

WISCONSIN'S FORESTED LANDS:

OPPORTUNITIES FOR CARBON SEQUESTRATION AND STORAGE

SPRING 2022 REPORT



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A Report of the Climate & Energy Initiative of the
Wisconsin Academy of Sciences, Arts & Letters

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ABOUT THIS REPORT

This report is published by the Wisconsin Academy of Sciences, Arts & Letters through its Climate & Energy Initiative. Through peer learning events, conferences and summits, and reports such as this, the Academy's Climate & Energy Initiative seeks to understand and address Wisconsin's role in global climate change and explore diverse energy choices for a sustainable future. For questions about this report or to reach report contributors, contact environment@wisconsinacademy.org.

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PREFACE

As we face the realities of climate change, the powerful role trees can play is well known. It seems an obvious answer to simply “plant more trees!”. Certainly, trees are essential, but when combined with forest products a myriad of climate change solutions emerge, as well as many economic, social, and environmental co-benefits. From the great Northwoods to downtown Milwaukee, Wisconsin can be a positive leader in mitigating climate change by working with one of our state’s most amazing assets, its forested landscapes.

In 2021, the Wisconsin Academy of Sciences, Arts & Letters published a report titled *Carbon Storage in Wisconsin’s Landscapes: Identifying Priorities and Potential* as part of our Climate-Critical Lands project, which examined forested landscapes in Wisconsin, along with the carbon storage potential of other landscape types. We identified three high-impact practices for enhancing carbon uptake and/or storage in forestry: avoiding forest loss, protecting existing forests and/or establishing reserves, and delaying harvest and/or extending rotations.

As a follow-up to this work, the Academy decided to delve further into the potential of Wisconsin’s forested landscapes to mitigate the impacts of climate change. The impact of the forestry industry in Wisconsin is wide-ranging and complex. We spoke with many people involved in both forestry and forest products, including foresters, policy analysts, consultants, mill owners, biologists, small- and large-scale private land owners, non-profits, carbon credit developers, and others.

From these focus groups, interviews, conversations, and other forms of research, we have identified a path forward that is realistic and achievable for Wisconsin, economically beneficial to the state, and impacts climate change. We crafted this report for professionals involved in decision-making in forestry, and we have included a glossary and some further definitions to make this report accessible to a wider audience.

Adopting the recommendations in this report will require true statewide commitment and collaboration across industries. The Academy has acted as a convener for Wisconsin people and ideas throughout its history, and we will continue to use this “superpower” to work with our partners in forestry and related industries to move forward on these recommendations.

Thank you to the many who shared knowledge and insights. With gratitude and partnership, I thank McKnight and Sally Mead Hands foundations, donors to the Wisconsin Academy, and all those engaged in environmental and climate work. Together, we can and will change the trajectory of climate change, redefining the future of Wisconsin, and improving life for generations.



Erika Monroe-Kane
Executive Director, Wisconsin Academy of Sciences, Arts & Letters

INTRODUCTION

Although Wisconsinites are not experiencing the increasingly frequent and intense hurricanes on the Gulf Coast, or the devastating fires in the Western United States, the state is in no way immune to the impacts of climate change. We are also contributing to the cause of climate change through fossil fuel emissions.

How does Wisconsin stack up? Wisconsin is the 19th largest carbon emitter in the nation, emitting 102 million metric tons of carbon in 2018. This translates to 17.6 tons of carbon per Wisconsinite per year, slightly above the national average of 16.7 tons per American. Additionally, we contribute to the cause of climate change through fossil fuel emissions. The bulk of emissions in Wisconsin come from electric power generation at 39.9 percent and transportation at 31 percent (U.S. Energy Information Administration, 2022).

This report focuses on carbon sequestration and storage potential in Wisconsin forestry. Natural climate solutions (NCS) are actions that can increase carbon sequestration and storage, or can avoid greenhouse gas emissions, on natural landscapes. If used to their full potential, NCS could offset 37 percent of carbon emissions from burning fossil fuels. Forests are climate-critical lands, meaning that they play a large role in natural climate solutions, potentially offering over two-thirds of all-natural carbon solution mitigation (Griscom et al., 2017). Wisconsin in particular has large opportunities for carbon sequestration, storage, and emissions reduction in forestry.

Wisconsin has 17 million acres of forested landcover comprising 46 percent of the total land area of the state. The entire state has forested landcover, with the highest density of forested lands in northern Wisconsin, the quintessential Northwoods. Forests throughout the state provide wildlife habitat, recreational and tourism opportunities, and support a large forestry industry; Wisconsin's forests generate products valued at nearly \$24.5 billion each year, support more than 63,000 jobs, and the forest products industry is ranked second in the state in terms of industry output (Dahal, 2021).

Nationally, forests store about 68 percent of terrestrial carbon stocks (Liu et al., 2014). Under current management strategies, Wisconsin forests sequester about 3.7 million metric tons of carbon annually (*Carbon in Wisconsin Forests*, 2021). This is equivalent to about 3.6 percent of Wisconsin's annual carbon emissions, much lower than the 15 percent that all US forests offset annually (Woodall et al., 2015). How can we close the gap?

The forests of northern Wisconsin have been net carbon sinks for at least the last two decades, though the rate of sequestration has been declining. Public lands sequester more carbon, on average, than private lands. Likely causes for the declining rate of sequestration are increased harvesting for wood products, aging forests, and increasing natural disturbances. – Birdsey et al 2014 (pg 9)

How do forests become carbon sinks? Trees pull carbon from the atmosphere and convert it to living biomass, which is called carbon sequestration. Forests continue to store carbon as standing dead trees, in soil organic carbon, and as harvested wood products, which is carbon storage (Anderson, 2021).

Young, rapidly growing forests, once established, have higher rates of carbon sequestration but lower levels of stored carbon compared with older forests. In contrast, older forests have higher levels of stored carbon, but lower rates of net sequestration due to greater mortality and respiration (Harmon 2001, Malmshiemer et al. 2008)(Birdsey et al. 2014 pg 17)

Carbon sequestration and storage are simple in concept, but best practices for increasing both are situational– dependent on the forest type, its composition, its geographic location, and a suite of other factors.



JOHN GREENLER

Many variables impact carbon sequestration and storage rates in a forest, such as tree species, tree density, forest structure, geology, soil type, and many other factors.

The age-class distribution over a landscape, which reflects the legacy of past harvest, natural disturbance, and abandonment of agriculture, is a useful indicator of potential for additional carbon storage. If the landscape is dominated by young forests, there is significant potential to increase carbon stocks, whereas an area with mostly old forests will not likely increase carbon stocks significantly in the future. (Birdsey et al., pg 17)

There are many methods for increasing carbon sequestration and storage in forestry. A commonly discussed method involves increasing growth rates and storage in forestry by delaying harvests, allowing more of the forest to reach an older age class. Other methods include but are not limited to: reducing emissions in forestry management practices, maintaining existing forest cover, thinning overstocked forests to enhance the growth of the most productive trees, planting trees, and storing carbon in durable wood products (Ontl et al., 2020). There is potential for any or all of these techniques to be used across Wisconsin's forested landscapes. Many of these techniques also produce co-benefits.



One of the many co-benefits to maintaining forested landcover for carbon sequestration and storage is providing forest bird habitat. This Blackburnian warbler depends on boreal coniferous and mixed forests for its breeding habitat.

The goal of this project is to advance land-based carbon sinks as a drawdown strategy in Wisconsin by developing a detailed policy and management roadmap to protect carbon-sequestering landscapes—especially in forests. This report identifies policies, practices, and ways to incentivize near-term action while laying the groundwork for a scalable statewide mosaic of resilient carbon-sequestering forested lands in Wisconsin.

If we eliminate harvesting completely for the next 50 years, we could potentially sequester around 10.8 percent of Wisconsin's annual emissions (Birdsey et al., 2014), or 11.1 million metric tons of carbon, which is equivalent to the total carbon emissions that Milwaukee County generates on an annual basis (Herrod, 2020). However, this change would have a rippling impact for the Wisconsin forestry industry, which relies on harvested trees for forest products. In this report we focus on solutions that will increase carbon sequestration and storage in the state's forests, while also providing economic, ecological, and social benefits to Wisconsinites.

The Academy has a history of convening experts and synthesizing their ideas into actionable plans for the betterment of everyone in Wisconsin. We have leveraged our established role as conveners to engage a strong cross-section of leaders in Wisconsin forestry. For this project, we reconnected with the forestry subgroup of our Climate-Critical Lands team and added new experts. This team helped us connect with foresters and others in forestry to identify the most realistic and achievable changes that can be made in Wisconsin. They also reviewed and provided feedback on this report.

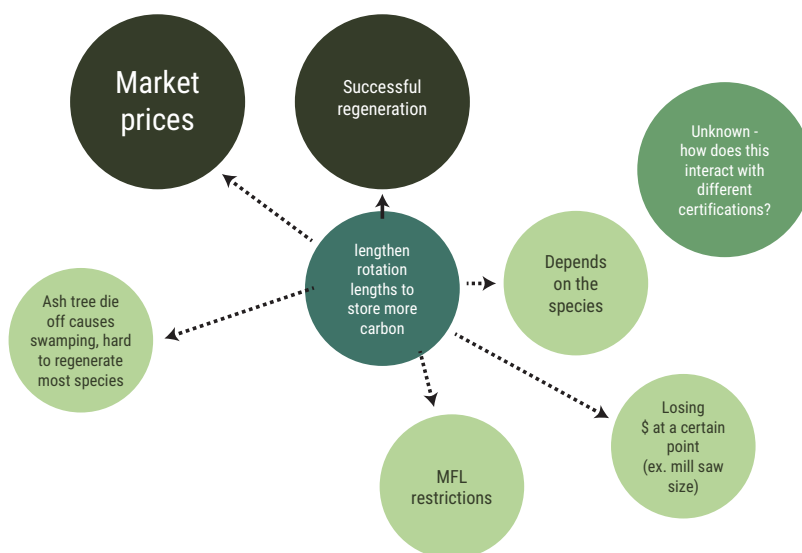
In this report we first summarize the results of our focus groups and interviews, roughly in order of percentage of forest cover in Wisconsin, followed by a summary of cross-cutting issues we learned about from focus groups and individual interviews. Following this summary of findings, we present our recommendations for policies, practices, incentives that will increase carbon sequestration and storage in Wisconsin forestry.

METHODS

We conducted five focus groups with forest managers in Wisconsin in the following categories:

- ▶ Wisconsin Department of Natural Resources (DNR) foresters
- ▶ Tribal Nations foresters
- ▶ Small scale (<700 acres) private landowners
- ▶ County-employed foresters
- ▶ Urban foresters, employed by or volunteering for municipalities

We identified focus group participants through a snowball sampling method. Each focus group had 5-10 participants. We asked the same questions of each focus group in a two-hour Zoom session, and used a free online program called Mural to map out responses in real time. We referred back to Mural documents, notes, and recordings in the analysis for this report.



Example of a Mural section from a focus group discussion on barriers and incentives for practices that can increase carbon sequestration and storage in forestry.

Focus group questions

1. What are your top three forestry management goals, in order if you can?
2. What policies or plans (federal, state, or other) most impact the way you manage your property?
3. When you think about prioritizing carbon storage in your forestry practices, what practices do you think of?
4. Do you consider storing carbon in forest products for the long term as part of your management practices?
5. Do you consider carbon emissions in your forestry management practices?
6. If you are participating in a carbon sequestration program, what program is it?
7. What changes have you made to the way you manage your forested property to participate in the program?
8. Do you feel that foresters in your community have enough information to participate in carbon sequestration programs?
9. What are some concerns that you have, or you think that other people might have, when it comes to participating in a carbon sequestration programs on property that you manage?
10. Do you want to sequester more carbon on the forested properties that you manage?
11. Are there any social factors that you consider in your decision making?
12. How do you receive information?

For the Tribal Nations foresters group, we added the following question: Will the development of statewide policies, practices, or guidance have any influence on your respective tribe's decision-making on carbon management?

We received written responses to our questions from US Forest Service employees at Chequamegon-Nicolet National Forest.

After collecting data from foresters, we interviewed 27 people who are involved in different aspects of the forestry industry to dive deeper into specific topics. This included personnel who work in building codes, tax law, policy, economics, research, urban wood, and forest products. These focus groups and interviews were the primary source of data for this report.

We looked for common themes and differences throughout the focus groups and interviews. Combined with other background research and recommendations from the Forestry Subgroup, we came up with a set of recommendations.

RESULTS

Table 1. The top three forest management goals described by each focus group.

Goals	Small-Scale Private Lands	County Lands	State Lands	Tribal Lands	Urban Lands
Economics/return on investment	*	*	*		
Forest health	*	*	*	*	
Growing the tree canopy					*
Preserve and enhance Tribal traditions				*	
Preventing fragmentation				*	
Public safety					*
Recreational opportunities	*	*	*		
Tree and stand diversity					*

Full list of goals mentioned by all focus groups in alphabetical order:

- Aesthetics

Carbon sequestration and/or storage

Diversity (stand/forest)

Economics/return on investment

Forest health

Future generations

Grow tree canopy

Increase pine component

Maintain public safety

Master plan guidelines
- Preserve and enhance Tribal traditions

Protect from insects and disease

Protect historical sites

Protecting from fragmentation

Public access, recreational opportunities

Public outreach and education

Soil and water quality

Statute

Tree preservation

Wildlife

SMALL-SCALE PRIVATELY OWNED FORESTS

About two thirds of Wisconsin's forests are in private ownership, with the majority owned by non-industrial private forest (NIPF) landowners (Public Sector Consultants et al., 2020). This is a large portion of Wisconsin's forested landcover, with a lot of potential for mitigating climate change through carbon sequestration and storage.



WISCONSIN DEPARTMENT OF NATURAL RESOURCES

For this focus group, we only included private landowners who held fewer than 700 acres of forested property. Focus group participants listed forest health, recreational access, and return on investment as their top management goals (Table 1). Carbon was not mentioned as an explicit management goal by any of the focus group participants, although many of them expressed an interest and curiosity in the concept of managing for carbon. Although the participants were able to list management actions that could promote carbon sequestration and storage on their properties, they expressed a lot of uncertainty over which actions would be most appropriate on their land.

None of the six landowners in the focus group were enrolled in a carbon credit program; most were not aware that they could participate in one. All focus group members felt that they did not have enough information to decide whether or not to enroll in a carbon credit program.

When asked which policies or programs most impact the way they manage their properties, the focus group members all pointed to *Wisconsin's Managed Forest Law* (MFL). MFL succeeded the *Forest Crop Law* (FCL), a similar landowner incentive program that existed from 1927 to 1986. The Wisconsin State Legislature established MFL in 1980 for the purpose of encouraging sustainable forestry on private woodlands and to provide a steady supply of timber to Wisconsin mills (Wisconsin DNR, 2017). MFL is an open enrollment tax program that requires the landowner to work with a Certified Plan Writer (CPW) to create a forest management plan. Once the plan is created, the forest owner is given a tax break on the forest parcel. MFL provides a tax incentive to keep forested lands intact and prevent conversion to agriculture and development. There are currently about 3.5 million acres enrolled in the MFL program, or about 20 percent of all forested lands in Wisconsin (Wisconsin Department of Natural Resources, 2017).

Most of the people we interviewed about MFL viewed the program primarily as a way to increase the supply of trees to Wisconsin's timber industry. Some saw room for change within the MFL in its current form, while others felt that changes should be made to MFL to move it away from a focus on traditional forestry towards carbon sequestration and storage. In its current form, carbon can be listed as a goal within an MFL plan, along with many other goals not directly related to the sale of timber, but in practice, very few MFL plans include carbon sequestration and storage as a goal.

The private landowners we spoke with expressed both curiosity and confusion about the carbon credit market. Most felt that they were not eligible to enroll, but over the course of the research and writing of this report, new opportunities in carbon credit markets for small scale landowners have emerged.

COUNTY FORESTS

County forests are Wisconsin's largest publicly owned forest land base, representing about 14 percent of Wisconsin's forested lands, or over 2.4 million acres, spread out over 30 counties ("Wisconsin County Forests Association," 2022). The county foresters we spoke with listed their top forestry management goals as being long-term sustainability, forest health, providing recreational opportunities, and economics (Table 1). Similar to other public lands, county foresters felt pressure from their governing bodies and the public to manage for many different, sometimes conflicting, uses.

Under *Wisconsin Statute 28.11*, Administration of County Forests, the county board has broad power to make decisions governing county forests. The county foresters in our focus group were the only public property foresters we spoke with who were actively pursuing enrollment in the carbon market, and they expressed that this was being supported by the local county board. County foresters were also the only focus group that listed carbon markets as a motivating factor for management practices. This focus group shared that the carbon

exchange that had approached them about enrollment framed this as payment for continuing their usual management activities. Some county board members viewed the fact that they could continue “business as usual” as a positive aspect of entering into a carbon exchange. In other words, it was viewed as “free money”.

County foresters listed Wisconsin Statute 28.11 as being the top policy that impacted their forestry management practices. This is the statute that describes the administration of county forests, which includes multiple uses, starting with “optimum production of forest products”.

LARGE-SCALE CORPORATE FORESTS

About 1.5 million acres, or 8.8 percent, of Wisconsin’s forest land cover is owned by large-scale (>1,000 acres) landowners. Historically, vertically integrated forest product companies (VIFPCs) owned a large portion of Wisconsin’s forested land, which they used to supply their mills. Today, only 5.4 percent of large-scale ownership forested land in Wisconsin is owned by VIFPCs (L’Roe and Rissman, 2016). Most of this land has been purchased by “investment owners”, who manage the forested land to create profit for investors, including timber real estate investment trusts (REITs) and funds managed by timberland investment management organizations (TIMOs). Both REITs and TIMOs manage real estate for the greatest possible return to investors. As of 2015, TIMOs owned 53.3 percent of all large ownership forest area in Wisconsin (Wisconsin DNR, 2017). A large portion of corporately held land in Wisconsin is enrolled in the Managed Forest Law (MFL) program.

We did not conduct a focus group for large-scale corporate landowners, and were not able to speak to anyone directly involved in TIMOs or REITs in Wisconsin. We interviewed consultants and others who work with these types of landowners, and we feel that there may be other opportunities to work with large-scale corporate landowners that are not identified here. Those that we did speak with told us that large-scale corporate landowners in Wisconsin are the most active ownership class in the voluntary carbon market.

Enrollment in carbon credits is one strategy that TIMOs and REITs use to increase their financial returns on timberland holdings in combination with traditional harvesting activities. As the voluntary carbon market grows, TIMOs and REITs will likely gain value and become more valuable to investors (Fernholz et al., 2007). Shareholders in a REIT or investors in a TIMO might be interested in investing in carbon credits for social reasons in addition to their monetary return. Increased enrollment of large-scale corporate forests into carbon credits could reduce conversion of these types of forest lands into agriculture or development, increasing carbon sequestration and storage in the long run.

UNITED STATES DEPARTMENT OF AGRICULTURE FOREST SERVICE LANDS IN WISCONSIN

The 1.5-million-acre Chequamegon-Nicolet National Forest (CNNF) comprises about 9.4 percent of Wisconsin's forested land. The CNNF covers parts of ten northern Wisconsin counties (Birdsey et al., 2014).



A salvage logging operation in the Chequamegon-Nicolet National Forest.

Since the CNNF is part of the USDA Forest Service (USDAFS), their management activities are dictated by federal guidelines, including the Clean Air Act of 1970, the Clean Water Act of 1972, the National Environmental Policy Act, and Executive Order 13514. Most of these acts do not directly address carbon sequestration or storage. Executive Order 13514, "Federal Leadership in Environmental, Energy, and Economic Performance," requires periodic reporting of net carbon stock changes on forest land as related to land management techniques (Birdsey et al., 2014). Under the *2012 Planning Rule*, every National Forest must have a forest plan. The CNNF is managed under the *2004 Land and Resource Management Plan*. Carbon is not an explicitly mentioned management goal or component of that plan. USDAFS has access to federal programs and funds that enable them to provide leadership and guidance to Wisconsin's forestry industry. This includes information on strategies for increasing carbon sequestration and storage. USDAFS staff at the CNNF and elsewhere in the USDAFS should be included in Wisconsin's efforts to maximize climate change mitigation through forestry work.

WISCONSIN STATE FORESTS

The Wisconsin Department of Natural Resources (DNR) manages about seven percent of forested land in Wisconsin (Public Sector Consultants et al., 2020). Despite owning a relatively small percentage of forested lands, the DNR is seen as a leader in forestry in Wisconsin.

“DNR lands are only about 1 million acres of forested lands out of 17 million [acres of total DNR property]. [We] are one of the smaller public agencies, [and are] looked at as leaders, but [DNR] is directed by the government and state legislature. We have to have authority [from them] in order to do something.” - Focus group participant

DNR foresters are seen as trusted sources of advice and information by every group in the forestry industry that we talked with. The DNR focus group members we spoke with indicated that they are aware of their position as the go-to experts in the state, but felt that they are also looking for guidance and support, especially related to sequestering and storing carbon in DNR forested properties.



Springtime at the Flambeau River State Forest.

DNR foresters indicated that they are managing forests primarily for overall forest health, followed by providing recreational opportunities to Wisconsinites, and economics (Table 1). Carbon sequestration and storage was not an explicit management goal for any of the foresters in the focus group, but was seen more as a co-benefit of healthy forest management. The focus group participants did express an interest in including carbon sequestration and storage in their management actions, but were looking for guidance on how to achieve this.

RENA JOHNSON/COURTESY NATIONAL ASSOCIATION OF STATE FORESTERS

DNR foresters listed many techniques that can be used to increase carbon sequestration and storage, but also noted that every technique has advantages and drawbacks. For example, extending rotations to allow trees to store more carbon as they age may have co-benefits related to wildlife that depend on old-growth forests, but also may lead to a loss of revenue from the stand as older trees can develop inconsistencies that reduce their value after harvest.

DNR foresters in the focus group, as well as others in the DNR, considered agroforestry techniques important to increasing carbon sequestration and storage in Wisconsin. Agroforestry is the overlap between agriculture and forestry; it brings tree and shrub cultivation and conservation into agriculture. One example of an agroforestry technique is the creation of riparian forest buffers along rivers and streams in agricultural land. This sequesters and stores carbon, and also filters farm runoff thereby protecting water quality.



PAUL LITTLETON, COURTESY OF THE SAVANNA INSTITUTE

An illustration of alley cropping, an agroforestry technique.

TRIBAL NATIONS FORESTED LANDS

Tribal Nations in Wisconsin care for about two percent of Wisconsin's forested land (Buntrock, 2021). There are twelve Tribal Nations in Wisconsin; the focus group for this report consisted of four Tribal foresters representing three Tribal Nations.

The focus group of Tribal foresters differed slightly from other groups in their primary forest management goals; while they overlapped with state, federal, and county foresters in their desire to manage for overall forest health, their top priority was preserving and enhancing traditional practices for Tribal Nations members. These practices included collecting sap for maple syrup production, hunting, and gathering of traditional herbs and foods. The Tribal foresters in the focus group were not as concerned with profits from the sale of timber compared with the other focus groups.



A hand crafted ininaanatig (maple tree) sap tap made from sumac, Bear Trap Creek, WI, 2022.

Like DNR, county forests, and other publicly-owned forests, Tribal foresters reported that public opinion had a large impact on their management choices. Tribal foresters receive input from Tribal Councils and other governing bodies within their own Tribal Nation that affect how they make management decisions, like the decision whether or not to enroll in a private carbon exchange. Similar to federal, state, and county forests, Tribal foresters did not list carbon sequestration or storage as an explicit management goal. When asked about this, one of the Tribal foresters in the focus group had this to say:

“Carbon sequestration isn’t necessarily a specified goal of ours, but I think... that we’re doing it already. Sustainable forest management inherently sequesters and stores carbon.” – Focus group participant

Research supports this statement. In comparison to other land ownership types, Tribal Nations’ forests in Wisconsin are managed in ways that result in higher rates of carbon sequestration (Waller and Reo, 2018). Although the Tribal foresters we spoke with did not list carbon as a top management goal, other goals that they did list are known to increase carbon sequestration and storage. Tribal foresters agreed that preventing forest fragmentation, which keeps carbon stored in trees, was a top goal. This was also the only focus group where every participant expressed a desire to sequester and store more carbon in forests through their management practices.

A couple of the Tribal foresters stated that they had been approached by carbon exchange programs, and had gone through the process of considering enrollment. The Tribal Nations represented in the group that had been approached by private carbon exchanges ultimately decided not to move forward. This was determined by a vote by the Tribal Council, although it was not a unanimous decision. A large sum of money was being offered that the Tribal foresters knew could greatly benefit the Tribal Nation community, but a few factors stopped the Tribal Council from moving forward.

Three of our focus group participants mentioned feeling that they could not trust the people who approached them about enrolling in the voluntary carbon market. These Tribal foresters had been told that they would not need to make any changes to their management techniques, and would simply receive a check for continuing to operate as they always had. This proposition seemed too good to be true to the foresters in the focus group. Another major concern brought up by Tribal foresters was the length of the proposed contracts, which were between 50 and 100 years. They were also concerned about who would be responsible if a forest fire or other incident occurred that caused the loss of the designated carbon before the end of the carbon credit contract. Another issue brought up by others outside of this group was the issue of Tribal sovereignty; some Tribal Nations representatives and members are concerned that entering into a contract with a carbon credit developer would cause a loss of control Tribal lands.

The biggest issue brought up in the focus group was the idea that these carbon credits would not actually have a positive impact on climate change mitigation, a reference to the concept of additionality in carbon credits. This feeling can be summarized by this quote from a focus group participant:

“My biggest complaint about the current private carbon market is that it does not promote additional carbon sequestration or storage. In most cases, it only provides payments to entities who already have large stores of carbon with no plans to change their management. The companies are allowed to pollute more by buying these credits, but the carbon would have been stored regardless. It’s a net loss. If the program paid for changed management or additional carbon sequestration, that could be beneficial but that is not how it currently is working in my experience.”
– Focus group participant

One focus group member mentioned the [National Indian Carbon Coalition](#) (NICC) as being a trusted entity that was helping their Tribal Nation navigate the decision-making process for entering into the voluntary carbon market. NICC is led by Bryan Van Stippen, a member of the Oneida Nation and former attorney for the Ho-Chunk Nation, who understands the concerns and issues that Tribal Nations must consider before entering into the carbon market. NICC works across the United States and Canada to facilitate the conversation between Tribal Nations and carbon credit developers.

Entering into the carbon market is not going to be a fit for every Tribal Nation. The Menominee Nation currently has a law in place banning entry of Tribal forests into the carbon market (Tribal Government of Menominee Indian Tribe of WI, 2018). Although the Nation does not want to commodify carbon sequestration and storage in its forests, there is evidence that tribal lands in northern Wisconsin have higher rates of tree regeneration, higher tree volume, retained higher plant diversity, and had higher rates of seedling survival compared to non-tribal lands (Waller and Reo, 2018).

URBAN FORESTS

Urban forest acreage cannot be measured in the same way as most other ownership types. Municipal forest cover encompasses some ownership in urban areas, but some municipal forests are located in rural areas. The statewide average of urban canopy cover is 29 percent (Wisconsin DNR, 2013). Although urban forests may have relatively small landcover in Wisconsin, they have great value because they provide forest access for a large portion of Wisconsin’s population.



Two birders enjoying a forested park owned and managed by the city of Madison.

The urban foresters we spoke with felt a bit left out of traditional forestry circles. The top priority for six out of seven focus group participants was public safety, a goal that was not mentioned in any of the other focus groups (Table 1). Much of the work of urban forestry is removing hazardous trees, but this creates an opportunity; our focus group participants shared that most urban trees that they remove are turned into wood chips, which may be distributed for use around the city. This is a short-term carbon storage wood product. In order to store carbon from urban trees for a longer period of time, which would be beneficial for climate change mitigation, it would be better if the wood from these trees were used in furniture, building materials, or other durable wood products. Urban trees present complex problems for harvesting and use, making them more expensive than typical timber to process.

Urban foresters expressed an interest in finding a higher use for urban wood than wood chips, but were not sure how to go about finding a company that would purchase and pick up the trees. They felt this would take more time and effort, and urban forestry departments are already short staffed.

Urban foresters listed their second most important management goal as expanding tree canopy in underserved neighborhoods. Trees provide numerous benefits to people in urban areas, including improvements in air quality and human health (Nowak et al., 2017). Expanding tree canopy coverage in cities could also contribute significantly to climate change mitigation; urban trees have faster growth rates and reach larger diameters than non-urban trees, thereby sequestering and storing more carbon (Nowak and Crane, 2002).

LARGER THEMES IN FORESTRY

For the creation of this report, the Wisconsin Academy spoke with 57 experts in forestry and adjacent industries. From these conversations we gleaned some themes and actions that would be transformative for Wisconsin's forestry industry. Here we provide recommendations that cut across many aspects of forestry in Wisconsin. These recommendations would impact many if not all ownership types.



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Many foresters said that their best learning opportunities come through in-person field trips where they can connect with other foresters and see the practical applications of best management strategies.

Information and Communications

Nearly every person we spoke with for this report stated that the information on carbon sequestration and storage in forestry is difficult to understand, hard to obtain, or overwhelming. This precluded many foresters and forest owners that we spoke with from attempting to manage for carbon or consider entering the carbon market. Even those who are very interested in increasing carbon sequestration and storage are not sure where to get information on management strategies.

Reducing the Carbon Footprint of Forestry Activities

While this report is focused on methods for carbon sequestration and storage in forestry, reducing the overall carbon footprint of forestry activities is another opportunity to reduce atmospheric carbon. Rising fuel costs are already prompting logging companies and mills to consider ways to increase efficiency and reduce fuel consumption, so moving towards lowering the carbon footprint of the entire forestry process may already be aligned with forestry industry trends.



JESS JAMES, COURTESY OF THE WISCONSIN ACADEMY

The Rothschild Biomass Cogeneration Plant, located at the Domtar Rothschild Paper Mill in Rothschild, Wisconsin. This facility is owned and run by We Energies, and uses wood biomass to provide power and steam to the accompanying paper mill.

Another way to reduce the carbon footprint of forestry activities could come in the burning of waste wood biomass for the purpose of kiln drying lumber. Most sawmills in Wisconsin use electrically-run kilns to dry timber after it is harvested to ready it for shipment. Some sawmills are using waste wood biomass, tree limbs and branches, or other parts of trees that are not suitable for lumber production, as fuel to heat wood kilns. We Energies established a biomass cogeneration plant at a paper mill in Rothschild, Wisconsin. The biomass plant runs off of waste wood created at the pulp mill. This plant provides for all the electricity needs at the mill, as well as steam needed for paper processing. This is an efficient way to take care of mill waste and reduce the carbon footprint of the sawmill; waste wood biomass is a renewable resource, whereas the factory would otherwise be using electricity generated from fossil fuels.

Storing Carbon in Durable Wood Products

While the majority of the research for this report has focused on carbon sequestration and storage in forests, there are also opportunities in forest products. Durable wood products are a way to store carbon past the life of a tree. We spoke to several people who work on developing new durable wood products, or who use these materials in construction. With consumers wanting to move away from single-use plastics, new wood-derived products are creating new opportunities in the forestry sector. Although consumers are driving a shift towards more innovative wood products, several experts we spoke with echoed the idea that public perception is a major barrier to increasing storage of carbon in wood.

For many people, even within the environmental sphere, trees are only seen as environmentally valuable if they are standing in a forest; many people outside of forestry do not perceive the carbon storage benefits of durable wood products. In addition, a few people we spoke with who work with building codes and wood construction materials pointed out that the public has a bias against wood as a building material. One mentioned that the Chicago Fire of 1871 is still a vivid image for many people from middle school history classes, and they associate wood buildings with fire damage. Although some wood building materials do present an increased fire risk, the risk can be low or comparable to more commonly used building materials (Barber, 2018). These negative perceptions could change through marketing and communication, and the positive benefits of durable wood products could be promoted.

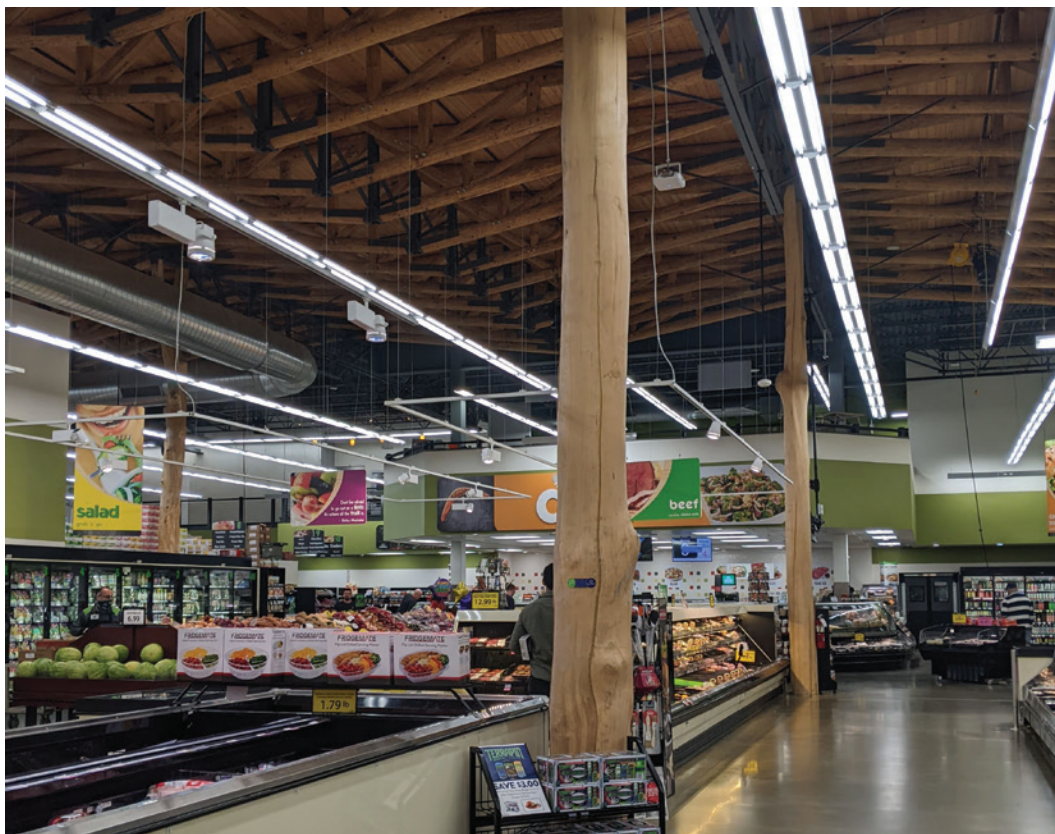
Replacing traditional building materials such as fossil-fuel intensive steel and concrete with engineered wood products and mass timber can reduce carbon emissions and increase carbon sequestration and storage (Allan and Phillips, 2021; Gu et al., 2021). Mass timber is a specialized wood product composed of layers of wood panels nailed or glued together, increasing its strength and stability and making it suitable as a building material.



NIKITA WERNER

Ascent MKE, the world's tallest mass timber building, located at 700 E Kilbourn Ave, Milwaukee, WI. The building was designed by Korb & Associates Architects. Ascent is 25 stories/284 feet tall. Ascent opened in the summer of 2022, and is a luxury apartment building

Mass timber has brought Wisconsin to the forefront of innovative, low-carbon construction. Many people we interviewed this report brought up the Ascent Building in Milwaukee, the world's tallest mass timber building. This first-of-its-kind building required a two-year process of research and seeking approvals (Udavant, 2021), partly due to the fact that Wisconsin's Commercial Building Code Council has not adopted the International Building Code's 2021 tall mass timber provisions. Currently, the construction of mass timber buildings above four stories is not allowed in Wisconsin without the pursuit of a variance by the architect and building owner. The Ascent developers conducted their own research and testing to demonstrate that a tall mass timber building can be safe and structurally sound.



LIZZIE GORDON, COURTESY OF THE WISCONSIN ACADEMY

Structural Round Timber (SRT) columns at Festival Foods near downtown Madison, Wisconsin. These columns were created from ash trees that had to be removed from a nearby city park.

In addition to mass timber, Wisconsin durable wood products can be used in non-structural interior elements. Madison has a beautiful example of locally-sourced wood incorporated into building materials at Festival Foods close to downtown. The grocery store has prominently displayed structural round timber (SRT) beams, created from urban wood harvested in a local Madison park. The results are aesthetically pleasing and carbon-friendly, storing about 100 tons of carbon (Whole Trees, 2015).

Increasing the use of mass timber and SRT in new buildings would increase demand for Wisconsin-sourced wood building materials, but the supply does not yet exist; one person who we spoke with pointed out that all of the mass timber for Ascent was sourced from Europe. The US has a very small number of mass timber suppliers, and there is only one mass timber producer in Wisconsin that creates glue-laminated timber; Ascent required the use of cross-laminated timber.

Creating more suppliers of mass timber in Wisconsin is an economic opportunity, especially if mass timber production facilities are located in towns that have experienced pulp and sawmill closures.

RECOMMENDATIONS

Recommendation 1: Revise Wisconsin DNR's Silviculture Handbook and Guidance to include recommended management strategies for carbon sequestration and storage in Wisconsin forests.

The Silviculture Handbook or future Silviculture Guidance are documents prepared by the DNR that provide guidance to Wisconsin foresters on how to manage forested properties with various goals in mind. This document is used by DNR foresters and by other foresters and property owners throughout the state. In its current form, the Silviculture Handbook does not contain guidance on how to manage for carbon sequestration or storage. The Silviculture Handbook is a living document that is revised frequently under the auspices of the Silviculture Guidance Team, an interdisciplinary group from across the forestry community. The Silviculture Guidance Team forms ad hoc subcommittees that enlist experts to contribute new information and chapters. The Academy recommends that the Silviculture Guidance Team forms a subcommittee on management strategies for carbon sequestration and storage in Wisconsin forests to write a new chapter, or embed recommendations throughout the handbook, with management strategies for carbon sequestration and storage under different conditions. We recommend that this subcommittee works closely with the team of authors behind the *Tribal Adaptation Menu* to ensure that strategies related to carbon consider knowledge from and impacts to Tribal Nations. This chapter should include:

- ▶ Management practices for forestry that will increase carbon sequestration rates and carbon storage while maintaining a healthy forest ecosystem based on the best available research
- ▶ Strategies for reducing carbon emissions from all aspects of forestry activities

Recommendation 2: Create a Wisconsin Forest Carbon Partnership (WFCP) to gather and distribute information about carbon sequestration and storage, and to provide a forum to share ideas, information, and foster collaboration across agencies and organizations.

One resounding theme from our discussions for this report was that the forestry world is vast, dispersed, and disconnected. Along with the need for clear and concise information, there is a great need for a place to share ideas and connect different sectors of the industry. The WFCP should include Tribal, state, federal, county, municipal, non-profit, industry (including mills, logging, carbon markets), and university representatives. This partnership should take on the following roles:

Identify priorities

- ▶ Work with all partners to create a set of priorities and goals for carbon sequestration and storage in forestry in ways that provide additionality and verifiability. Another top priority should be job creation in the forestry sector, and ensuring that changes to Wisconsin forestry with a shift towards carbon sequestration and storage are economically beneficial to Wisconsin communities. The partnership should also focus on justice and equitability in participation, discussion, and proposed actions.

Training, Education, and Communication

- ▶ Create fact sheets, produce webinars, and plan field trips for Wisconsin foresters and others in the industry to learn how to implement management strategies for carbon sequestration and storage in their work. Disseminate information through the channels outlined in Appendix I.
- ▶ Provide training opportunities for foresters, UW-Extension agents, and others on management strategies for carbon sequestration and storage in forestry.
- ▶ Provide training to MFL Certified Plan Writers (CPWs) on how to include management strategies for carbon sequestration and storage in MFL plans. In order to become a CPW, cooperating foresters must first attend a three-day CPW training course. This course should include material management strategies and potential markets for increasing carbon sequestration and storage in Wisconsin forests. CPWs also must attend one MFL update training session each year in order to maintain their CPW status. MFL update training sessions should include a section on management strategies for carbon sequestration and storage in Wisconsin forests.

Research and Information

- ▶ Conduct a study that analyzes the full carbon footprint of forestry and forest industry transportation activities under a variety of conditions, with a focus on opportunities for carbon emissions reduction. This will help direct forestry companies on the best and most efficient ways to reduce their carbon emissions.
- ▶ Create a working group on carbon credits on forested lands in Wisconsin. This group should inventory the enrollment of Wisconsin forested carbon credits, conduct education and outreach activities, and facilitate communications between forest owners, managers, and carbon credit developers.

Task Force Activities

- ▶ Create a task force within this partnership to promote the use of durable Wisconsin wood products in new construction products and the creation of production facilities for mass timber and other new durable wood products in Wisconsin, while considering existing forest product markets.
- ▶ Create a task force within this partnership to promote the use of agroforestry techniques on Wisconsin agricultural lands.

Funding and Investment

- ▶ Identify opportunities for funding from the Natural Resources Conservation Service (NRCS), USFS, and other sources, and work with partnership members to apply for and distribute funding for projects that increase carbon sequestration and storage in forestry practices. We recommend that this partnership creates a Regional Conservation Partnership Program (RCPP) through NRCS to fund forestry projects in Wisconsin that sequester and store carbon.

Recommendation 3: Communicate to institutional investors about the opportunity to include Wisconsin forest carbon credits in their investment portfolios.

Environmental, Social, and Governance Criteria investing is gaining in popularity with many investors. Shareholders in REITs and members of pension funds and other investors in TIMOs may be excited to learn that they can earn a return on investment while offsetting carbon emissions through the voluntary carbon market. This could be a selling point for these investment owners in Wisconsin's forested landscapes, and could provide increased investment security. If more corporate timberlands are enrolled in long-term contracts through the carbon market, there may be less conversion of forestlands to development or agriculture, as landowners would have a greater range of income generating tools to counter-act potential changes in forest product demand and pricing over time.

Recommendation 4: Create a carbon demonstration forest site run by Wisconsin DNR.

This site could be located anywhere in Wisconsin, but should be accessible to the public and have an educational component. This will be a place where public, Tribal, and private foresters can go to see carbon sequestration and storage techniques in action, learn how to manage for carbon and enroll in the carbon market, and where the public can learn about the value of forests for mitigating climate change. This demonstration site should emphasize the multiple co-benefits of management for carbon storage and sequestration.

Recommendation 5: Create incentives for small-scale private landowners to sequester and store carbon on their forested properties and reduce their carbon footprints.

Small-scale landowners are the largest ownership class of forests in the state, owning more than two thirds of all Wisconsin forested land (Dahal, 2018). Many of the carbon management strategies identified in the Silviculture Handbook update from recommendation one will be applicable to small-scale private landowners. The Wisconsin Forest Carbon Partnership (WFCP) recommended in recommendation two above should work with all partners to identify incentives for small-scale private landowners to reduce their carbon footprints and increase carbon sequestration and storage on their properties. This could come in the forms of reimbursements, tax incentives, grants for equipment purchasing or upgrades, or an incentive program similar to MFL that would give a tax break to small-scale private landowners who

develop and subscribe to a plan that increases carbon sequestration and storage and decreases the carbon footprint of their forestry activities.

Recommendation 6: Explore the potential of making carbon a commercial timber product under Wisconsin law.

Designating carbon as a forest product under Wisconsin law could encourage the use of management strategies for carbon sequestration and storage at county forests. If this change were made, county foresters would be in compliance with 28.11 if they were solely managing for carbon. This could potentially encourage more MFL enrollees to focus on carbon sequestration and storage within their MFL forest plans.

Recommendation 7: Adopt the tall mass timber provisions in the 2021 International Building Code into Wisconsin's Commercial Building Code.

Wisconsin's Commercial Building Code Council is currently weighing a decision on this. We recommend that Wisconsin joins the eight US states and handful of cities and counties have adopted the 2021 IBC tall mass timber provisions.

Recommendation 8: Give preference to proposals for Wisconsin state and municipal building construction that incorporate the use of Wisconsin-sourced and manufactured durable wood products.

Architects and developers will be incentivized to include Wisconsin-sourced durable wood products in plans for new government buildings if these proposals will receive higher consideration. Alongside this recommendation, the state and municipalities should work with partners in the forestry industry to educate the public about the safety and carbon benefits of durable wood materials in building construction.

Recommendation 9: Provide guidance to municipal forestry departments to prioritize finding the highest use for urban trees that must be removed.

We recommend creating an incentive program to help fund the additional logistics that go into these efforts, as well as other carbon sequestration and storage efforts undertaken in urban areas.

Recommendation 10: Provide incentives to help saw and pulp mills convert to waste biomass-fueled wood kilns and create biomass cogeneration plants.

This is a recommendation that some saw and pulp mills are already employing in Wisconsin, and other mills may be interested in adding a waste biomass-fueled wood kiln or biomass co-generation plant with additional incentives. Using waste biomass that is generated by mill activities for this purpose ultimately saves money for the mill by creating a use for its waste, reduces its carbon footprint, and saves money for the mill in the long-run.

CONCLUSION AND FUTURE DIRECTIONS

When we started the research process for this report, we initially focused more heavily on carbon credits and their potential for shifting Wisconsin forestry towards carbon sequestration and storage. Focus group participants helped us realize that carbon credits are one tool among many that can be used to encourage foresters and others to consider carbon sequestration and storage in their forest management practices. There is potential for carbon credits to have a positive impact on climate change mitigation, but their applicability for different ownership types and in different contexts is complicated. We took this into account in our recommendations.

Although we spoke with 57 people for this report, we felt that we were missing several perspectives. We were not able to speak to any large-scale landowners or representatives from the Wisconsin paper industry. We also wanted to speak with more Tribal foresters, but were unable to do so. In the future, as relationships are strengthened, we may supplement this report with more information from these segments of forestry.

Almost universally, the people we spoke with wanted to contribute to climate change solutions, and felt that forestry held great potential for offsetting fossil fuel emissions in Wisconsin. From these focus groups and interviews we heard two resounding themes: the need for clear guidance on how to increase carbon sequestration and storage through forestry practices, and the need for increased collaboration across sectors in order to achieve progress on climate change mitigation. The first two recommendations in this report address these themes directly, and we feel these are the most important actions needed to achieve progress on natural carbon solutions in Wisconsin forestry.

Some of the recommendations in this report pertain to forest products and their potential to store carbon. Many of the experts we spoke with were looking towards the future of forest products in Wisconsin, while also considering current markets and overall forest health. We urge the Wisconsin Forest Carbon Partnership, outlined in recommendation two, to take a holistic approach to the complexities of Wisconsin forestry.

There's an assumption that market demand for today's forest products will stay the same. This will likely not be the case. Some investment in new markets may be a carbon strategy so we have the ability to manage the forests to adapt to climate change and for the range of age classes we need to maximize sequestration rates and storage. - Matt Dallman, Deputy State Director, The Nature Conservancy in Wisconsin

Wisconsin's 17 million acres of forested land hold the potential to be part of global climate change solutions. Everyone we spoke to for this report felt excited about the future of sustainable forestry in Wisconsin. The recommendations in this report, if adopted, will help lay the groundwork for a forestry future that will include carbon sequestration and storage alongside traditional forestry activities. These recommendations are achievable for Wisconsin, but will require cross-sector collaboration.

It is clear that carbon emissions are the largest driver of climate change around the globe and reducing these emissions still poses the greatest relief, but there are many other ways to help offset emissions. Helping to alter one of the largest industries within the state to be a major player in carbon sequestration and storage is one big step toward the solution.

– Paul Koll, Stockbridge-Munsee Forester

We spoke to experts working in different sectors of forestry and forest products, and many felt isolated within their own circles. The Wisconsin Academy of Sciences, Arts & Letters is a convener for the Wisconsin Idea, and we will continue to work to bring Wisconsinites together to move the state forward into the next chapter of Wisconsin forestry which will include traditional forestry practices, the nurturing and growth of new forest product industries, and increased access to the many benefits of forests for Wisconsinites to enjoy.



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GLOSSARY

Some of the terms in this report may have multiple meanings; this glossary reflects the way these terms are used in the context of this report.

additionality

Measures that reduce greenhouse gas emissions that would not have occurred without the funding provided by carbon credits.

agroforestry

The intentional integration of forestry practices into agricultural systems to increase carbon sequestration and storage, along with other social and environmental benefits.

biomass

Organic material from plants. Often it refers to organic material that is burned to create heat or electricity. Biomass can come from trees, crops, industrial waste, or other plant-based sources.

carbon credit

A permit purchased through a carbon market that enables the purchaser to emit a certain amount of carbon dioxide or other greenhouse gas. One credit is equal to one ton of carbon dioxide.

carbon sequestration

The process of removing carbon from the atmosphere and depositing it into a reservoir. Trees and other plants take in carbon during the process of photosynthesis and store it as biomass (trunks, branches, foliage, and roots).

carbon storage

Carbon can be deposited in many different types of reservoirs and kept there for varying amounts of time. In the case of forests, carbon that is sequestered by trees can be stored in living and dead biomass, soil, or wood products.

certified plan writer (CPW)

A person who is certified with the Wisconsin DNR, and who receives additional training on how to prepare Managed Forest Law plans.

cross-laminated timber (CLT)

A pre-fabricated, large-scale, solid engineered wood panel composed of planks and layered wood, where each layer is oriented perpendicular to the previous layer.

durable wood products

Building, furniture, and other wood materials constructed from solid wood (as opposed to a wood product constructed from composite materials). Durable wood products tend to last longer than other types of wood products, storing carbon for a longer period of time.

glue-laminated timber

An engineered wood product where layers of timber are glued together, with the grain of each layer facing the same direction.

mass timber

An engineered wood building material composed of layers of wood that are bonded together. A building can be referred to as a mass timber building if its primary load-bearing structure is made of either solid or engineered wood.

non-industrial forest landowner (NIPF)

An individual, group, association, Tribal Nation, or other private legal entity that has decision-making authority over a forested property. This includes small-scale family forest owners. This does not include corporate ownerships such as TIMOs and REITs.

real estate investment trust (REIT)

A company that owns and may operate income-producing real estate, which can include timberlands.

structural round timber (SRT)

Unmilled, solid wood logs that can be fabricated with steel connections to provide structural support in a building.

timberland investment management organization (TIMO)

An investment management tool where managers focus on maximizing the value of timberland assets. TIMO investors must contribute a minimum investment of \$100,000, meaning that most TIMO owners are pension funds, insurance companies, corporations, foundations, financial institutions, universities, or endowments.

urban wood

Lumber produced from trees that were removed for reasons other than harvest of their lumber. Within this report, this typically refers to trees removed from urban areas.

vertically integrated forest product companies (VIFPCs)

Wood products companies that own substantial forestland that supplies their pulp and sawmills.

voluntary carbon market

Individuals, companies, and organizations that purchase carbon credits in order to offset carbon emissions to meet their own emissions reduction goals (not goals set by an outside entity). Certification programs, such as the Verified Carbon Standard, provide standards for project developers to follow in order to generate carbon credits, which are purchased voluntarily. The United States is in a voluntary carbon market.

wisconsin's managed forest law (MFL)

A landowner incentive program that provides a tax break to enrolled forest owners in exchange for a commitment to sustainable forest management.

wood biomass

The organic material of a tree. Often woody biomass is categorized for its ability to be converted to heat or energy through direct combustion or gasification. This could come from firewood, wood waste produced at a mill, sawdust, manufactured wood pellets, or a variety of other products. Some people consider this to be a renewable form of energy, as trees can be replanted. Others feel this is a misleading classification, as creating heat or energy from wood biomass can outpace carbon sequestration through replanting efforts.

BIBLIOGRAPHY

Allan, K., Phillips, A.R., 2021. Comparative cradle-to-grave life cycle assessment of low and mid-rise mass timber buildings with equivalent structural steel alternatives. Sustainability (Switzerland) 13(6), 3401. <https://doi.org/10.3390/su13063401>

Anderson, B., 2021. Carbon in Wisconsin Forests. Madison, WI. <https://forestrynews.blogs.govdelivery.com/2021/10/07/carbon-in-wisconsin-forests/> (Accessed 5.18.22)

Barber, D., 2018. Fire safety of mass timber buildings with CLT in USA. Wood and Fiber Science 50, 83–95. <https://doi.org/10.22382/wfs-2018-042>

Birdsey, Richard, Pan, Yude, Janowiak, Maria, Stewart, Susan, Hines, Sarah, Parker, Linda, Gower, Stith, Lichstein, Jeremy, McCullough, Kevin, Zhang, Fangmin, Chen, Jing, Mladenoff, David, Wayson, Craig, Swanston, Chris, 2014. Past and Prospective Carbon Stocks in Forests of Northern Wisconsin: A Report from the Chequamegon-Nicolet National Forest Climate Change Response Framework. Newton Square, PA. <https://doi.org/10.2737/NRS-GTR-127>

Buntrock, C., 2021. Wisconsin's Forest Resource: Past, Present and Future. Wisconsin Department of Natural Resources. Forestry News. <https://forestrynews.blogs.govdelivery.com/2021/07/26/wisconsins-forest-resource-past-present-and-future/> (Accessed 5.18.22).

Dahal, R., 2021. Economic Contribution Of Forest Products Industry To Wisconsin Economy. Wisconsin Department of Natural Resources. Madison, WI.

Griscom, B.W., Adams, J., Ellis, P.W., Houghton, R.A., Lomax, G., Miteva, D.A., Schlesinger, W.H., Shoch, D., Siikamäki, J. v., Smith, P., Woodbury, P., Zganjar, C., Blackman, A., Campari, J., Conant, R.T., Delgado, C., Elias, P., Gopalakrishna, T., Hamsik, M.R., Herrero, M., Kiesecker, J., Landis, E., Laestadius, L., Leavitt, S.M., Minnemeyer, S., Polasky, S., Potapov, P., Putz, F.E., Sanderman, J., Silvius, M., Wollenberg, E., Fargione, J., 2017.

Natural climate solutions. Proceedings of the National Academy of Sciences 114, 11645–11650. <https://doi.org/10.1073/PNAS.1710465114/-/DCSUPPLEMENTAL/PNAS.1710465114.SAPP.PDF>

Gu, H., Nepal, P., Arvanitis, M., Alderman, D., 2021. Carbon Impacts of Engineered Wood Products in Construction, in: Gong, M. (Ed.), Engineered Wood Products for Construction. IntechOpen. <https://doi.org/10.5772/INTECHOPEN.99193>

Harmon, M., 2001. Carbon sequestration in forests: addressing the scale question. Journal of Forestry 99, 24–29. <https://doi.org/10.1093/jof/99.4.24>

Herrod, T., Katz, M., 2020. Milwaukee County, Wisconsin 2018 Community Greenhouse Gas Emissions Inventory. ICLEI Local Governments for Sustainability <https://urbanmilwaukee.com/wp-content/uploads/2020/12/20-889-2018-COMMUNITY-GREENHOUSE-GAS-EMISSIONS-INVENTORY.pdf>

Liu, S., Liu, J., Wu, Y., Young, C.J., Werner, J., Dahal, D., Oeding, J., 2014. Baseline and projected future carbon storage, carbon sequestration, and greenhouse-gas fluxes in terrestrial ecosystems of the eastern United States, in: Zhu, Z., Reed, B.C. (Eds.), Baseline and Projected Future Carbon Storage and Greenhouse-Gas Fluxes in Ecosystems of the Eastern United States. U.S. Geological Survey, Reston, VA, pp. 115–156.

L’Roe, A.W., Rissman, A.R., 2016. Changes in Wisconsin’s Large Private Forests, 1999–2015: Land Ownership, Conservation, and Recreational Access. *Society & Natural Resources* 30, 63–78. <https://doi.org/10.1080/08941920.2016.1180729>

Malmsheimer, R.W.; Heffernan, P.; Brink, S.; Crandall, D.; Deneke, F.; Galik, C.; Gee, E.; Helms, J.A.; McClure, N.; Mortimer, M.; Ruddell, S.; Smith, M.; Stewart, J. 2008. Forest management solutions for mitigating climate change in the United States. *Journal of Forestry* 106(3), 115–117.

Nowak, D.J., Bodine, A.R., Hoehn, R.E., Rideout, R., Stoltman, A., Lorentz, L., 2017. Urban Forests of Wisconsin. Wisconsin Department of Natural Resources. Madison, WI.

Nowak, D.J., Crane, D.E., 2002. Carbon storage and sequestration by urban trees in the USA. *Environmental Pollution* 116, 381–389. [https://doi.org/10.1016/S0269-7491\(01\)00214-7](https://doi.org/10.1016/S0269-7491(01)00214-7)

Ontl, T.A., Janowiak, M.K., Swanston, C.W., Daley, J., Handler, S., Cornett, M., Hagenbuch, S., Handrick, C., McCarthy, L., Patch, N., 2020. Forest management for carbon sequestration and climate adaptation. *Journal of Forestry* 118, 86–101. <https://doi.org/10.1093/jofore/fvz062>

Public Sector Consultants, Buntrock, C., Dahal, R., Dhungana, S., 2020. Forest Products Industries’ Economic Contributions: Wisconsin. <https://doi.org/10.13140/RG.2.2.30824.80641>

Tribal Government of Menominee Indian Tribe of WI, 2018. Chapter 270: Carbon Credits. <https://www.menomineeensn.gov/GovernmentPages/Documents/AnnualReports/2018%20MITW%20Annual%20Report.pdf>

Udavant, S., 2021. A Building of Timber: Milwaukee’s Ascent tower could become the future of sustainable construction. *The Milwaukee Independent*.

U.S. Energy Information Administration, 2022. Independent Statistics and Analysis, <https://www.eia.gov/state/?sid=WI> (accessed 5.18.22).

Waller, D.M., Reo, N.J., 2018. First stewards: ecological outcomes of forest and wildlife stewardship by indigenous peoples of Wisconsin, USA. *Ecology and Society* 23, 45. <https://doi.org/10.5751/ES-09865-230145>

Wisconsin County Forests Association, 2022. <https://wisconsincountyforests.com/> (accessed 5.18.22).

Wisconsin Department of Natural Resources, 2013. Wisconsin Community Canopy Cover. <https://dnr.wisconsin.gov/topic/urbanforests/ufia/landcover> (accessed 5.18.22)

Wisconsin Department of Natural Resources, 2017. Wisconsin's Managed Forest Law: A Program Summary. <http://www.co.forest.wi.gov/docview.asp?docid=24817&locid=145>

Whole Trees, 2015. Case Study: Festival Foods Grocery. Madison, WI. <https://wholetrees.com/case-study-festival-foods/> (accessed 5.18.22).

Woodall, C.W., Coulston, J.W. Domke, G.M., Walters, B.F., Wear, D.N., Smith, J.E., Andersen, H., Clough, B.J., Cohen, W.B., Griffith, D.M., Hagen, S.C., Hanou, I., Nichols, M.C., Perry, C.H., Russell, M.B., Westfall, J.A., Wilson, B.T., 2015. The U.S. Forest carbon accounting framework: stocks and stock change, 1990-2016. Newtown Square, PA. <https://doi.org/10.2737/NRS-GTR-154>

APPENDIX I:

LIST OF FORESTRY-FOCUSED MEDIA OUTLETS SHARED BY FOCUS GROUPS AND INTERVIEWEES

We asked all focus group participants and most interviewees to share where they get information and which organizations or people they most trust to deliver accurate information on forestry practices. The Wisconsin Academy will work with our partners to disseminate the recommendations from this report to the organizations and outlets in this list.

American Forest Foundation	Sustaining Forest Education Cooperative
Bureau of Indian Affairs	University of Minnesota trainings
Wisconsin Department of Natural Resources	University of Wisconsin Extension
The Connection (internal newsletter)	University of Wisconsin-Madison trainings
The Resource (internal newsletter)	U.S. Department of Agriculture
Wisconsin DNR Tribal Liaison	U.S. Environmental Protection Agency
Dovetail Partners	U.S.D.A. Forest Service
Facebook - Wisconsin Loggers	Walnut Council
Forest Cast – U.S. Forest Service podcast	Wisconsin Alliance of Forest Owners
Forest Stewards Guild	Wisconsin Urban Forestry Council
Intertribal Timber Council	Wisconsin Initiative on Climate Change
Northwoods Alliance Inc/Partners in	Impacts
Forestry Coop	Wisconsin Arborists Association
Natural Resources Conservation Service	Wisconsin County Forests Association
Society of American Foresters	Wisconsin Woodland Owners Association
SilviCast (podcast from UW-Stevens Point	Wisconsin Tribal Conservation Advisory
Wisconsin Forestry Center)	Council
StatQuest Podcast	

The foresters we talked with shared a preference for receiving communications in the form of concise fact sheets with sources listed that they could look into if they wanted more information. Many of them also stated that on-demand webinars and in-person interactions, such as field trips organized by one of the groups above, were useful ways to learn as well.

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About the Wisconsin Academy of Sciences, Arts & Letters

The Wisconsin Academy creates opportunities for people to connect, learn, and collaborate to improve life in Wisconsin. The Wisconsin Academy showcases contemporary Wisconsin art at the James Watrous Gallery, examines science and culture in Wisconsin People & Ideas magazine, and explores pathways to a sustainable future through the Climate and Energy Initiative. The Academy Courses and public talks provide opportunities to learn and explore, while making connections with curious and creative people across Wisconsin. The Academy recognizes excellence through the annual Fiction & Poetry Awards and Fellows Awards for leadership in and across disciplines. We also support the Wisconsin Poet Laureate and many other endeavors that help the Academy create a better world by connecting Wisconsin people and ideas.



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