	0.00
White spruce	0.87	1.65	46.97	46.82	2.40	2.16	0.00
Black spruce	8.52	0.22	2.04	2.19	0.71	94.60	0.25
Tamarack	6.69	0.00	2.16	1.02	0.28	96.54	0.00
Northern white-cedar	3.71	0.00	10.50	5.70	2.99	80.68	0.13
Eastern redcedar	0.14	45.43	0.00	54.57	0.00	0.00	0.00
Other softwoods	0.06	22.99	52.86	24.16	0.00	0.00	0.00
Oak	9.17	1.86	33.47	55.46	8.55	0.67	0.00
Northern hardwoods	9.63	0.17	25.08	67.41	6.37	0.97	0.00
Lowland hardwoods	8.86	0.18	33.60	8.16	20.13	36.56	1.38
Cottonwood / Willow	0.49	0.00	36.26	13.44	27.61	21.50	1.19
Aspen	29.85	0.55	53.62	42.88	0.93	1.94	0.08
Birch	5.31	1.05	23.19	55.58	5.29	14.89	0.00
Balsam poplar	2.75	0.87	71.69	16.76	5.11	4.89	0.69
Non stocked	1.16	0.00	24.51	11.74	5.20	58.55	0.00
Other	3.51	4.87	36.68	44.79	5.47	8.19	0.00

A new potential threat to summer harvesting in Minnesota is the proposed listing of the northern long-eared bat on the federal Endangered Species List by the U.S. Department of Interior Fish and Wildlife Service following mortality on the East Coast from white-nose syndrome, a virulent disease caused by an introduced fungus. If this species is listed as federally endangered, summer harvest in Minnesota would likely no longer be possible.

Logging infrastructure

Logging is a vital tool for managing forests, but several recent closures of important mills have affected loggers adversely and driven some out of business. A 2011 report that evaluated the status of the logging sector in Minnesota concluded: "Over time, there has been a trend toward larger producers who harvest an increasing percentage of the total annual volume harvested"[12] (Table 4). The array of smaller logging businesses that produce up to 5,000 cords per year only produce a small portion of the total annual volume harvested, often use the oldest equipment, operate during the winter and are "operating at the lowest level of their reported capacity."[11] The number of small logging businesses likely to decline in the future.

Table 4. Summary of cords harvested by respondents in 2011 (respondents = 209), 2003 (respondents = 101) and 1996 (respondents = 361)[12]. Percentages may not total 100 due to rounding error.

	2011 Survey			2003 survey (Powers 2004)	1996 survey (Puettmann et al. 1998)
Volume harvested (cords)	Number of respondents	Percent of respondents (%)	Percent of total volume (%)	Percent of respondents (%)	Percent of respondents (%)
≤ 1,000	55	26.3	1.5	15.8	44
1,001 – 2,500	27	12.9	2.6	17.8	31
2,501 – 5,000	40	19.1	7.6	20.8	--
5,001 – 10,000	32	15.3	12.6	20.8	13
10, 001 – 15,000	17	8.1	11.1	15.8	8
15,001 – 20,000	8	3.8	7.6	8.9	1
20,001 – 30,000	20	9.6	24.3	--	2
30,001 – 40,000	4	1.9	6.7	--	1
40,001 – 50,000	1	0.5	2.3	--	--
> 50,000	5	2.4	23.6	--	--

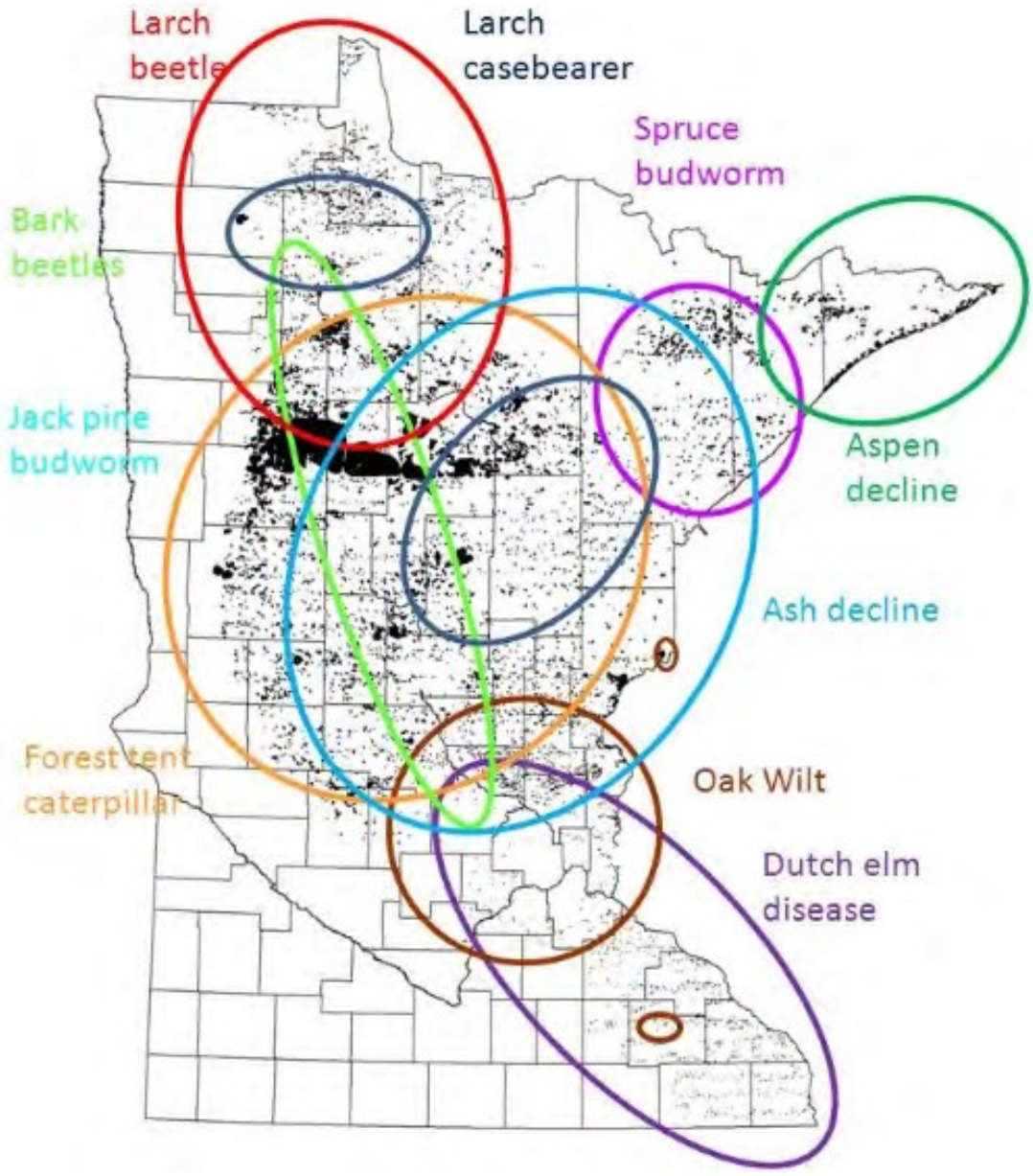
Biomass

The forest products industry has used woody biomass for combined heat and power or for thermal applications for over 30 years. Use of woody biomass is expected to expand in the future due to climate change concerns, rising fossil fuel prices and the value of energy security.[14] The demand for bioenergy sourced from forest biomass will largely depend on demand for the sawlogs and pulp, as harvest of the latter products provides tops and limbs and helps cover biomass removal and transportation costs.[15] Other factors include the availability and price of other energy sources, state and federal policies and technological development.

Driver 2. Forest Insects, Diseases and Invasive Species

Figure 3 shows some of the wide variety of native and nonnative forest insects and diseases that threaten the competitiveness of the forest products industry by causing commercial timber species to have lower regeneration capability and shorter lifespans. This results in decreased timber supply and lower productivity. Some of these species, as well as some plant and earthworm species, are invasive, and controlling them generally becomes more expensive with time.[16] The impacts to the forest products industry from known infestations of invasive species (e.g., emerald ash borer, common buckthorn, European gypsy moth, Dutch elm disease) will only be compounded by the potential introduction of other invasives (e.g., mountain pine beetle, walnut twig beetle, sudden oak death).

Figure 3. Minnesota Department of Natural Resources 2012 aerial survey results.[17]



Driver 3. Blowdown

Minnesota occasionally experiences very powerful windstorms, or blowdowns. A catastrophic storm in 1999 affected about 583,000 acres of forest in the Boundary Water Canoe Area Wilderness (BWCAW),[18] and more recent blowdowns have affected additional large acreages of commercial forest. Forest industry, loggers and public agencies have done a good job salvaging timber and cleaning up these blowdowns, but some affected areas are not accessible. The resulting accumulation of large woody debris in blowdown areas may lead to more extreme fire behavior and intensity in these areas.[19] Older stands of all forest types have greater susceptibility to this type of disturbance.[18] Timber harvesting at earlier rotation ages can mitigate the risk of blowdown to public safety and improve timber quality.

Driver 4. Climate Change

Observed and predicted climatic changes add an element of uncertainty to predicting the future character of Minnesota's forest resources. However, Minnesota's forest products industry has adapted to substantial changes in the past and can remain viable with continued responsiveness.[20] Potential impacts of climate change that land managers and industry may need to respond to are reduced winter harvest duration, increased invasive species, more frequent, larger blowdowns and more destructive wildfires.

Driver 5. White-tailed Deer Browsing

Local deer populations can significantly affect forest health. The impacts of prolonged deer browsing include lowered regeneration success of favored browse species, many of which have commercial value (e.g., northern red oak, jack pine and eastern white pine).[21] Eventually, these changes will alter forest composition and structure[22] and may also reduce food sources, cover and nesting sites for other wildlife species.[23]

Driver 6. Wildfire

Wildfire is a natural agent of disturbance in Minnesota's forests;[24] however, the role of fire has evolved throughout the last century due to enhanced fire suppression efforts and changes in forest management. Wildland fire danger is projected to increase significantly through the next century, particularly in northern latitudes.[25] Elevated fire danger is expected mostly due to expected increases in potential fire intensity and potentially longer fire seasons. High intensity crown fires are extremely difficult and costly to control, and this type of fire is projected to be more frequent in the future. From a public safety standpoint, reducing the risk of catastrophic fires by reducing human-caused ignitions and modifying woody debris fuel loads will be vital throughout the next century.[25] Developing markets for woody biomass has the potential to reduce fuel loads, but markets have been slow to develop in recent years for reasons described later in this report.

Wildlife Habitat

The Wildlife Habitat Indicator for Native Genera and Species[26, 27] (WHINGS) was applied to the USDA Forest Inventory and Analysis database for Minnesota.[28] WHINGS highlights how forest management (or lack thereof) has affected the habitat of native forest wildlife species. The model uses percent changes in Habitat Suitability Indices (HSI) to quality/abundance, where HSI ranges from 0 (non-habitat) to 1 (abundant, optimal habitat). Results are for timberland only (Table 5).

For most species in Table 5, those that increased generally preferred forest types in the seedling/sawtimber stand size class, whereas those that decreased preferred forest types in the poletimber/sawtimber size classes. This result is consistent with FIA inventory data that shows an increase in the percentage of the small size class, even though the timberland is aging. White-tailed deer, a species which prefers early successional forests, experienced a 27 percent increase in HIS. White-tailed deer hunting licenses account for 80 percent of all hunting licenses sold in the state. The total economic multiplier effect of hunting activities in Minnesota in 2011 was $1,259,270,783.[29] Some of this value is clearly attributable to the positive impacts of timber harvesting of deer habitat. Other changes in HSI values were due to shifts in the unique habitat requirements of specific species (e.g., fox squirrel, gray squirrel, pickerel frog and eastern hognose snake). Interestingly, 75 percent of the threatened, endangered and special concern (TESC) species saw reductions in habitat, though none appeared severe.

Table 5. HSI values for the individual species with percent changes ≥ 40 percent| (in descending order), large mammals, grouse, and TESC species. Percent changes (%Ch) are between the 1977 and 2013 HSI values. The table also includes the average HIS standard error across measurement periods.

Summary Group	Common Name	Habitat Suitability Index (HSI)					
		1977	1990	1990	2008	2013	%Ch
Species with Absolute Change ≥ 40%	Wilson's Warbler	0.243	0.318	0.428	0.463	0.432	78%
	Fox Squirrel	0.164	0.173	0.240	0.252	0.259	58%
	Gray Squirrel	0.164	0.173	0.240	0.252	0.259	58%
	Lincolns Sparrow	0.071	0.089	0.104	0.109	0.112	56%
	Pickerel Frog	0.215	0.189	0.133	0.126	0.095	-56%
	Rufous-sided Towhee	0.195	0.261	0.274	0.298	0.294	51%
	Bell's Vireo	0.045	0.106	0.065	0.095	0.065	46%
	Yellow-breasted Chat	0.045	0.106	0.065	0.095	0.065	46%
	Least Chipmunk	0.195	0.224	0.264	0.284	0.280	44%
	Black Bear	0.181	0.204	0.231	0.243	0.258	43%
	Eastern Hognose Snake	0.166	0.151	0.104	0.104	0.099	-40%
Large Mammals (in addition to Black Bear above)	Moose	0.065	0.087	0.060	0.059	0.069	7%
	White-tailed Deer	0.272	0.322	0.301	0.320	0.345	27%
	Gray Wolf	0.174	0.200	0.191	0.192	0.212	22%
Grouse	Ruffed Grouse	0.315	0.326	0.279	0.278	0.272	-14%
	Spruce Grouse	0.132	0.134	0.124	0.112	0.106	-20%
TESC (in addition to Bell's Vireo and Moose above)	Acadian Flycatcher	0.898	0.821	0.824	0.795	0.799	-11%
	Boreal Owl	0.753	0.684	0.652	0.628	0.631	-16%
	Cerulean Warbler	0.907	0.830	0.838	0.811	0.822	-9%
	Hooded Warbler	0.898	0.821	0.824	0.795	0.800	-11%
	Loggerhead Shrike	0.138	0.192	0.148	0.168	0.142	3%
	Louisiana Waterthrush	0.746	0.671	0.649	0.642	0.654	-12%
	Lynx	0.394	0.397	0.388	0.385	0.377	-4%
	Northern Goshawk	0.702	0.625	0.602	0.580	0.583	-17%
	Red-Shouldered Hawk	0.746	0.671	0.649	0.642	0.654	-12%
	Timber Rattlesnake	0.798	0.719	0.661	0.694	0.657	-18%

Timber Supply

The 1994 Generic Environmental Impact Statement for timber harvesting and management in Minnesota developed three harvesting scenarios to model timber supplies needed to meet levels of demand in 1990 (4.0 million cords/year), those projected to occur if all planned industrial developments would take place (4.9 million cords/year) and a hypothetical high level of demand (7.0 million cords/year). The study confirmed that all three levels of harvesting would be feasible in Minnesota, but the high level of harvest was reduced to 5.5 million cords per year to mitigate ecological concerns.[30]

According to a report prepared by the DNR, "Based on analysis of mill consumption (actual survey figures are not yet available), it appears that 2013 harvest levels are within the 2.4 to 2.7 million cord range…Overall net growth for all species continued to outpace harvest levels. According to 2012 Forest Inventory and Analysis figures, annual net growth of growing stock on timberland was approximately 5.0 million cords, with mortality of approximately 4.2 million cords. Draft 2011 mill and fuelwood survey data indicate that the volume of wood harvested and utilized by industry and fuelwood users was approximately 3.02 million cords. Hence, there are significant volumes of wood above current harvest levels potentially available for additional harvest." [14] Figure 4 shows the estimated annual sustainable timber yield under existing management investment levels, compared to the actual amount harvested and utilized by industry and for fuel. The figure also shows net growth.

Figure 4. Estimated annual sustainable timber yield under existing management investment levels, compared to actual amount harvested and utilized for industry and fuel use, and net growth.[14]

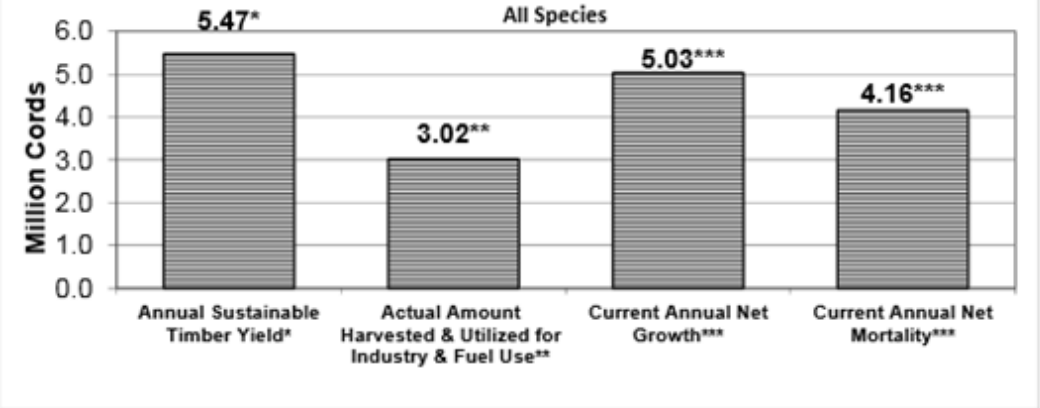


*Table 6.25, GEIS, High Long-Term Sustainable Level, Timber Productivity Tech. Paper, Dec. '92.
** 2011 NRS pulpwood survey, 2010 DNR sawmill survey, 2007-08 fuelwood survey. For Harvest comparisons to Net Growth, it is necessary to add annual "growing stock" logging residue of approximately 275,000 cords to this figure.
***USFS FIA 2012 database.

This section includes updates of the six key competitiveness issues, followed by recommendations designed to help improve the competitiveness of Minnesota's primary forest products industry. In all cases, the agencies or organizations that should be involved in implementing or advocating for the recommendation are suggested. Please note that the recommendations are **not** listed in priority order.

Wood Fiber Availability and Cost

Minnesota contains 17.4 million acres of land that is covered by forests, but only about 15.6 million acres are considered capable of producing a commercially viable harvest (Table 6). The state has nearly as much forestland available to produce commercial timber products as a number of comparable states that have similarly viable forest products industries. Productivity levels on a per acre basis, however, are lower than in most of these other states, and the mortality to growth ratio is significantly higher. When compared to Michigan and Wisconsin, Minnesota has a greater amount of black spruce and tamarack acres that are generally lower in productivity than aspen, red pine plantations or northern hardwood stands. The eastern larch beetle, for example, has destroyed nearly 120,000 acres of Minnesota's tamarack cover type over the past 10 years. Minnesota also has serious mortality and growth concerns in its birch, aspen, jack pine and fir/spruce cover types.

In comparison to other states being considered in this study, Minnesota has lower forest productivity and much greater mortality as a percentage of annual growth (Table 6). In addition, Minnesota has significantly lower potential and actual average mean annual increment per acre (Table 7).

Table 6. Wood Fiber Availability and Cost.

	Wood and Fiber Quality: Rough and Rotten	Wood and Fiber Quality: Grade 1 and 2 %	Wood and Fiber Quality: Mortality as % of Annual Growth	Wood and Fiber Quality: Acres Certified	Forest Productivity: Growth (cords)	Forest Productivity: Mortality (cords)	Forest Productivity: Potential Average MAI/Acre	Forest Productivity: Actual Average MAI/Acre	Plantation Forest Acreage as % of Timberland	% Timberland Privately Owned	Timberland Area (acres)
Minnesota	14.3	11.82/32.08	68.3	14.1	5,097,574	3,946,065	0.728	0.326	5.50	48.61	15,654,278
Wisconsin	10.7	21.59/34.06	41.4	8.7	8,156,314	3,744,340	0.885	0.492	6.34	71.47	16,582,508
Michigan	7.9	16.70/35.16	43.3	9.9	9,221,620	3,714,485	0.821	0.476	6.82	64.58	19,353,670
Mississippi	13.8	13.05/19.80	22.9	3.6	23,890,784	4,893,990	1.418	1.240	30.86	88.97	19,266,824
Louisiana	11.7	17.95/31.31	31.6	4.3	12,823,009	3,653,036	1.321	0.879	31.11	88.83	14,595,480
Georgia	13.5	9.20/23.22	18.7	1.6	24,873,703	5,073,243	1.318	1.029	31.83	91.70	24,164,204
North Carolina	8.8	22.06/31.99	24.8	1.5	20,049,306	4,074,678	1.048	1.121	18.03	86.20	17,887,864
Washington	0.00001			7.7			1.486		26.25	52.32	17,830,786
United States											
Germany				19.8							
Finland				51.7							
Canada				621.7							

Legend

= Better than Minnesota
= About Same as Minnesota
= Worse than Minnesota
= Mixed

Table 7. Potential and actual average MAI (mean annual increment) per acre, mortality/growth ratio, and total number of timberland acres[1] as defined by FIA (MAI/acre, mortality and growth figures in cords, assuming 79 cubic feet per cord).

	Total Acres [2,3] (A)	Potential Average MAI/Acre[4,5]	Mortality[2]	Growth[2] (B)	Ratio	Actual Average MAI/Acre (B/A)[6]
MN	15,648,399	0.728	3,946,065	5,097,574	0.77	0.326
MI	19,353,670	0.821	4,714,485	9,221,620	0.51	0.476
WI	16,582,508	0.885	3,744,340	8,156,314	0.46	0.492
MS	19,266,824	1.418	4,893,990	23,890,784	0.20	1.240
LA	14,595,480	1.321	3,653,036	12,823,009	0.28	0.879
GA	24,164,204	1.318	5,073,243	24,873,703	0.20	1.029
NC	17,887,864	1.048	4,074,678	20,049,306	0.20	1.121
WA	17,830,786	1.486	-	-	-	-
MB	35,336,015	0.402	-	-	-	-
ON	81,040,556	0.308	-	-	-	-

[1] For FIA, timberland is defined as land capable of producing 20 ft^3/acre/yr of industrial wood.
[2] State data from Miles, P.D. Thu Sep 18 11:18:40 MDT 2014. Forest Inventory EVALIDator web-application version 1.6.0.01. St. Paul, MN: U.S. Department of Agriculture, Forest Service, Northern Research Station. [Available only on internet : http://apps.fs.fed.us/Evalidator/evalidator.jsp]
[3] Ontario - http://www.web2.mnr.gov.on.ca/mnr/forests/public/publications/SOF_2011/indicators/211.pdf, Manitoba - http://www.gov.mb.ca/conservation/forestry/pdf/mb-forests/5yr_report_2012.pdf
[4] For US states, determined number of timberland acres by site class to calculate a weighted average of site class productivity estimates. FIA has 6 site class mean annual increment (MAI) estimates for timberland and the following values were used for a particular site class: 1 – 2.85 cords/acre/yr, 2 – 2.46 cords/acre/yr, 3 – 1.80 cords/acre/yr, 4 – 1.29 cords/acre/yr, 5 – 0.85 cords/acre/yr, and 6 – 0.44 cords/acre/yr. These MAIs can be considered more permanent and are conceptually at least independent of the existing age-class distribution and in many cases the existing cover type.
[5] Ontario - http://www.web2.mnr.gov.on.ca/mnr/forests/public/publications/SOF_2011/indicators/211.pdf. Manitoba - http://www.gov.mb.ca/conservation/pdf/sustainabilty_report_2009.pdfhttp://www.gov.mb.ca/conservation/forestry/pdf/mb-forests/5yr_report_2012.pdf. Based on reports, assumed 2,000,000 m^3 harvested annually, divide this by 13,842 ha harvested annually, producing 144.5 m^3/ha, multiply by 35.31467 to convert to ft^3, divide by 2.47105 to convert to acres, divide by an assumed average rotation age of 65 years, and then divide by 79 to convert to cords. For these two provinces, whether values should be considered Potential or Actual MAI is somewhat difficult to determine.
[6] Determined by dividing column B by column A. These MAI numbers are more reflective of the existing age-class distribution and of the existing cover type, applied rotation ages, and silvicultural harvesting practices.

Minnesota land managers need to develop creative ways to market their timber and must more fully utilize woody biomass lost to mortality. Current stumpage values are comparable to those of other states, Canada and European countries. The harvest level in 2005 was 3.73 million cords while in 2012 it was 2.90 million cords (both values include firewood). The state can likely support at least another 1.50 to 2.00 million cords of annual harvest beyond the 2.90 million cord level. Unlike the western U.S., Minnesota has a more extensive existing infrastructure to harvest pulpwood sized material. Similar mills in the western U.S. procure almost all of their fiber from sawmill residues.

Minnesota has a lower percentage of privately owned forests (45 percent) than most other eastern states. Many of the southern states have nearly 85 percent of their forestland acreages in private ownership. Both

Washington and Oregon have a relatively high percentage of their most productive timberlands in private ownership, much of it on the western side of the Cascade Mountain range. Some other states have a fair amount of state-owned land (e.g., Washington has 43 percent of its forestland in state ownership). Most western states contain a large percentage of federally owned land.

A relatively small percentage of privately owned acreage can be both beneficial and detrimental. Private forestland owners are generally much more responsive to markets and generally have fewer restrictions related to planning and harvest operations than public agencies. For instance, federal policies may not always be fully responsive to local conditions, and public land agencies in general often have complex landscape level goals beyond simply maximizing harvested volume. On the other hand, public agencies are often required to provide some type of sustainable harvest even in poor market conditions. This can help to support the forest products industry when markets are poor, a time when private landowners often do not sell timber.

Michigan and Wisconsin have a greater percentage of private forestland than Minnesota (62 and 70 percent, respectively), yet their commercial statewide timber harvest rates, excluding firewood, are greater than Minnesota's. Recent harvest levels were 4.2 and 3.7 million cords in Michigan and Wisconsin, respectively. The most recent harvest level in Minnesota was 2.6 million cords, excluding firewood. Productivity levels in Minnesota are on average lower than in these two other states, but forestland acreages are nearly identical. Minnesota must encourage private landowners to harvest more of their forest lands, as Wisconsin and Michigan do. Incentive programs to help promote more active forest management will not only increase harvest levels but also produce healthier, more productive forests.

Timber Availability in Relation to the Sustainable Forest Incentive Act

Minnesota employs a hybrid financial incentive/tax program entitled the Sustainable Forestry Incentive Act (SFIA), as well as a preferential property tax classification (2C – managed forest land). Forty-seven counties have lands enrolled in the SFIA program, and currently the program has over 2,300 participants with 740,878 acres enrolled. Half of the participants have enrolled 120 acres or less, while the average holding is 320 acres. The number of program enrollees continues to grow every year, but at a modest pace. Ten participants have more than 1,920 acres enrolled, which requires the provision of public recreational access.

The SFIA program, which requires a management plan and certain other eligibility factors, has not been as successful as originally envisioned. Limited awareness and visibility of the program have hampered enrollment. An important drawback for many potential enrollees is the need for a covenant that runs with the property.

The actual incentive payment made to the landowner is another issue. Currently the SFIA payment is $7.00 per acre. Some other Midwestern states have much higher property taxes and have a much higher average benefit (e.g., preferential property tax benefits range from $1.25 per acre in Michigan to $20.00-$35.00 per acre in Wisconsin, Indiana and Ohio). In the Southern states, payments range from less than a $1.00 to over $30.00 per acre (Funk, 2014)[7]. Some states with higher net benefits, such as Wisconsin, attract many more participants than Minnesota. Minnesota also has the smallest amount of acreage enrolled of any of the comparison states .

[7] Funk, Travis. (2014). Valuing the financial benefit that private forest landowners enrolled in preferential property tax programs receive for providing ecosystem services. M.S. Thesis. University of Minnesota.

In 2013, the Office of the Legislative Auditor released a report on the SFIA program that identified a number of areas of concern and several key recommendation to the legislature to improve the SFIA program:

1) either tie sustainable forest incentive payments more directly to SFIA's goals or repeal SFIA and use other programs to encourage sustainable forest management;
2) require program applicants to register their forest management plans with the DNR;
3) require increased verification of program compliance;
4) clarify and expand penalty options for noncompliance with SFIA; and
5) amend SFIA to better address changes in ownership of land.

In response to the Legislative Auditor's report, a stakeholder group appointed by the Department of Revenue, the DNR and the MFRC met to develop a response to the auditor's report and, to the extent possible, develop consensus recommendations for revising the program. These recommendations are listed at the end of this section.

Timber Availability in Relation to Conservation Easements Versus the SFIA

The SFIA covenant covers only an eight year period, while a permanent conservation easement is much better for ensuring the lands will remain forest far into the future, thereby assuring long-term timber supply. Failure to allow large ownerships which sold conservation easements to enroll in SFIA would likely result in their lands being sold to new owners, thus complicating future management of what were once more contiguous tracts of forest land (i.e., there likely would be more road construction, more partitioning of forest stands, etc.) The SFIA and conservation easements are complementary but quite different, in that a conservation easement is a real estate transaction in which the primary benefit to the state is the acquisition of development rights associated with forest lands under the easement, while SFIA is primarily a program in which the state pays landowners to manage forest lands sustainably.

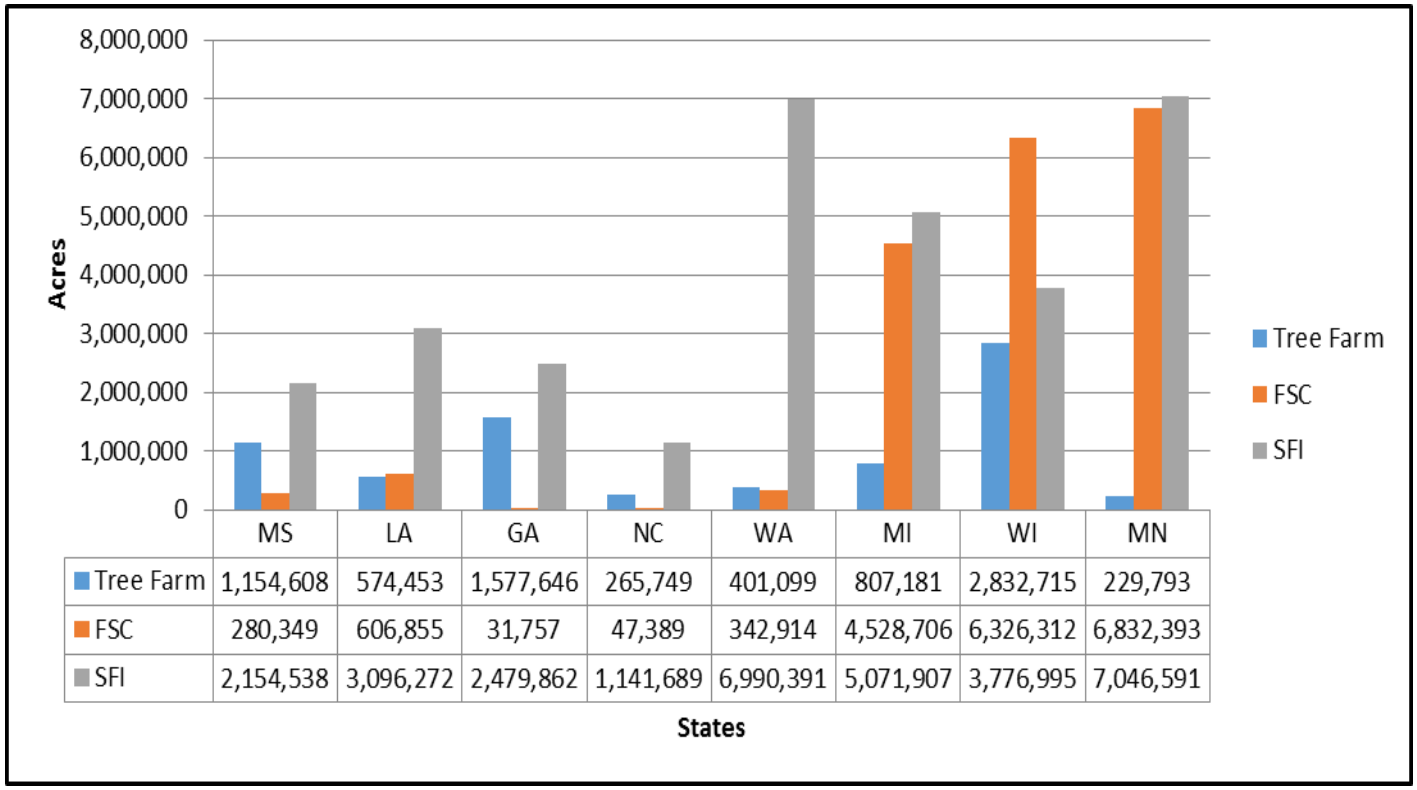
Timber Availability in Relation to Forest Certification

Forest certification is a process in which a third-party auditing service reviews forest landowner and forest industry practices against a management standard to assure customers of wood products that the product they are purchasing came from a well-managed forest. The three most common standards in the United States are the Forest Stewardship Council (FSC), Sustainable Forestry Initiative (SFI) and American Tree Farm System Certification (ATFS). Programme for the Endorsement of Forest Certification (PEFC) is an umbrella standard comprised of a number of separate certification systems, including SFI. FSC and PEFC are global certification systems and SFI and ATFS are North American certification systems. Additionally, ATFS is recognized by SFI as a source of certified fiber.

Certified fiber comes from certified forests. That fiber is tracked from the forest floor to the showroom floor via a chain of custody (CoC). The CoC covers all stages of forest management, harvesting, manufacturing and distribution. If the CoC is maintained from the forest to the consumer, then the final product can display the certification program's logo and CoC tracking number on the product. Purchasing products with the logo and CoC helps to ensure that forests remain forests, wildlife habitat is maintained, water quality is protected, employees have safe working conditions and that a host of other management standards are met.

Minnesota continues to be a leader in the third-party certification of forest lands and of companies that

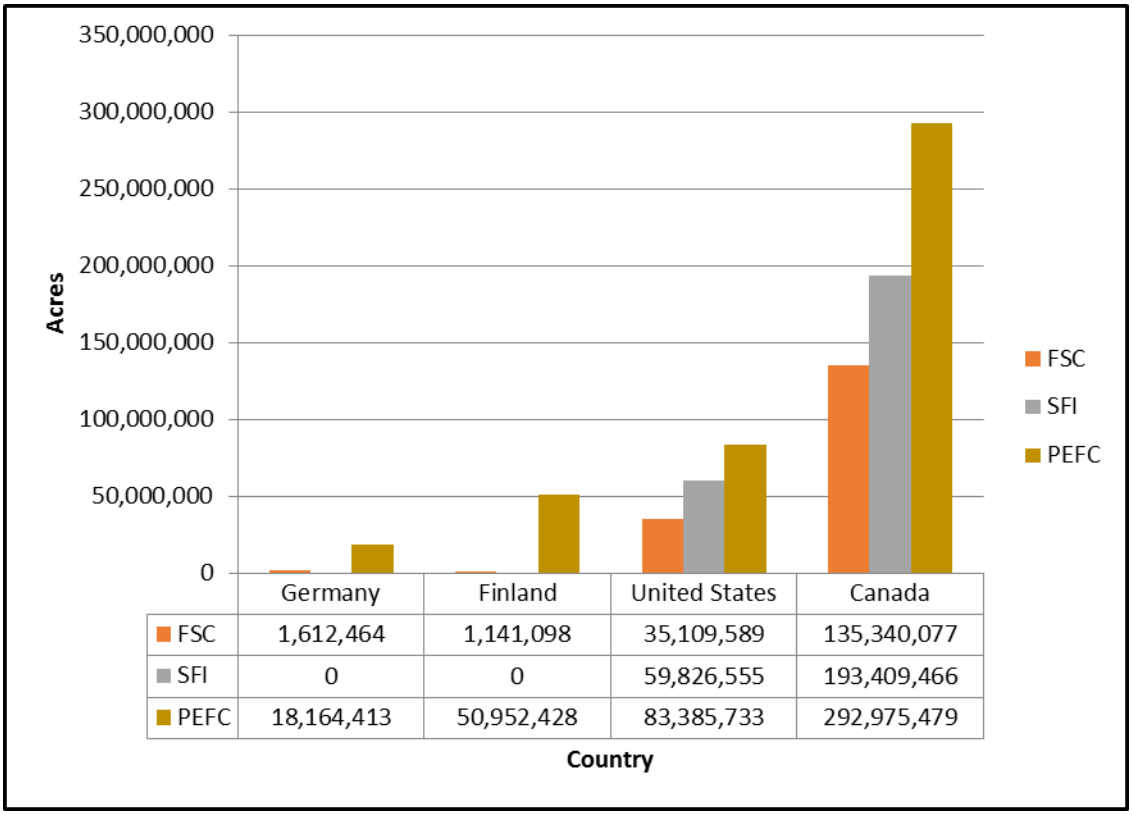
Figure 5 Acreage of certified land by major certification program in selected states.



	MS	LA	GA	NC	WA	MI	WI	MN
Tree Farm	1,154,608	574,453	1,577,646	265,749	401,099	807,181	2,832,715	229,793
FSC	280,349	606,855	31,757	47,389	342,914	4,528,706	6,326,312	6,832,393
SFI	2,154,538	3,096,272	2,479,862	1,141,689	6,990,391	5,071,907	3,776,995	7,046,591

maintain a CoC certificate (Figure 5). With 6.8 million Forest Stewardship Council (FSC) and 7.2 million Sustainable Forestry Initiative (SFI) certified acres, Minnesota has the most certified lands of any state in the U.S. Because state, county, and industrial forest lands have been certified for a number of years, the state's certified wood basket is well known by regional industries. State and county lands account for the vast majority of the FSC and SFI certified acres, with less than 10 percent of Minnesota's certified lands in private ownership, most of them are industrial lands. Minnesota trails a number of states in the amount of certified private lands, thus reducing the ability to market products as being certified and limiting the amount of certified fiber available to the mills. Figure 6 shows that the U.S. trails

Figure 6. Acres of certified land in the U.S. versus selected countries.



	Germany	Finland	United States	Canada
FSC	1,612,464	1,141,098	35,109,589	135,340,077
SFI	0	0	59,826,555	193,409,466
PEFC	18,164,413	50,952,428	83,385,733	292,975,479

Canada but leads Germany and Finland in the number of FSC and PEFC certified acres. The U.S. also trails Canada in the number of SFI certified acres. Finland has the highest percentage of its forests certified by PEFC and FSC at 94 percent. Germany ranks second at 72 percent, Canada is at 42 percent, and the United States has 16 percent of its forests certified.

The U.S., much less Minnesota, cannot compete with Canada on the amount of certified acres due to that country's vast forested landscape, but we can work to more widely promote our certified fiber in the marketplace, especially in international markets.

Recommendations: Wood Fiber Availability and Cost

1. **Increase availability of wood on the market (USDA Forest Service - Superior and Chippewa National Forests, Department of Natural Resources [DNR], counties).** Appraise more wood where it is accessible and at the time of year when needed. Land managers of public agencies should harvest timber at economic rotation age. Additionally, public managers should focus on red pine thinnings.

2. **Increase outreach to family forest landowners by professional foresters, with particular focus on pursuing financial incentive payments to help develop and implement forest management plans and promoting more timber harvests to attain landowner goals (NRCS, USDA Forest Service – State and Private Forestry, DNR, forest industry, consulting foresters, UMN Extension, MFA).** A cooperative effort is needed to get large-scale engagement by Minnesota's 200,000 private landowners, with a major focus on active forest management and reducing parcelization.

3. **Develop a comprehensive plan for identifying and accessing sites that can be made available for summer harvesting where site conditions and management objectives support non-frozen ground operations (USDA Forest Service – Chippewa and Superior National Forests, DNR, counties, forest industry, consulting foresters).** More summer harvesting would help loggers and forest industry to have a more even flow of work and raw material, increase recreational access and increase revenue for public and private landowners because summer sales command higher prices per unit volume.

4. **Increase revenue for public and private forest landowners by encouraging them to conduct larger volume sales (i.e., more volume per sale) (USDA Forest Service – Chippewa and Superior National Forests, DNR, counties, forest industry, consulting foresters).**

5. **Conduct pine thinnings year-round (USDA Forest Service – Chippewa and Superior National Forests, DNR, counties, consulting foresters).**

6. **Employ additional tools, such as the purchase of permanent conservation easements, to ensure the protection of high value forest lands and associated timber supply (Legislature, DNR, LSOHC).**

7. **Enhance the effectiveness of the Sustainable Forestry Incentive Act (SFIA) at providing a multitude of benefits including increased timber supply, slowed parcelization, maintenance of water quality and maintenance of public recreational access (Legislature, DNR, Department of Revenue).**

    a. **Clarify the goals of the SFIA program, providing more specificity regarding the benefits of the program and identifying the different benefits from small and large forestland owners. (Legislature).**

    b. **Identify SFIA as an incentive program rather than as a tax program. This would allow a shift in much of the administration and funding of SFIA from the Department of Revenue to DNR (Legislature, Department of Revenue, DNR).**

c. **Implement a two-tiered payment, with a higher payment for all forest landowners who provide public recreational public access on their lands and a lower payment for those who do not allow public recreational access (Legislature).** This is likely to have limited fiscal impact, as research indicates that to get even 20 percent of family forest landowners to provide recreational access would require at least $5.00 in additional payments per acre.

d. **Private landowner forest management plans should be registered with the DNR (Legislature, DNR).**

e. **Contingent upon funding, DNR should be charged with periodically reviewing landowner compliance by program participants for their conformance with SFIA program requirements (Legislature, DNR).**

f. **Penalties should be increased, with stronger penalties for forest land converted to non-forest uses (e.g. gravel pits or clearing for agricultural purposes versus constructing a structure on a small part of the tax parcel) (Legislature).**

g. **Clarify penalty requirements relative to ownership changes - i.e., clarify who incurs payment responsibilities and identify who receives payment when land ownership is transferred (Legislature).**

h. **Repeal the 60,000 easement acre limit for current and future landowners eligible for SFIA (Legislature).**

i. **Maintain a strong tax incentive for future voluntary donations of conservation easements to prevent development, expanded mixed ownership patterns and creation of more roads required by new owners to access their properties (Legislature, DNR).**

8. **A delegation led by DNR should work collaboratively with the SFI, FSC and ATFS certification systems to establish recognition of the Minnesota Master Logger Certification program as a credible third-party certification program (DNR, MLEP, MFI, MFA).**

Cost of Energy

The pulp and paper manufacturing sector is one of the most energy intensive industries in the U.S., ranking third behind the refinery and chemical industries. This forest-based manufacturing sector is also a leader in the use of renewable energy (biomass), cogeneration (CHP – combined heat and power) and energy efficiency.

Minnesota's forest products industry competes nationally and globally. The decline in printing and writing paper demand nationally and the energy intensive nature of the manufacturing process makes this industry vulnerable to energy price increases. Energy costs account for 5 to 20 percent of the industry's production costs. Three energy sources have the greatest impact on the profitability and competitiveness of Minnesota's loggers and mills: natural gas, electricity and diesel fuel. Table 8 on the next page compares Minnesota to a number of other states and countries with regard to natural gas and industrial electricity prices.

Natural gas

Natural gas is the largest purchased energy source. Minnesota's mills use natural gas throughout the paper- or board-making process. Minnesota's industrial natural gas costs in 2012 were second lowest in the U.S. comparison group as shown in Table 9 on the next page, with only Louisiana reporting lower industrial gas rates.

Table 8. Cost of Energy.

	Average Industrial Rates for Electricity in 2013	Industrial Natural Gas Prices in 2012
Minnesota	$66.20	$4.48
Wisconsin	$74.90	$5.81
Michigan	$82.10	$7.38
Mississippi	$67.30	$4.86
Louisiana	$58.60	$2.96
Georgia	$60.30	$4.60
North Carolina	$62.40	$6.37
Washington	$72.90	$8.77
United States		
Germany		
Finland		
Canada		

Legend

= Better than Minnesota
= About Same as Minnesota
= Worse than Minnesota

Table 9. U.S. Industrial Natural Gas Prices.

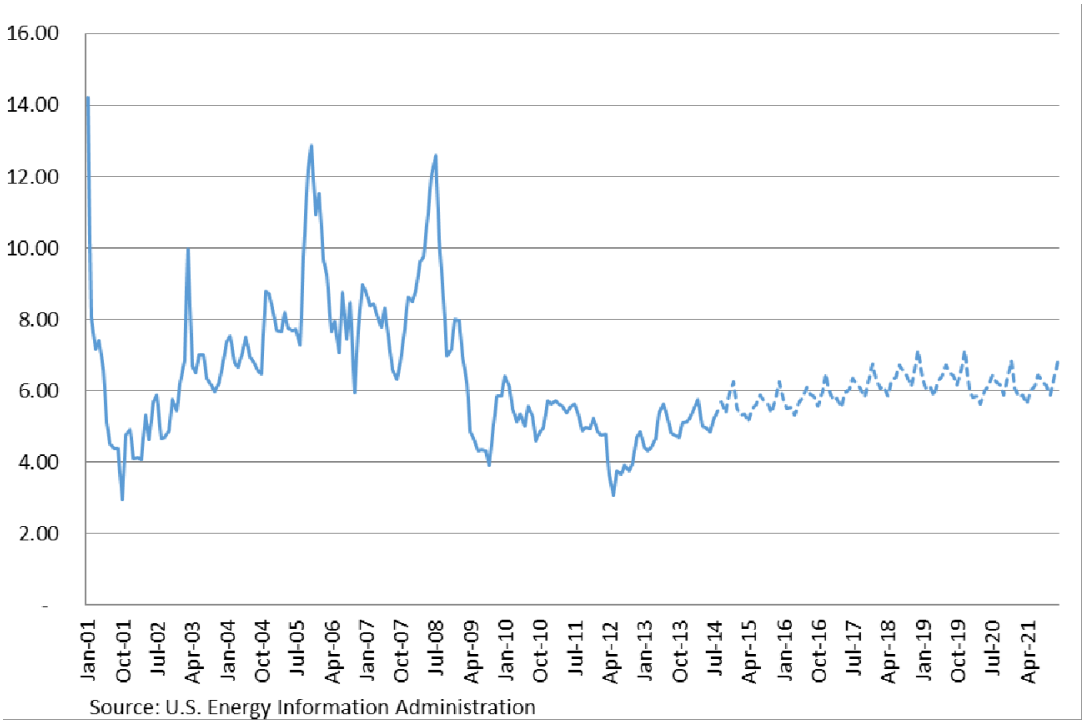
	2012 $/MMBtu	Ranking
Lousiana	$ 2.96	1
Minnesota	$ 4.48	2
Georgia	$ 4.60	3
Mississippi	$ 4.86	4
Wisconsin	$ 5.81	5
North Carolina	$ 6.37	6
Michigan	$ 7.38	7
Washington	$ 8.77	8
Maine	$ 10.35	9
	Source: US EIA	

Note: 2012 is the last year pricing was available for all states in the comparison group.

On the supply side, the recent rapid development of natural gas resources in Canada and the U.S. have significantly increased supply, reduced volatility and lowered prices. While natural gas usage by other industry segments is projected to increase in the future, the U.S. Energy Information Administration forecasts relatively flat industrial natural gas pricing through 2021 as shown in Figure 7.

Minnesota's forest products industry should continue to experience stable and competitively priced natural gas through 2021.

Figure 7. Minnesota Natural Gas Prices – Industrial, 2001-2021 (Nominal USD/ MMBtu).



Electricity

Electricity is another major energy input to Minnesota's forest-based manufacturing sector. Some of Minnesota's paper mills have significant self-generation which reduces the amount of purchased electricity.

North American industrial electric prices for 2013 are shown in Table 10. Values represent the average price for reporting utilities in the respective state or province. Minnesota's industrial electric rates are lower than other Great Lakes states, but higher than the industrial rates in the southern U.S. and western Canada. Actual prices paid by individual industrial customers can vary from the prices shown by as much as +/- 20 percent due to EEI sample size and/or special contract features that individual customers may have negotiated with their respective utility .

Table 10. North American Industrial Electric Prices.

	2013 $/MWh	Ranking
Manitoba Hydro	$ 42.90	1
BC Hydro	$ 45.70	2
Lousiana	$ 58.60	3
Georgia	$ 60.30	4
North Carolina	$ 62.40	5
N Brunswick	$ 64.60	6
Minnesota	$ 66.20	7
Mississippi	$ 67.30	8
Washington	$ 72.90	9
Wisconsin	$ 74.90	10
Nova Scotia	$ 79.50	11
Michigan	$ 82.10	12
Maine	$ 108.80	13

Source: EEI Ave. Rates Report - Winter 2014

While Minnesota's industrial electric pricing is generally competitive, industry is more concerned about the rate of price increases in Minnesota compared to other states and provinces over the past decade, and projections of future electric price increases.

Based on historical EEI reports, Minnesota's average industrial rates have increased 55 percent in the last 10 years (2003-2013). In Minnesota these cost increases have been largely driven by federal environmental regulation and state renewable energy mandates. Compared to the comparison group of states and provinces, similar cost pressures drove comparable price increases in a number of jurisdictions as shown in Table 11. Minnesota's historic rate of increase, although significant, is less than the increases experienced by other Great Lakes States and four Canadian provinces. However it is a larger rate of increase than experienced in Maine, Washington and four southern states.

Table 11. North America Industrial Electric Prices (Percent Increase 2003-2013).

	% Increase	Ranking
Lousiana	5%	1
Maine	19%	2
North Carolina	32%	3
Washington	41%	4
Mississippi	44%	5
Georgia	53%	6
Minnesota	55%	7
Wisconsin	57%	8
New Brunswick	70%	9
BC Hydro	74%	10
Manitoba Hydro	76%	11
Nova Scotia	84%	12
Michigan	157%	13

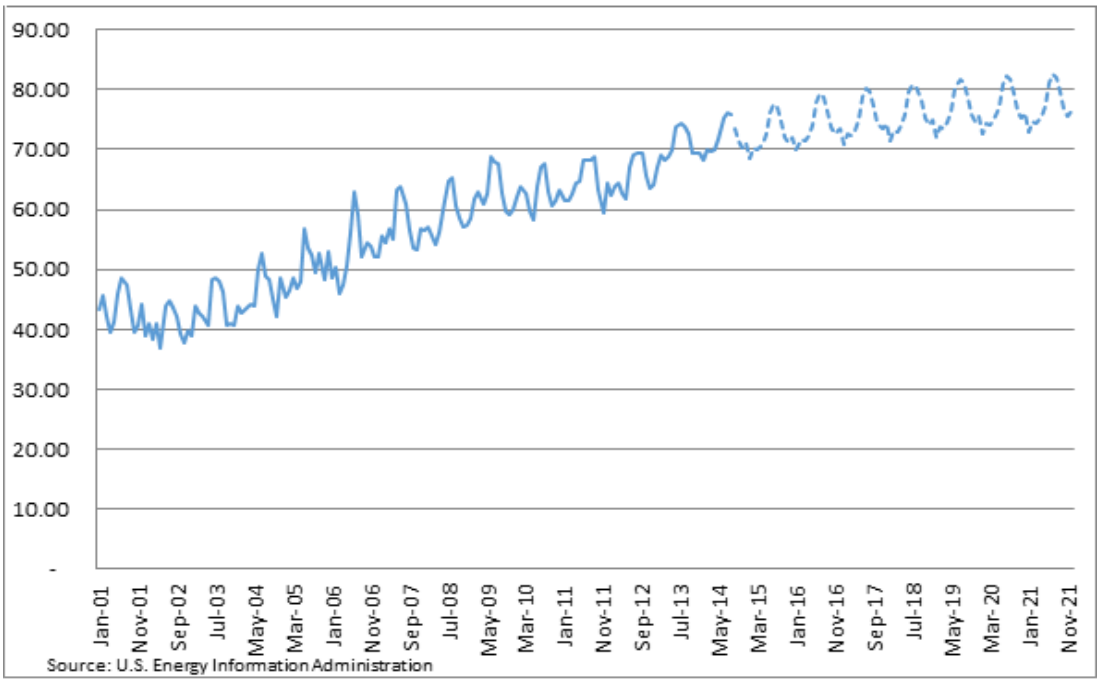
Source: EEI Ave. Rates Report - 2003-2013

Since 2007, industrial rates in Minnesota have gone from below to above the national average. According to the U.S. Energy Information Administration, Minnesota ranks 31st out of 50 states for industrial electric utility rates as of 2012. In 1990, Minnesota was ranked 15th out of 50 states. This precipitous drop in competitiveness, which is forecast to continue, is not sustainable for an energy-intensive, trade-exposed industry. For these businesses, the cost of energy is a factor that influences investment and operations. This is not a cost businesses operating in a global marketplace can pass on to customers, as many regulators incorrectly believe. Fair, predictable, and competitive utility rates are critical to job retention, business development and job growth in Minnesota.

The EIA's industrial electric price projections for Minnesota are shown in Figure 8. The projected continuing price pressure is concerning as Minnesota utilities and their customers continue to face more stringent environmental requirements, new energy policy initiatives and electric infrastructure development costs.

In summary, Minnesota's industrial electric rates are competitive with other locations. The steady increase of purchased electrical costs, both historic and projected, is challenging to the forest products industry as it strives to compete and survive. Minnesota's paper producers are particularly challenged since they have limited ability to increase paper pricing in the face of a decline in printing and writing paper markets, and excess production capacity nationally. The end result is often that mills must find cost savings elsewhere in the mill or experience reduced operating margins.

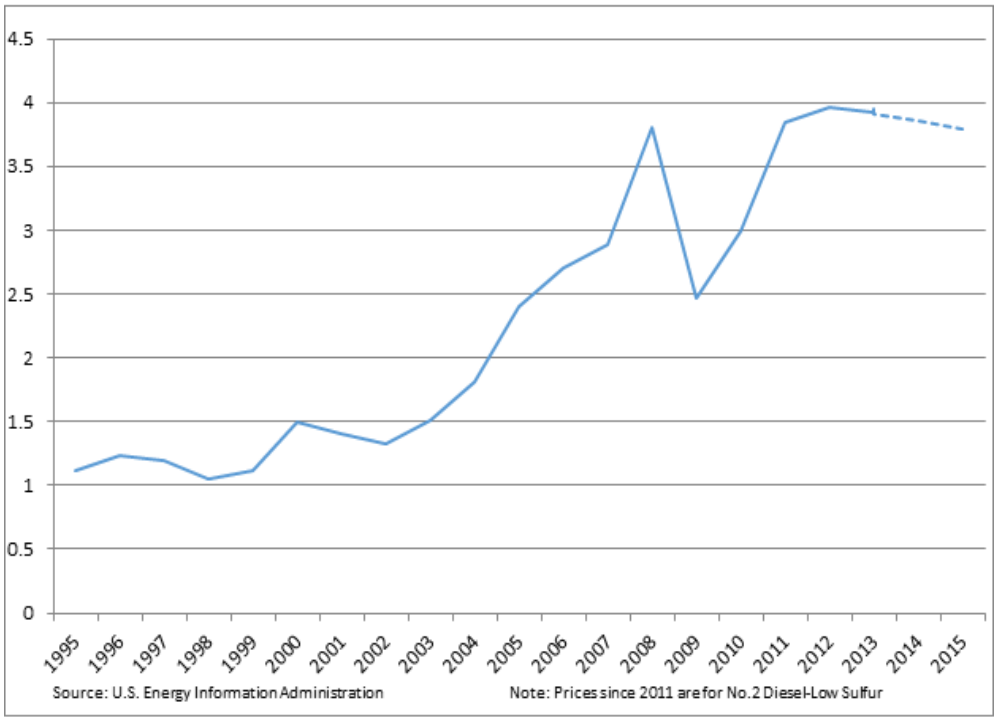
Figure 8. Nominal Minnesota Electric Rates – Industrial, 2001-2021 ($/MWh).



Diesel

The cost of diesel fuel is a significant component of the delivered cost of fiber to mills. Loggers report significant increased transportation costs in recent years, along with increase cold-weather downtime and increased maintenance costs due to the engine technology associated with new ultra-low sulfur fuel mandates. These increased costs are difficult for the loggers to recover and impact their profitability. The increase in diesel fuel costs in the past decade is clearly shown in Figure 9.

Figure 9. U.S. No. 2 Diesel - Retail Prices, 1995-2015 (USD/Gallon).



Diesel fuel increased from $1.50 per gallon in 2003 to just under $4.00 per gallon in 2013. These diesel cost increases were driven by world oil prices and increased regulatory costs related to the low-sulfur mandate. Diesel fuel is also subject to higher federal excise taxes than gasoline. In the near term the U.S. Energy Information Agency projects flat diesel pricing through 2015 as global oil prices decline on weaker demand and increased U.S. oil production.

Recommendations: Cost of Energy

1. The state should provide utilities and their customers with the authority to offer a special tariff to those energy intensive customers who are exposed to global competition and able to move production to other locations outside Minnesota (Governor, Legislature).

2. The state should require that industrial electric rates be based upon cost of service (Governor, Legislature).

3. The state should continue to exempt vehicles used for off-road activities from the biodiesel mandate and from fuel taxes for logging vehicles and equipment (Legislature, Department of Revenue).

4. Direct the Department of Commerce to evaluate and report on alternatives to diesel fuel for the logging industry, including compressed natural gas (with fueling stations at paper mill sites) and other bio-based alternatives (Legislature, Department of Commerce).

Workforce Development

Overall, Minnesota's workforce appears strong in comparison with other selected states (Table 12). Compared to the selected states, Minnesota has the highest rates of literacy, high school graduation and college completion.

The K-12 programs in Minnesota are well developed and supported. The University of Minnesota (UMN) offers B.S, M.S. and PhD programs in bioproducts and biosystems engineering, chemical engineering, business, and forest and natural resource management, all fields that directly pertain to meeting forest-based industry workforce needs. The Minnesota State College and University System (MNSCU) system also has multiple two year community college and technical programs and four year Bachelor's programs in fields related to the forest products industry.

The major workforce challenges to the forest-based industry sector are attracting and retaining a logging workforce in a time of declining profitability, the aging of this work force and the fact that the need for large capital investment hinders the development of new logging businesses. Other areas of concern are the need for education and training of the forest products mill and supporting workforce and the need for continuing education in all these areas. High school, vocational/technical school and MNSCU programs that deliver vocational skills need to deliver these skills faster and at lower costs. A positive example of how to do this is the Minnesota Innovation Institute in Bemidji and its work with local educational institutions.

A recent Blandin Foundation survey found that 20 percent of loggers planned to leave the logging business within four years. A recent UMN study found that loggers are older and their equipment is also older than a decade ago. Further, it is difficult to attract and keep employees. Finally, the capital investment to start a business is substantial and a major barrier to creation of new logging businesses.

Table 12. Workforce Development.

	Literacy Rate (%)	High School Graduates (%)	College Graduates (%)	Average Unemployment Insurance Cost	Building Construction Costs
Minnesota	94	91.4	31.8	$1.16	$98.50
Wisconsin	93	89.9	25.8	$1.38	$95.20
Michigan	92	88.6	25.2	$1.28	$92.20
Mississippi	84	80.7	19.8	$0.94	$77.10
Louisiana	84	81.8	21.1	$0.39	$81.50
Georgia	83	84.1	27.4	$0.58	$81.10
North Carolina	86	84.1	26.4	$0.01	$77.90
Washington	90	89.7	31	$1.00	$101.00
United States					
Germany					
Finland					
Canada					

Legend

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Two year community college programs are not necessarily the most time and cost effective route for training in some of the above areas. Training could be started in high schools and extended into technical school programs. With respect to the logging industry, qualified truck drivers are needed but difficult to find. One barrier is finding a location to take the driver's exam, which is given in only a few places in northern Minnesota.

There is a significant skilled labor gap not only in logging and trucking but also in forest products industry manufacturing plants. While the forest products industry faces significant workforce challenges, the education and training infrastructure in place to prepare individuals for work in the industry is robust and has the potential to make additional improvements across northern Minnesota. One reason the infrastructure is robust is that the core set of skills required by the forest products industry transcends the major employers in the region, including mining, power generation, manufacturing and transportation. Because of these transferable skills, competition between these sectors is an important factor in new business development.

The technical programs available at the five member colleges of the Northeast Higher Education District (NHED) have a long and successful history of preparing individuals for work at the technical level in the forest products industry. Hibbing Community College, Mesabi Range College and Rainy River Community College offer programs in millwright, industrial maintenance, mobile equipment repair, process automation, diesel mechanics and commercial driver's licenses to meet industry needs on the operations side. Central Lakes College Staples Campus houses a successful heavy equipment operations and maintenance program in the region as well.

Both Itasca Community College (ICC) (in association with the UMN) and Vermilion Community College (VCC) have well established technician programs in forestry, natural resources management, conservation and technology and natural resources law. With funding from the Iron Range Resources and Rehabilitation Board (IRRRB), ICC is developing a new program in biochemical systems technology to meet the needs of the emerging biochemical sector in the region. ICC has also worked collaboratively with UPM Blandin to develop the very successful pulp and paper technology program that continues to produce a pipeline of highly skilled individuals in the field. There is a particular need for programs to focus on developing skilled electrical and mechanical maintenance craftsmen and workers in the building trades.

VCC also has the capacity to deliver the professional timber harvester program that makes use of state of the art simulators and curricula. This program is currently on hiatus due to lack of enrollment based on the current employment projections for the industry. Northeast Higher Education District's (NHED) customized training division Advanced Minnesota offers Occupational Safety and Health Administration (OSHA), Mine Safety and Health Administration (MSHA) and the Minnesota Department of Labor and Industry's Log Safe training as well a host of other opportunities designed to meet industry needs. Continuing education for loggers is currently offered by the Minnesota Logger Education Program and continuing education for forest management is provided in large part through the UMN Sustainable Forests Education Cooperative.

While the above capabilities seek to address the immediate needs of northern Minnesota residents, there is a further need to broaden community, social, educational and employment opportunities that will reverse rural population loss and thereby provide more financial capital and growth potential to the region. This in turn will foster the human and financial capital essential to long term industry viability.

Recommendations: Workforce Development

1. **Improve the targeting, timing and availability of job training models and programs for logging businesses and the forest industry sector, especially for skilled electrical and mechanical maintenance craftsmen and the building trades (MNSCU, UMN).**

2. **Develop new apprenticeship and training programs for entry level logging business employees, enhance continuing education offerings to increase the capacity and capability of existing logging business employees and expand efforts to recruit students into these programs, including truck driving (MLEP).**

3. **Urge Minnesota's Congressional delegation to support legislation that would amend the Fair Labor Standards Act of 1938 so that 16 and 17 year olds would be allowed to work on mechanized logging operations under parental supervision (Governor, Congressional delegation).**

4. **Establish at least one high-performance training school in northern Minnesota that will deliver electrical, instrumentation, mechatronics, craft and operating skills that will lead graduates to immediate placement in living wage forest industry jobs close to home (Legislature, MNSCU).**

Environmental Review and Permitting

Minnesota is at a competitive disadvantage relative to states that have environmental review and permitting requirements that are about as stringent as those in Minnesota (Table 13).

Table 13. Environmental Review, Permitting and Regulation.

	Stringency of Requirements	Projects Subject to Review: State Actions	Projects Subject to Review: Local Actions	Projects Subject to Review: Private Actions	Environmental Assessment (EA) Required	Environmental Impact Statement (EIS) Required	Mantatory EA Thresholds	Mandatory EIS Thresholds	Criteria for Determining Environmental Significance
Minnesota	Similar	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wisconsin	Similar	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Michigan	Less Competitive								
Mississippi	Less Competitive								
Louisiana	Less Competitive								
Georgia	Similar	Yes	No	No	No	Yes	No	No	No
North Carolina	Similar	Yes	Yes	No	Yes	Yes	No	No	No
Washington	Similar	Yes	Yes	Yes	Yes	Yes	No	No	Yes
United States*	23								
Germany*	1								
Finland*	1								
Canada*	29								

*Summary of stringency ratings according to a study from the University of Birmingham and World Economic Forum surveys. Numbers indicate rank of each country.

Legend

= Better than Minnesota
= About Same as Minnesota
= Worse than Minnesota

Types of activities that need permits

In the states and countries with which Minnesota is being compared, permits are needed for all activities that involve major discharge of pollutants into the environment (e.g., large wastewater facilities or factories that make use of hazardous chemicals such as paper mills). Each country's legislation identifies regulated pollutants and sets discharge limits (i.e., National Environmental Policy Act [NEPA] and State Environmental Policy Act [SEPA] in the United States). Typically, implementation of pollution permitting and enforcement actions is the responsibility of subnational governmental units (e.g., states, provinces). There are, however, significant differences among states with regard to the types and threshold of smaller scale activities (e.g., logging) that require permits and environmental review.

Permitting thresholds and exemptions

There also are significant differences in water appropriation permit exemption thresholds within the United States. For example, in Michigan the threshold for withdrawing water before needing a permit is two million gallons per day, while the same thresholds in Washington and Minnesota are five thousand and ten thousand gallons per day, respectively. Germany[1] and Canada[2] require water appropriation permits for any commercial use. With respect to air pollution discharge, Minnesota generally adheres to federal air quality standards for activities requiring permits. For certain air pollutants, however, the threshold is at least twice as strict compared to that required by the Environmental Protection Agency.[3] Mississippi, follows the federal requirements, but unlike Minnesota does not have more stringent rules than what is federally mandated and thus allows companies to emit larger quantities of some pollutants. Washington has more stringent permitting thresholds than Minnesota with respect to forestry-related activities. Timber harvesting operations in Washington, for example, require a permit regardless of the location and scope of the harvest operation.[4]

Consistency of permitting/environmental review

Consistency in reviewing proposed forest industry projects varies across the United States. A study conducted by the University of Minnesota in 2009 classified states into three categories of environmental review[5]: those that mirrored the NEPA on the state level and had comprehensive and consistent environmental review process (Tier 1); those that did so only in certain circumstances (Tier 2); and those that did not have a formal review process (Tier 3). Five of the eight states examined in this study fall within Tier 1, while the remaining three are Tier 2 states. Minnesota is a Tier 1 state. Permitting and environmental review in Tier 1 states have a higher degree of stringency as opposed to Tier 2 and Tier 3 states. Table 14 illustrates the classification for each state.

For the two European Union countries (Finland and Germany) examined, their environmental review process is comparable to a Tier 1 state in the United States. In Finland, the environmental permitting and enforcement process has become more stringent in recent years and in some areas is even stricter than European Union directives.[6]

Table 14. Classification of selected states according to review stringency. Tier 1 states have a consistent environmental review process while Tier 2 states only apply the process under certain circumstances.

State/Country	Tier
Georgia	1
Minnesota	1
North Carolina	1
Washington	1
Wisconsin	1
Louisiana	2
Michigan	2
Mississippi	2

Table 15 summarizes the specific attributes of environmental review for the states that were examined. Of the five states listed (all of which are Tier 1 states), Minnesota is the only one that has no exemptions for any of the nine review categories listed in the table.

Table 15. Comparison of review requirements for Tier 1 states according to Ma (2009).

Projects subject to review	Georgia	Minnesota	North Carolina	Washington	Wisconsin
State actions	Yes	Yes	Yes	Yes	Yes
Local actions	No	Yes	Yes	Yes	No
Private actions requiring state or local funds	No	Yes	No	Yes	Yes
Procedures for public participation	Yes	Yes	Yes	Yes	Yes
Environmental Assessment (EA) required	No	Yes	Yes	Yes	Yes
Environmental Impact Statement (EIS) required	Yes	Yes	Yes	Yes	Yes
EA mandatory thresholds	No	Yes	No	No	Yes
EIS mandatory thresholds	No	Yes	No	No	Yes
Criteria for determining environmental significance	No	Yes	No	Yes	Yes

Based on a 2004 OECD Environmental Performance Review, Canada has the least consistent environmental permitting system of all countries examined.[7] The report recommended that Canada improve the coordination between federal and provincial compliance and enforcement programs. In response to the report's recommendations, Canada shortened the time required to conduct environmental review and issue permits.[8]

The World Economic Forum report provides useful information about national comparisons of environmental laws and processes (Table 16).[9] In the report, participants were surveyed for their perceived stringency of regulation in their countries. Germany and Finland tied for first place, the United States was ranked 23rd and Canada 29th. Table 15 also summarizes results from an environmental review survey conducted by the World Economic Forum in 2013.[10] Finland was ranked as the most rigorous country in enforcing environmental regulations. Germany was ranked 3rd, the United States 22nd and Canada 24th. Columns three to six in Table 16 summarize the findings from a report about the state of world bureaucracies conducted by the University of Birmingham.[11] The values in each column indicate the rank of each country based on the criteria listed in the table.

Table 16. Summary of stringency ratings according to a study from the University of Birmingham and World Economic Forum surveys. Numbers indicate rank of each country.

	Stringency of Environmental Rules	Enforcement of Environmental Rules	Government Effectiveness	Administrative Performance	Public Sector Performance
Canada	29	24	9	17	10
Finland	1	1	5	2	2
Germany	1	3	18	8	13
United States	23	22	13	14	9

Permitting and environmental review process timeframes

Few data are available to directly compare environmental review and permitting process timeframes across states and countries. Generally, the time needed for environmental review in the U.S. has steadily increased since NEPA was passed in the 1970s.[12] A recent case study found that environmental permitting in Minnesota took considerably more time than in other states such as Georgia or Maine.[13] While assessing the timeframes for environmental permitting and review, we found that the actual time required and indicated time required are often different. One of the main causes for these delays was incomplete applications submitted by the project proposers. A 2011 report by the MN Legislative Auditor recommends the two reviewing agencies, the MN DNR and the MN Pollution Control Agency (MPCA), establish more defined timelines and documentation requirements associated with environmental review and permitting activities.[14] With respect to permitting activities, there have been recent attempts in Minnesota to expedite the permitting process. In 2011, legislation was enacted that reduced the time needed for a permit decision. Since that legislation has passed, the timeliness of permitting decisions has increased to 99 percent of all permits granted or denied within 150 days by both the DNR and the MPCA.[15]

An Organisation for Economic Co-operation and Development (OECD) report further admonishes the United States to increase the effectiveness of environmental regulation by relying more on cap and trade programs.[16] Further recommendations include stronger reductions in emissions and better coordination between regulating agencies. With regard to forests, the OECD recommends that "protection concerns" be more integrated into best management practices and that wildlife and endangered species be considered to

a greater degree. Such changes in policy might have an impact on time required for environmental review in the future.

Conclusion

While the process for environmental permitting has become more efficient in Minnesota (efficiency being measured by the time required to compete the permitting process), environmental review still needs to improve in order to make Minnesota more competitive with other states. Compared to other states, Minnesota is more stringent with respect to its thresholds for conducting environmental review, as well as the scope of environmental review. Minnesota also appears to incorporate forest resource impact analyses to a greater degree than other benchmarked states.

Recommendations: Environmental Review and Permitting

1. **Exempt wood harvest from the environmental review process until a cumulative harvest threshold quantity of four million cords/year is reached (Legislature, Environmental Quality Board, DNR, MPCA).**

2. **Improve environmental review predictability timelines and efficiency by taking the following actions:**

    a. **Continue to support Minnesota Business First Stop, which provides a helpful service to the Minnesota business community (Governor).**

    b. **Let applicants know what documents are needed and make this information easily accessible at the outset of the environmental review process (DNR, MPCA).** This will reduce the time it takes for applicants to submit a complete application.

    c. **Adhere to the rules set at the beginning of the review process so as to avoid 'scope creep' during the later stages of the review process (DNR, MPCA).**

    d. **Provide applicants with one contact who handles the required documentation at the outset of the environmental review process (DNR, MPCA).** This will prevent double submissions and miscommunication.

    e. **Recognize that electronic communication allows for faster exchange of information, and use that to shorten the length of environmental review by reducing the 'dead time' during the review process (DNR, MPCA).**

Taxation

With a multitude of types and configurations of taxes, it is difficult to compare across states and countries. One measure that allows for a reasonable comparison between states is business taxes as a percentage of State Gross Domestic Product (GDP) (Table 17). Of the selected states, Minnesota appears to be middle of the road, third out of eight states. Mississippi and Washington are highest in this regard, while Georgia and North Carolina are lowest.

Comparing across countries is even more difficult. In comparing the United States to Germany, Finland and Canada, the U.S. is considerably lower than its counterparts in terms of tax revenue as a percentage of GDP. Other measures, such as capital gains taxes and corporate income tax, were more variable in these categories.

Table 17. Taxation.

	Business Taxes as % of State GDP	International Tax Measures: Tax Revenue as % of GDP	International Tax Measures: Capital Gains Tax %	International Tax Measures: Corporate Income Tax %	Preferential Property Tax Programs: Special Tax Treatment for Private Forestland	Preferential Property Tax Programs: Acres Enrolled	Preferential Property Tax Programs: # of Landowners	Preferential Property Tax Programs: Payment Amount*	Preferential Property Tax Programs: Total Program Layout
Minnesota	4.6			9.8	Yes	995,700	7,000	$5.60 or $7.00	$6,652,520
Wisconsin	4.5			7.9	Yes	3,295,000	47,800	$28.82 or $32.46	$95,671,700
Michigan	4.0			6.0	Yes	2,295,000	1,800	$1.25 or $15.00	$3,831,250
Mississippi	6.2			3.0-5.0	Yes	12,000,000	125,000	$29.36	$352,620,000
Louisiana	4.6			4.0-8.0	Yes	11,860,400		$1.17	$13,876,668
Georgia	3.8			6.0	Yes	18,105,600	198,700	$1.43	$25,891,008
North Carolina	3.3			6.0	Yes	8,000,000		$6.15	$49,200,000
Washington	5.3				Yes				
United States		24	15-39	15-39	Yes				
Germany		38	15	15	Yes				
Finland		44	20	20	Yes				
Canada		31	8	15	Yes				

*States with two numbers indicate the existence of two programs

Legend

= Better than Minnesota
= About Same as Minnesota
= Worse than Minnesota
= Mixed

Sales and use tax on capital equipment

The 2003 report to Governor Pawlenty on **The Competitiveness of Minnesota's Primary Forest Products Industry** noted that Minnesota fared poorly relative to other competing states in rebating rather than exempting the sales and use tax on capital equipment. The 2014 MN Legislature addressed this issue by revising the law so that the refund for some capital equipment purchases will be converted into an exemption as of July 1, 2015. However, not all capital equipment purchases and no logging equipment purchases are eligible for this exemption. This limitation on the types of capital equipment purchases that are eligible for an exemption from the sales and use tax creates challenges for the forest products and logging industries.

Property taxes

Property taxes are one of the biggest carrying costs for owners of forestland, as their lands only generate income periodically at best. In trying to maintain private forestland and the benefits that flow to the public, tax and other financial policies are used in all 50 states to influence forest landowner behavior. These can come in the form of a reduction in taxes, a rebate of taxes already paid and/or financial incentive payments, among others. In Minnesota, there are a number of policy instruments to encourage the delivery of private and public goods from private forestland.

Minnesota employs a hybrid financial incentive/tax program entitled the Sustainable Forestry Incentive Act (SFIA), as well as a preferential property tax classification (2C – managed forest land) (Table 18). Because it is primarily an incentive program rather than a tax program , the SFIA and recommendations related to the SFIA are found in the Timber Availability and Price section earlier in this report.

In addition to SFIA, there are a number of property tax classifications which may include forestland including agricultural homestead, rural vacant land, seasonal residential recreational land and managed forestland. The 2C-managed forestland is an additional preferential property tax classification. The tax rate is 0.65 percent as opposed to 1.0 percent for rural vacant land and 0.5 percent for certain agricultural classes. 2C requires 20 acres and a management plan; however, there are no covenant or public access requirements. With 2C, there is an annual renewal requirement and a cap of 1,920 acres. As of 2012, 226,713 acres were enrolled.

Table 18. Property tax programs in selected states.

	Acres enrolled	# of participants	Average net benefit per acre[17]	Total program payments
Minnesota	995,700	7,000	$5.60 or $7.00	$6,652,520
Wisconsin	3,295,000	47,800	$28.82 or $32.46	$95,671,700
Michigan	2,295,000	1,800	$1.25 or $15.00	$3,831,250
Mississippi	12,000,000	125,000	$29.36	$352,620,000
Louisiana	11,860,400	N/A	$1.17	$13,876,668
Georgia	18,105,600	198,700	$1.43	$25,891,008
North Carolina	8,000,000	N/A	$6.15	$49,200,000

Funk, Travis. (2014). Valuing the financial benefit that private forest landowners enrolled in preferential property tax programs receive for providing ecosystem services. M.S. Thesis. University of Minnesota.

Income and estate taxes

In addition to property taxes, income and estate tax policy can also be used to ensure the flow of public benefits from private land. Income tax policy can have an effect on forest management by encouraging or discouraging specific practices. These practices include the deduction and amortization of land management and tree planting costs. Most of these policy instruments are used at the federal level, although some states piggy-back on federal policies such as state tax credits for the donation of land or conservation easements. Estate tax policy can also influence retention of forest land.

Conservation easements

The 2014 Legislature passed legislation that precludes county assessors from reducing tax assessments on land that is encumbered by conservation easements after May 30, 2013 This law has resulted in the cessation of activity relative to large acreage forest conservation easements. The long-term effect of retaining this law will be increased parcelization and subsequent development of forestland, reduced timber supply for the forest products industry and adverse impacts on public recreational access, wildlife habitat and water quality.

Recommendations: Taxation

1. Assure that the up-front exemption on capital equipment rather than a rebate occurs on July 1, 2015 and consider expanding the definition of capital equipment to include entire projects as well as logging equipment (Legislature). The Legislature has extended the implementation date of these kinds of exemptions in the past, and extending the implementation date for this exemption should be avoided. Expanding the definition of capital equipment to include entire forest products industry projects would encourage these projects, and expanding the definition to include logging equipment would help loggers.

2. **Adjust the current 2C rate for forest landowners to make it comparable to the rate for agricultural landowners (Legislature).** This would provide greater equity in tax obligations for rural taxpayers and encourage further enrollment into the 2C program by forest landowners.

3. Revise the language that precludes reduced tax assessments by county assessors on conservation easements (Legislature).

Transportation

Transportation is a key competiveness factor for the primary forest products industry in Minnesota. It includes receiving inbound raw materials (including wood hauled from the forest) and shipping of finished products.

The distance from harvest sites to the mills is a key factor in transportation costs for both loggers and mills. A recent UM study (Blinn 2014), found that the haul distance from point of harvest to a mill is variable, but can often be a significant competitiveness factor. Blinn found that 55 percent of all loads originated beyond 60 miles from the mill and 24 percent travelled over 90 miles, a major cost to loggers. Allowable gross vehicle weights, another key factor, differ across the country (Table 19). Of the states examined in this study, Georgia was found to have the most restrictive weight limits at 80,000 pounds and Michigan had the highest limits at 164,000 pounds. These weight limit issues are a larger concern in Minnesota than elsewhere, since Minnesota industries are more dependent on trucking than industries in many other states. Another issue is the difference between lower federal weight limits and higher state weight limits. These weight limit differences can impede efficient transport of products to market or of raw material out of the woods.

Rail transportation is also a critical issue for Minnesota's forest products industry. Rail transportation can be expensive and unpredictable, in part because of low levels of rail competition in Minnesota. The situation has recently gotten worse because of increasing competition with higher value products such as petroleum from western North Dakota and elsewhere. The lack of competition is strongly correlated with a 76 percent increase in rail rates experienced by the industry during the last decade.

Table 19. Transportation.

	Allowable gross vehicle weight (thousand pounds)
Minnesota*	90,000 - 99,000
Wisconsin	98,000
Michigan	164,000
Mississippi	
Louisiana	100,000
Georgia	80,000
North Carolina	
Washington	105,500
United States	
Germany	
Finland	
Canada	

*Allowable gross vehicle weight in summer and winter

Legend

= Better than Minnesota

= About Same as Minnesota

= Worse than Minnesota

Forest roads and bridges are also a critical component of the transportation infrastructure, not only for timber harvesting but also for recreational access. The DNR maintains a system of more than 2,300 miles of roads, and county as well as federal road systems are also substantial. It is important to regularly maintain these roads and bridges, not only for safety but also to maintain critical access to public resources such as timber, wildlife and recreation.

Recommendations: Transportation

1. Urge Minnesota's Congressional delegation to move federal highway vehicle weight limits at least up to current state limits, 90,000 pounds with 6 axles in the summer and 99,000 pounds with 6 axles in the winter, to ensure a more seamless road network (Governor, Congressional delegation). Currently, federal vehicle weight limits differ from state vehicle weight limits. As Minnesota is more dependent on trucking than many other states with a substantial forest industry, it is imperative to equalize the weight limits.

2. Urge Minnesota's Congressional delegation to change laws that prevent rail competition (Governor, Congressional delegation). With a low level of rail competition coupled with high and increasing rail rates, it is difficult to move raw materials and finished products by rail within and outside of Minnesota.

3. Support development of pipelines as an option to increase the availability of rail service for the forest products industry (Governor, Legislature, MN Public Utilities Commission).

4. Fund improvements to and maintenance of existing forest roads and bridges in the forested parts of the state (Legislature). Deficient forest roads and bridges in Minnesota are posing mounting challenges to the state's residents and businesses in the form of lost time, increased vehicle operating costs and the financial burden of making needed transportation improvements.

Results from National Survey of Utilization and Marketing Staff

To help determine how competitive Minnesota is relative to other states that may vie for similar investments by the forest products industry, a survey was sent to at least one Utilization and Marketing staff member in each state in August 2014. The purpose of this survey was to gather information on the size of each state's primary forest products industry, barriers to forest products industry maintenance and expansion, and strengths that promote investment in the industry.

Twenty-nine states provided feedback, although the number of useable answers varied. Surveys were returned from Alaska, Arizona, Connecticut, Delaware, Georgia, Hawaii, Iowa, Louisiana, Maine, Maryland, Michigan, Minnesota, Mississippi, Missouri, Montana, New Mexico, New York, North Carolina, North Dakota, Oklahoma, Oregon, Pennsylvania, Rhode Island, Utah, Vermont, Virginia, Washington, West Virginia and Wyoming.

Size of the forest products industry

The majority of the responding states provided a monetary estimate of the size of their respective forest products industries (Table 20). The results ranged from $175 million in Arizona to $30 billion in Georgia, but some states reported only a qualitative assessment of the size of their respective forest industry. Hawaii, Rhode Island, and Utah all reported small forest products industries.

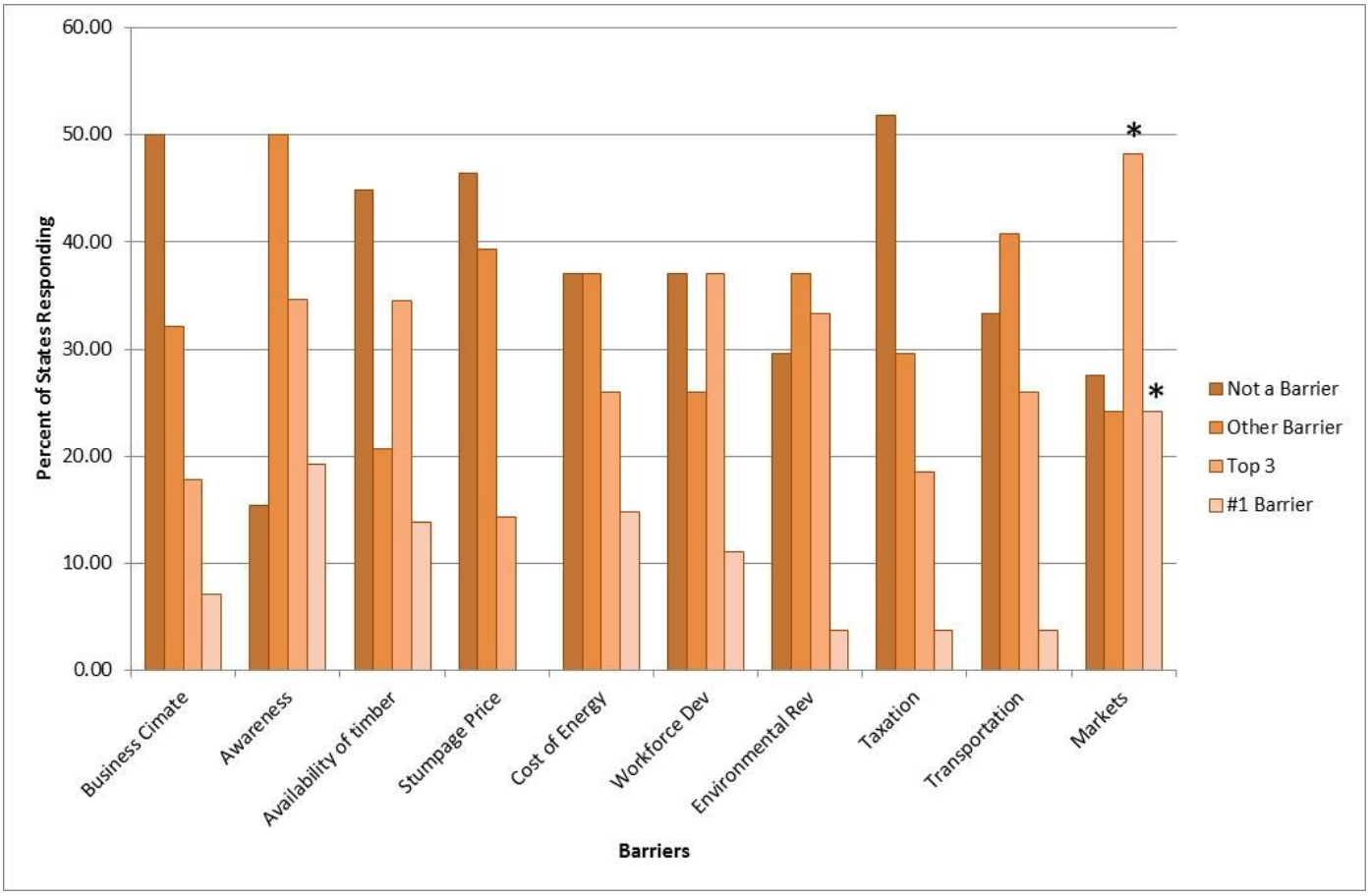
Table 20. Size of forest products industry by U.S. state.

State	Industry Size	State	Industry Size
Arizona	$175 million	Missouri	$8.0 billion
Connecticut	$1.1 billion	Montana	$1 billion
Delaware	$92 million	North Carolina	$23.4 billion
Georgia	$30 billion	North Dakota	$400 million
Maine	$8 billion	Oklahoma	$2.9 billion
Maryland	$1.0 billion	Oregon	$7.1 billion
Michigan	$14 billion	Pennsylvania	$5.5 billion
Minnesota	18 billion	Vermont	$861 million
Mississippi	$10.38 billion	Washington	$5 billion

Barriers to forest industry maintenance and expansion

Survey respondents were asked to identify the top barriers to maintaining or growing the forest products industry in their respective states. The focus states for this report (Minnesota, Wisconsin, Michigan, North Carolina, Louisiana, Georgia, Mississippi and Washington) identified 'Awareness by decision makers regarding the forest industry' as the top barrier (57 percent). Almost a quarter (24 percent) of all responding states identified 'Existence of markets' as the top barrier to the primary forest products industry in their state (Figure 10). Almost half of the responding states reported this factor as one of the top three barriers to the industry. The other two top barriers identified were 'Awareness by decision makers regarding the forest industry' (19 percent of respondents) and the 'Cost of energy' (15 percent of respondents).

Figure 10. State responses to questions asked about barriers to maintenance and expansion of the forest products industry. Asterisks indicate 1) the #1 barrier with the highest percentage of respondents; and 2) one of the top three barriers with the highest percentage of respondents.

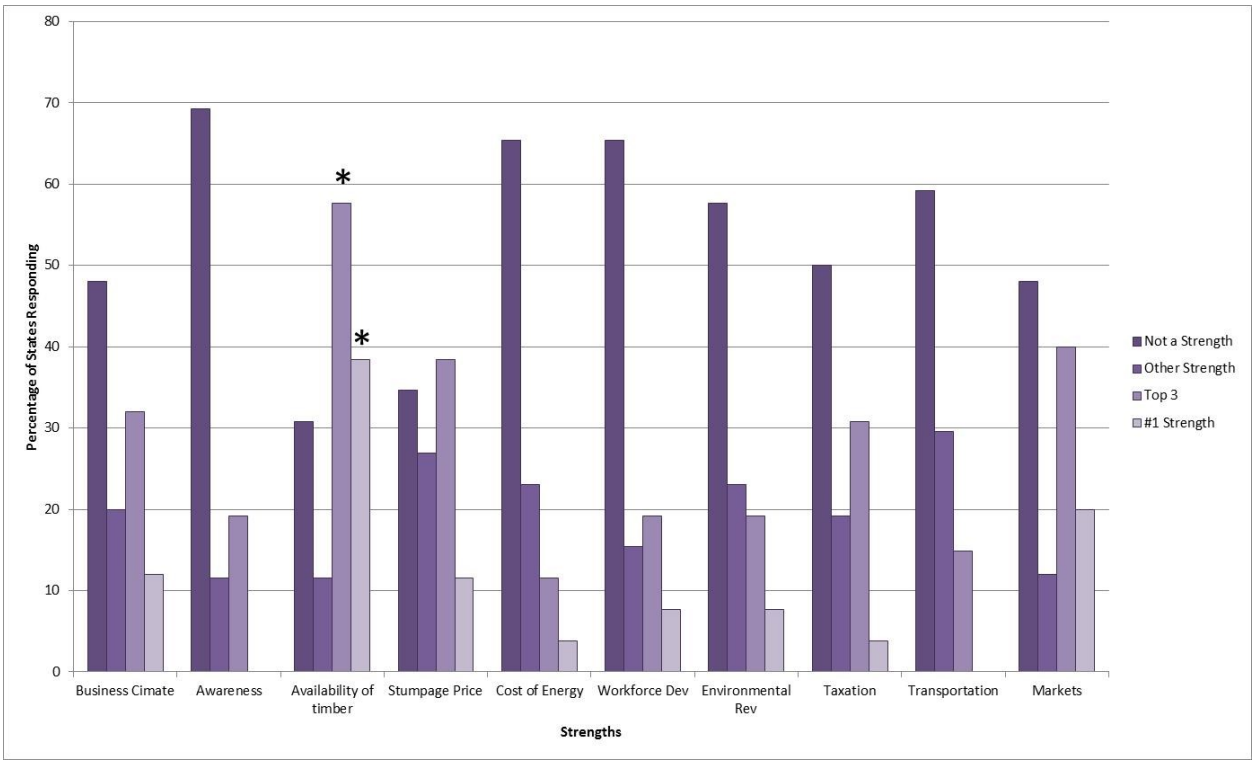


Top barriers identified by states also varied by region. Two of the three Lake States (Minnesota, Wisconsin and Michigan) identified ‘Cost of energy’ as the top barrier. Twenty percent of responding states in the Southeast identified 'Awareness by decision makers regarding the forest industry,' ‘Workforce development’ and ‘Taxation’ as the top three barriers. ‘Existence of markets’ and ‘Cost of energy’ were identified as the top barriers in the Northeast (25 percent each). ‘Existence of markets’ was the top barrier in the West (36 percent). Other barriers identified included environmental opposition, policy uncertainty and lack of capital.

Strengths that promote investment in the forest products industry

Survey recipients were also asked about their respective strengths in maintaining or growing the forest products industry in their state (Figure 11). Thirty-eight percent of all responding states identified 'Availability of timber' as the top strength to promote investment in the forest products industry. Fifty-eight percent of the responding states also identified this parameter as one of the top three strengths. Other top strengths reported by the states were: 'Existence of markets' (20 percent) and 'Overall business climate' (12 percent).

Figure 11. States' responses to questions asked about strengths to promote investment in the forest products industry. Asterisks indicate 1) the #1 strength with the highest percentage of respondents; and 2) one of the top three strengths with the highest percentage of respondents.



'Availability of timber' was a common strength reported by region. Eighty percent of responding states in the Southeast reported it as one of the top three strengths. Similarly, forty-two percent of responding states in the Northeast identified 'Availability of timber' as the top strength. Two of the three Lake States identified 'Workforce development' and 'Existence of markets' as the top strengths. Western states reported 'The overall business climate' as the top strength (33 percent). Other strengths identified by survey respondents included strong political support, incentive and tax policy, quality of the resource and partnerships with universities.

Policy tools used to retain or expand the forest products industry

A variety of policy tools used to retain or expand the forest products industry were noted by the survey respondents. Several states noted that these tools are not used effectively or often enough. Some of the policy tools that were mentioned included forest industrial development grants, tax credits, employee training assistance, state capital investments, and the creation of a Forest Industry Retention Roundtable.

Sixty percent of responding states reported that there are currently no policy tools employed to encourage the next generation of forest products or none that were known. As one state noted, 'Bioenergy offers a good opportunity, but lack of capital and difficulty in competing with low-cost natural gas and oil makes new development challenging."

The barriers and strengths to maintaining and growing the forest products industry are many and varied. The existence of markets, awareness of decision-makers and costs of energy are important factors. Identified strengths include availability of timber, existence of markets and the overall business climate. To maintain and grow forest industry, sates have used policy tools such as research and employment funding, providing loans to industry, and tax credits.

Introduction

There is growing interest nationally and globally in developing forest-based biorefineries for producing renewable energy and renewable products from bio-based feedstocks. There are multiple drivers for this heightened interest, including ever-increasing economic pressures on traditional forest-based industries, increased global demand for transportation fuels, the need for energy security and societal interest in and growing marketability of "green" products utilizing renewable resources to reduce greenhouse gas emissions, enhance environmental stability and improve local economies. By integrating or partnering on forest biorefinery activities, existing facilities have the opportunity to diversify and enhance revenue streams by producing significant amounts of bioenergy and/or bioproducts while continuing to produce wood, pulp and paper products and more fully utilize the existing supply chain infrastructure.

The forest products industry and others in Minnesota are aware of these potential new wood-based bioeconomy opportunities. There are several activities currently underway to support their development in the state (See Appendix A), and the following section provides a summary of future potential opportunities. *However, there is general agreement that the key issues impacting the existing forest products industry noted earlier in this report must be addressed before significant expansion into these new areas can occur.*

Areas of Opportunity for Minnesota's Forest-based Bioresources

There are three broad categories of opportunity for capturing higher value from forest-based resources: 1) thermal energy; 2) biochemicals and specialty materials, and; 3) renewable fuels.

Thermal Energy from Wood. (See Appendix B for additional details). Thermal energy from wood includes single source heating and cooling applications: industrial process heat/steam and combined heat and power (CHP); and district heating and cooling applications. Capturing thermal energy from wood and processing residues can play a meaningful role in forest management in various areas of the state currently challenged for traditional markets. These thermal conversion technologies add the least value to wood biomass, but applications have been demonstrated on a commercial scale and are likely the nearest-term development opportunity. This is especially true for areas of the state lacking access to natural gas, and thus reliant on propane.

Woody biomass for thermal energy applications could include round wood, harvest residues, pre- or post processing residues and urban wood residue. Processing methods could include reducing wood biomass to chunks or chips for direct combustion, pelletizing and torrefaction technologies.

Markets for sawmill and forest residuals are key for the growth and health of Minnesota's sawmilling industry. One near-term opportunity is to use pellet technology to replace propane with locally grown and produced renewable fuel, especially in public buildings and schools. Several recent projects in Duluth and Walker are showcases for this application.

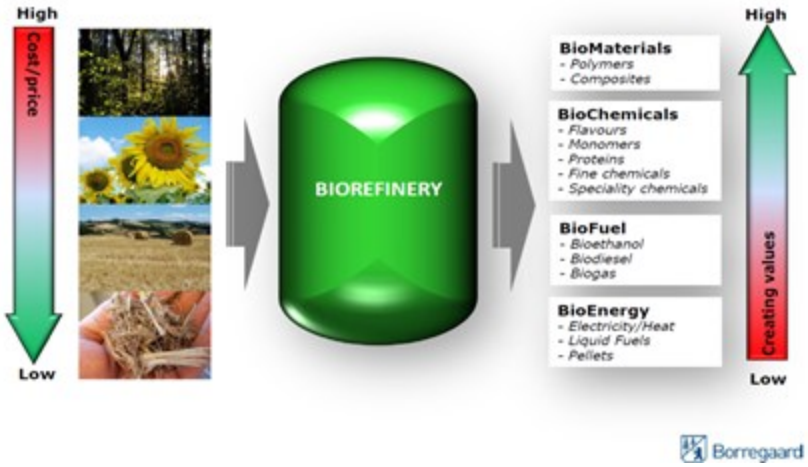
Biochemicals and Biomaterials. (See Appendix C for additional details). A second area of value-added opportunity is in the conversion of bio-based materials to high value commodity or specialty chemicals and materials. These products represent a significantly higher value-add to the biobased raw product, and significant economic potential for Minnesota forest-based biomass. The structural materials that plants produce to form the cell walls, leaves, stalks and woody portions of biomass are composed of cellulose, hemicelluloses and

lignin. Together, these are referred to as lignocelluloses, a composite material of rigid cellulose fibers embedded in a cross-linked matrix of lignin and hemicellulose that bind the fibers. Lignocellulosic feedstocks may be broadly grouped into two classes: agricultural crops/residues, which typically are harvested annually, and wood harvest and processing residues. Figure 2 depicts a flow chart for biobased feedstocks.

University, private, and national laboratory research is developing a myriad of approaches. Wood is superior as a raw material in many respects to the annual crops. In a very general sense, it is a more homogeneous feedstock, and benefits from a well-established collection, storage and transport infrastructure. While offering substantial opportunities for adding value to forest-based biomass, there are some significant challenges. Wood has relatively low bulk density, and depending on the nature of the biorefining system, the energy and equipment needed for handling and preparation as well as pre-treatment for further processing can be costly. Lignocellulose material is by necessity resistant to physical, chemical and biological attack. Converting lignocellulosic biomass into usable output is more challenging than other types of biomass (e.g. starches, oils). The main reason for this is the protective shield of hemicelluloses and lignin that surrounds cellulose has to be broken down, as well as the complex and varied chemical structure of lignocellulosic feedstocks. Thus the conversion technologies are fairly complex biological or thermochemical reactions and are very specific to the characteristics of targeted biomass source, the conversion platform, and the targeted intermediate or final products. In many instances the technology is nascent or not yet proven at demonstration or commercial scale. Further, while there are numerous technological approaches for conversion of woody biomass, few have yet been demonstrated at a commercial scale, while the technologies for the starch-based intermediate products from the agriculture-based industry are well-established.

Biorefineries will encompass a variety of conversion processes and different sized installations due to the range of processes – biological, chemical and thermal – that can be employed (Figure 12). Optimization and high efficiency are the keys to making biorefineries sustainable and economically viable. Regardless of the biorefining platform/ conversion approach, a fundamental objective is to optimize the use of resources, minimize waste and create multiple, high-value product streams from the biomass feedstock.

Figure 12. Further development of the biorefinery concept.



Renewable Fuels. (See Appendix D for additional details). The third area of opportunity for woody biomass biorefining is renewable fuels. Renewable fuels represent the most challenging area for development for forest based biorefining for two fundamental reasons. First, in Minnesota and the U.S., the renewable fuels industry is currently almost exclusively focused on corn-based ethanol and soy-based biodiesel and is well-established, having steadily developed since the 1980's. As of February, 2014, Minnesota ranked fourth nationally in production of ethanol, with the state's 20 facilities having a combined production of 1,129 Million Gallons per Year (MGY) and ranging in capacity from 19 -110 MGY. The capability to produce at this scale is likely a limiting constraint for a new market entrant.

Second, a number of policy issues constrain the development of forest-based renewable transportation fuels. Minnesota and the U.S. have developed numerous policy incentives, and the existing ethanol industry has benefitted. Minnesota was the first state to mandate the use of ethanol in the fuel supply and to support this mandate, provided a 20 cent per gallon producer incentive and appropriated $550 million for corn/ethanol plant construction and startup costs. While the biofuel mandates remain, the producer payment program and construction/start-up cost program no longer exist.

At the federal level, the Renewable Fuels Standard (RFS) program was created under the Energy Policy Act (EPAct) of 2005, and established the first renewable fuel volume mandate in the United States. Under the Energy Independence and Security Act (EISA) of 2007, the RFS program was expanded to include biomass-based diesel (including renewable diesel) and new categories of renewable fuel, including cellulosic biofuel/ renewable fuel produced from cellulose, hemicellulose or lignin.

It would seem that expanding the RFS by expanding volumetric requirements and including cellulosic biofuels would enhance the opportunities for forest-based renewable fuel production. However, in order for a fuel to qualify under RFS2 program it must be derived from feedstocks that meet the definition of renewable biomass. Under that definition, woody biomass (including residues from saw mills and paper mills) must be from planted trees from actively managed tree plantations on non-federal land cleared at any time prior to December 19, 2007. In addition, for woody residue from saw mills or paper mills to be considered "tree residue" within the definition of renewable biomass it must not be mixed with similar residue from trees that do not originate in tree plantations.

Given the lack of state incentives such as those which enabled the development of Minnesota's corn ethanol industry, the complexities of the RFS2 standards and the substantial economies of scale required for a new entrant in the renewable fuels market, establishing (or retrofitting) a renewable fuels facility utilizing woody biomass seems daunting.

One approach with potential for the Minnesota forest sector is the gasification of black liquor resulting from the Kraft pulping process. The Chemrec company, headquartered in Stockholm, Sweden, builds on existing industrial infrastructure to transform pulp and paper mills into biorefineries with its proprietary black liquor gasification technology, opening new markets for mills, producing sustainable, low-carbon chemicals and fuels including dimethyl ether, methanol, synthetic diesel and synthetic gasoline. Research faculty at the UM's Center for Diesel Research are in frequent contact with Chemrec, as one of the products, dimethyl ether, holds significant promise as an "ideal" renewable fuel for diesel engines. An additional opportunity for the black liquor gasification process would be to convert the syngas produced to a propane substitute, a solution of significant interest given recent propane shortages.

Minnesota Advantages

The Minnesota forest Industry enjoys several inherent advantages which lend themselves to successful deployment of biorefining technologies. The paper and forest products industries partner with a very efficient and well-established infrastructure of growers, harvesters and transporters, and already are efficient processors of biomass for their primary products. The processing facilities are located near significant sources of biomass, including agricultural biomass, and have existing infrastructure to transport intermediate and/or finished products. Wood processing facilities are familiar with producing power from biomass and employ a highly trained workforce capable of operating energy and biorefinery systems. There are sufficient and diverse feedstocks available.

The state has a critical mass of companies on the cutting edge of the development and implementation of new bioprocessing technologies. Minnesota has experienced executives in an array of biobased industries, scientists and engineers with superior expertise in the production and conversion of biobased feedstocks, and accomplished service providers such as lawyers, engineers, and accountants.

The market opportunities and demands clearly exist. According to the Minnesota Roadmap analysis conducted by the Minnesota Biobusiness Alliance, the emerging bioproducts industry has the potential to create 12,000 high paying jobs by 2025, especially in greater Minnesota. The global market value of biobased chemicals is projected to increase 8 to 9 percent annually through 2025. The manufacturing of advanced biofuels and biochemicals could result in the employment of over 6,000 people by 2025 in a combination of partnerships with existing biorefineries as well as new construction. The impact for rural communities in Greater Minnesota could be considerable.

The report also cautioned, however, that "years of research and development and commercial development will be required before a product in the emerging biobased industry can be viable in the market place, creating significant high-technology jobs." Additionally, manufacturing of advanced biofuels and biobased chemicals is capital intensive, making it important to ensure funding availability across the spectrum.

Advancing a particular biorefining model requires a comprehensive analysis of market potential, risk analysis, required capital investments, technology readiness, feedstock supplies and logistics. As is the case in a petrochemical refinery, an integrated biorefinery requires specific processes and protocols, depending on the nature of the physical and chemical nature of the available feedstocks and the desired mix of primary end products and/or secondary chemicals, intermediates, or high value energy, biofuel, biochemicals or biomaterials. It is conceivable to construct a greenfield forest biorefinery from the ground up. It seems more likely, however, that forest biorefining concepts will be added to or integrated with existing processing facilities, or co-located adjacent to forest processing facilities to take advantage of existing supply chains, infrastructure, and potential heat, energy and water synergies.

Recommendations: Bioeconomy

1. Create biomarkets to use sawmill and forest residuals, with specific initial focus on pellet technology that can replace propane with locally grown and produced renewable fuels in schools and other public buildings (DNR, DEED, IRRRB).

2. Request state funding for the UMN targeted specifically at the earlier stages of the bioeconomy research and development continuum (Governor, UMN, Legislature). Minnesota has a choice – we can import technologies to develop a robust Minnesota forest bioeconomy, or we can strategically invest in research and development to enhance the prospects of developing a home-grown forest bioeconomy and export those new technologies, creating additional economic value.

APPENDIX A. Examples of current efforts in Minnesota to support the developing MN bioeconomy

Examples of current state initiatives include MNDNR's leadership in the Statewide Wood Energy Team – focused on commercial scale applications – displacing delivered fuels with high efficiency wood energy systems (http://www.dnr.state.mn.us/forestry/biomass/swet.html).

The Next Generation Energy Board has issued an RFP targeted specifically at woody biomass thermal applications (http://www.mda.state.mn.us/en/renewable/nextgen/fy15biomassgrant.aspx).

Utilizing funding provided by the Minnesota Department of Commerce, Division of Energy Resources the Clean Energy Resource Teams (CERTS) periodically issues an RFP for Seed Grants to catalyze energy efficiency and renewable energy projects across the state (http://www.cleanenergyresourceteams.org/rfp).

In June, 2013 the state of Minnesota and Sweden signed a Memorandum of Understanding that pledges to continue working together on research, technology and public policy related to the field of bioenergy, with a near-term emphasis on woody biomass thermal opportunities.

The March, 2012 report entitled*: Minnesota Roadmap: Recommendations for Bioindustrial Processing* (prepared by the BioBusiness Alliance of Minnesota with contributions from the BioIndustrial Partnership of Minnesota and the Great Plains Institute) details various factors influencing the development of the global advanced biofuels and biobased chemicals industry, identifies strengths and opportunity areas for Minnesota, and sets forth some recommendations.

The **Bioeconomy Coalition of Minnesota** (http://mnbioeconomy.org/) is a multi-sector partnership between members of the conventional and advanced biofuels industries, biobased chemicals and products companies, nonprofit organizations, environmental groups, as well as consulting, investment and legal firms. The Coalition, organized by the Great Plains Institute, BioBusiness Alliance of Minnesota and Life Science Alley, has as its mission to "articulate and implement a Minnesota state policy and regulatory agenda to expand renewable chemical, advanced biofuel and biomass thermal energy industries, along the entire value chain from R&D through commercial production and use." The Coalition states "there is an opportunity for Minnesota to become THE global center for the industry by enabling companies to build and operate next-generation biorefineries, but this will require supportive policies."

In order to establish a next generation industry in Minnesota, the coalition believes the following steps should be taken:

- Production Growth: Create policies to help finance production of renewable chemicals and advanced biofuels using agricultural and forestry materials in Minnesota
- Technology Innovation: Strengthen state support of research and development to keep the innovation machine running.
- Biomass Heat: Support the forestry economy and displace fossil fuels by supporting small-scale community biomass heating projects.
- Market Development: Support a robust market for biobased products, and improve end-of-life management of plastics.
- Biofuels Leadership: Produce advanced and cellulosic biofuels in Minnesota, and expand use of biofuels.

The **Minnesota Green Chemistry Forum** (http://www.greenchemistrymn.org) is committed to fostering a common understanding among businesses, government, non-governmental organizations (NGOs) and academia to advance green chemistry practice and policy in Minnesota and nationally. Comprised of membership from business/industry, academia, government agencies and NGO's, the Forum's goals are to:

- Build momentum and create awareness for green chemistry by highlighting existing leadership, best practices and innovations in green chemistry by Minnesota businesses.
- Capitalize on and invest in current green chemistry activities and incubate new business models/ ideas.
- Promote a healthy business environment for green chemistry in Minnesota by providing incentives for research and development, advocating for including green chemistry in academic curricula and supporting consumer education in "cleantech."

The University of Minnesota's **Center for Sustainable Polymers** (http://csp.umn.edu/) was launched in May 2009 as a research center within the UMN's College of Science and Engineering. The center's mission is to transform how plastics are made and unmade through innovative research, engaging education and diverse partnerships that together foster environmental stewardship. On August 1, 2014 it was announced that the Center has been awarded a $20 million grant over five years from the National Science Foundation (NSF) focused on discoveries of the next generation of biobased plastics. The Center for Sustainable Polymers will be one of only eight NSF Centers for Chemical Innovation in the nation.

APPENDIX B. Some current Minnesota examples of utilizing woody biomass for thermal applications

District Energy – St. Paul, MN. St. Paul Cogeneration was developed in the 1990s to increase the fuel efficiency and effectiveness of the Saint Paul district heating system and to provide an environmentally sound energy source for heating customers and the local electric provider. Combined heat and power (CHP) plants generate both electricity and heat from the same fuel source, thereby increasing efficiency and making use of the waste heat that results from generating electricity.

The facility simultaneously produces 65 megawatts of heat and up to 33 megawatts of electricity. Up to 25 megawatts of this renewable electricity are supplied to the local electric utility, enough for 20,000 homes and the excess thermal energy heats enough water for approximately 65 percent of District Energy's heating needs

Urban wood residuals are the primary biomass source for the CHP plant with approximately 50 truckloads of wood chips delivered each day and 280,000 tons of urban wood residuals (biomass) annually. These urban wood residuals typically originate within 60 miles of the plant and are from storm-damaged trees, tree trimmings, land clearing, clean construction residues (pallets), habitat restoration and municipal and private tree and brush sites.

Wolf Ridge Environmental Learning Center, Finland, MN. Following several incremental upgrades to the centralized wood heating system, during winter 2011-2012, Wolf Ridge replaced the cord wood boilers with two new ABioNova biomass wood pellet boilers to bring even greater energy efficiency to its campus. The new ABioNova system is a pressurized, closed-loop computer controlled system operating at 22 psi. The old cordwood boilers consumed 200 cords of birch round wood per year and were only operating at 50 percent of their maximum efficiency due to corrosion buildup on the heat exchanger. The new boilers increased capacity by 58 percent from 1.9 MBtu to 3.0 MBtu while reducing the volume of water needed to store the energy by 75 percent (without including the distribution system volume). The system utilizes 175 Tons/year of

wood pellets supplied by Great Lakes Renewable Energy of Wisconsin. The pellets are 1/4 to 3/8 inch in diameter and up to 1 inch long, yielding 8,800 Btu/lb (versus 6,400 Btu/lb for the white birch used previously).

City of Franklin, MN. The City of Franklin (population 510), located in Renville county in southwest Minnesota, has quickly become an area leader in renewable energy with the installation of its 250,000 Btu biomass boiler heating system. Utilizing funding from an American Recovery and Reinvestment Act (**ARRA**) grant received through the Minnesota Department of Commerce, Division of Energy Resources, the city was able to build its current two boiler system, which heats three primary city buildings: city hall, the fire hall and the city maintenance shop**.** The city reduced its heating costs from about $7,000 to about $2,200 per year.

APPENDIX C. Examples of forest-based biorefining technologies with existing or potential connections to Minnesota

Lonza, Inc., Cohasset, MN. The Swiss-based company, Lonza, specializes in the manufacture of pharmaceuticals with markets including materials science, agriculture, personal care and nutrition. Since 2006, the company has been operating a facility in Cohasset, Minnesota. The company extracts the biochemical arabinogalactan from tamarack trees. Larch arabinogalactan (LAG) was originally sold as an additive to inks, but has since been approved by the Food and Drug Administration for use as a food and feed additive that increases the performance of the digestive tract and immune system.

Sappi – Cloquet, MN. In late 2013, Sappi Fine Paper North America completed a $170 million capital conversion project at its Cloquet, Minnesota mill to produce "Specialized Cellulose" used in textile and consumer goods markets. Specialized Cellulose, also known as dissolving wood pulp, is a versatile raw material used by manufacturers to produce a wide range of products including textile fibers, pharmaceutical, beauty and household products. The conversion is the first of its kind for a Minnesota paper producer and will give Sappi the capacity to supply the pulp to mills in China, Indonesia and India, nations where textiles are booming. Based in South Africa, Sappi already is the world's largest producer of chemical cellulose. This project reflects Sappi Limited's and Sappi Fine Paper North America's diversification into fast growing, high value markets. Sappi also configured the mill to be able to switch from dissolved pulp to paper and vice versa to take best advantage of changing markets.

Segetis, Inc. – Hoyt Lakes, MN. In April of 2014, Segetis, Inc. a Golden Valley, MN-based "green chemistry" company that makes plant-based solvents that are petroleum substitutes, announced that Minnesota's Iron Range Resource and Rehabilitation Board (IRRRB) voted unanimously to approve $21.2 million in funding for Segetis to construct a $105 million commercial-scale plant at the Laskin Energy Park in Hoyt Lakes, MN. Segetis is a leader in creating high performance, sustainable materials , thereby reducing the world's dependence on fossil fuel based petrochemicals. Segetis uses proprietary technology to convert biomass to Levulinic Acid and its derivatives for use in wide market applications including bio-based plastics and home cleaning products. The company currently uses corn sugars as the feedstock, and its new plant will initially do the same, according to IRRRB documents. The company expects to transition the plant to wood feedstock by 2018. At that time, the company will require 90,000 cords of wood annually.

Weyland AS/SilvaNova, Inc., Weyland AS. This Norwegian company has developed a novel, patent protected process for the strong acid hydrolysis of biomass. A new Minnesota-based company (SilvaNova, Inc.) is being formed to continue Weyland's technology development in North America. The process provides high recovery of carbohydrates, separated lignin, with moderate energy expenditure, and is particularly suitable for use of woody biomass. The currently-targeted end-products are cellulose microfibers, fermentation feedstock and high purity lignin. The proprietary technology recovers the acid by means of solvent extraction with minimal production of waste materials.

BioFore/UPM. With corporate headquarters in Helsinki, Finland, BioFore/UPM's innovations target the creation and development of new products that can be used to replace non-renewable materials with renewable, recyclable and low-impact alternatives and provide resource-efficient alternatives for the future. Biofuels are a typical example of UPM's innovation work, with the renewable diesel biorefinery in Lappeenranta due to start operating in summer 2014. Other new businesses include biocomposites, which are already being marketed to customers, as well as biochemicals and biofibrils, which are currently in the development phase. UPM uses fiber and forest biomass in its current products and its aim is to create new growth opportunities based on continuous product development and innovation. In July, 2014 UPM announced an agreement for UPM to become the exclusive distributor of Domtar's BioChoice™ lignin in Europe. BioChoice™ is produced at Domtar's biorefinery in Plymouth, North Carolina, US. BioChoice™ lignin is a by-product of the kraft pulping process. It is a 100 percent biobased sustainable alternative to replace fossil based products. BioChoice™ lignin holds the USDA Certified Biobased product label.

Borregaard. Based in Norway, Borregaard is an international company with factories and sales offices in 16 countries in Europe, the Americas, Asia and Africa. By using natural, sustainable raw materials, Borregaard produces advanced and environmentally friendly biochemicals, biomaterials and bioethanol that can replace oil-based products. Borregaard has one of the world's most advanced and sustainable biorefineries. Borregaard ChemCell has a unique concept for the utilization on non-GMO wood from sustainable regional forestry as a raw material for a wide range of advanced products including the production of high quality specialty cellulose for methyl cellulose derivatives (MC, MHEC and HPMC), hydroxyethyl cellulose (HEC) and carboxymethyl cellulose (CMC) for such end products as food, pharmaceuticals, cosmetic and personal care applications, coatings, oil drilling and paper coating; production of cellulose for the acetate industry for such products as textiles, plastics and film; specialty cellulose for the production of nitrocellulose for such products as printing inks, lacquers, coatings (for wood, metal and leather), nail varnishes and energetic grades; and specialty cellulose for the production of microcrystalline cellulose (MCC) with important end-uses within food and pharmaceutical applications. Borregaard Ligno Tech is a leading global supplier of lignin-based binding (animal feed, briquettes) and dispersing agents (to give fluidity and stabilization) in concrete, textile dyes, pesticides, batteries and ceramic products. Lignin-based products are also used in drilling for oil, where the products have cost effective and environmentally friendly properties.

Stora Enso. In June of 2014, Stora Enso announced the acquisition of the US-based biotechnology company Virdia, a leading developer of extraction and separation technologies for conversion of cellulosic biomass into highly refined sugars and lignin. This is a new step in implementing the company's strategy, following the recent lignin extraction investment at Sunila Mill in Finland. This acquisition continues Stora Enso's strategy of growth in bio-based chemicals, ingredients and solutions, building on cost-effective, non-food-competing raw materials. In September, 2014, Stora Enso announced the investment of EUR 32 million (USD 43 million) in a demonstration and market development plant to be built at Raceland, Louisiana. The plant will be used for industrial validation of the newly acquired extraction and separation technology developed by Virdia that enables cellulosic biomass, such as wood or agricultural waste, to be converted into highly refined sugars. The investment shows the feasibility of the technology on an industrial scale in the future, possibly also in some of Stora Enso's existing pulp mills. While the facility will utilize bagasse waste from sugar cane plantations as feedstock, it will demonstrate the production of high purity five-carbon sugars (particularly xylose) which will be converted and upgraded for applications in food and personal care.

Cellulose Filaments. In April, 2014, the Government of British Columbia contributed $2.25 million to cellulose filaments (CF) research. The investment will be used as part of an existing R&D program focused on non-traditional applications of cellulose filament (CF). FPInnovations' cellulose filament research and innovation project is the subject of investments to date totaling $43.1 million, including funding from Natural Resources Canada, through the Investments in Forest Industry Transformation (IFIT) program, as well as a grant from

the Québec Ministry of Natural Resources, a loan from Investissement Québec, a contribution from Kruger Inc. and funds from FPInnovations' pulp, paper and bioproducts industry members. FPInnovations (https://fpinnovations.ca) is a not-for-profit organization that specializes in the creation of scientific solutions in support of the Canadian forest sector's global competitiveness. The R&D organization says the potential initial market for CF as a strength reinforcing agent for traditional pulp and paper products is conservatively estimated at 125,000 tons per year in North America.

In June of 2014, two Canadian-based forest product companies – Resolute Forest Products and Mercer International, announced a joint venture to form Performance BioFilaments, Inc. to commercialize uses for cellulose filaments in markets other than pulp and paper. Performance BioFilaments' cellulose filaments are made from wood pulp, processed using a proprietary technology licensed from FPInnovations Inc. The resulting cellulose filaments have exceptional strength and purity, with an extraordinarily high aspect ratio that is unique when compared to all other high-value, cellulose-based biomaterials. The strength of cellulose filaments can be compared to that of synthetic reinforcement fibers made from non-renewable petroleum inputs.

Nanocellulose. Nanocellulose is a material derived from wood fibers. It has exceptional strength characteristics on a par with Kevlar, a lightweight material used to manufacture high-strength, durable materials. However, in contrast to Kevlar and other materials based on fossil fuels, nanocellulose is completely renewable. There are a wide variety of potential applications for nanocellulose, including, for instance, the manufacture of both paper and board. With regard to paper/board, nanocellulose could be used as a strengthening agent in paper with a high filler content. Other areas of application may be surface sizing and coating (e.g., as a barrier material against oxygen, water vapor and grease/oil) in food packaging. There are also applications in the field of nanocomposites, non-caloric food thickeners, emulsion/dispersion, oil recovery applications, cosmetic/pharmaceutical applications and applications in the electronics sector. Previously, the production process was too energy-intensive to make commercialization of nanocellulose a viable option. Innventia, a Stockholm-based research institute that works with innovations based on forest raw materials, recently developed pre-treatment processes which reduced the energy consumption for the nannocellulose production process by 98 percent.

In the U.S., the University of Maine's Cellulose Nanofiber Pilot Plant is the newest addition to the Process Development Center (PDC). The new pilot plant was funded through a joint venture with the USDA Forest Service and is the only one of its kind in the U.S. Constructed in parallel to the Cellulose Nanocrystal Pilot Plant at the USDA Forest Service's Forest Products Laboratory (FPL) in Madison, Wisconsin.

The FPL has opened a U.S. $1.7 million pilot plant for the production of cellulose nanocrystals (CNC) from wood by-products materials such as wood chips and sawdust. Prepared properly, CNCs are stronger and stiffer than Kevlar or carbon fibers, so putting CNC into composite materials results in high strength, low weight products. In addition, the cost of CNCs is less than ten percent of the cost of Kevlar fiber or carbon fiber. These qualities have attracted the interest of the military for use in lightweight armor and ballistic glass (CNCs are transparent), as well as companies in the automotive, aerospace, electronics, consumer products and medical industries.

APPENDIX D. Examples of renewable fuel technologies from forest based feedstocks

Chemrec. One approach with potential for the Minnesota forest sector is the gasification of black liquor resulting from the Kraft pulping process. The Chemrec company, headquartered in Stockholm, Sweden, builds on existing industrial infrastructure to transform pulp and paper mills into biorefineries with its proprietary black liquor gasification technology, opening new markets for mills, producing sustainable, low-carbon chemicals and fuels including dimethyl ether, methanol, synthetic diesel and synthetic gasoline. Chemrec's

alkaline catalytic gasification technology was until recently applied exclusively for gasification of spent cooking liquors from the wood pulp industry. Now, additional feedstock will provide both an extension of the total potential and give flexibility and further increase profitability of industrial projects. This development is based on co-gasification of black liquor and pyrolysis oil derived from wood waste. The technology effectively doubles the feedstock potential of the Chemrec technology and makes possible larger scale, more flexible plants with high profitability.

Mascoma Corporation. The Mascoma Corporation is a provider of leading technology for the conversion of biomass to fuels and chemicals. Using its proprietary consolidated bioprocessing, or CBP, technology platform, Mascoma has developed bioengineered yeasts to reduce costs and improve yields in the production of renewable fuels and chemicals. The initial commercial application of Mascoma's CBP technology is targeted to the corn-based ethanol market, but Mascoma is currently working to develop and construct commercial scale facilities to convert hardwood feedstocks into cellulosic ethanol. Mascoma is currently proceeding with the development of a planned 72 million liter per year multi-product biorefinery in Drayton Valley, Alberta. The technology platform will convert woody biomass to cellulosic ethanol, isopropanol, purified xylose and bio-electricity. Mascoma is working with the Sustainable Development Technology Canada, a foundation funded by the Canadian government, on this project.

JetE Hydrotreatment of bio-oils. An additional thermochemical approach worth mentioning, although not immediately relevant to most MN forest processing entities is hydrogenation or the hydrotreatment of bio-oils into drop-in replacement transportation fuels such as green diesel or green jet fuel. This technological approach, typically aimed at oil crops, would provide an opportunity to convert tall oil from certain pulping processes into drop-in transportation fuels which have indistinguishable physical properties from fossil-based fuels. These fuels tend to have better combustion performance and higher energy content, similar to Fischer-Tropsch fuels and, most importantly, have good low-temperature stability, making them ideal as a renewable fuel source.

APPENDIX E. Environmental Review and Permitting references

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