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Emerging Markets for Wood and Their Positive Impact on Forest Resource Management

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by the National Association of State Foresters

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Introduction: Good Markets are Critical to Good Forest Management

In debates over the well-being of the Nation's forests some assume that harvesting trees for wood products represents a potential threat to their sustainability and to the environmental and social benefits forests provide. These concerns are often expressed in relation to new, emerging markets for wood. Using wood for renewable energy has been central to many of these debates, but other emerging uses are not immune to possible criticism, including the value of stored carbon in wood products.

NASF represents the heads of state forestry agencies for all 50 states, the US Protectorates and Territories and the District of Columbia. Collectively, they promote the proper management and protection of state, local government and privately-owned forests and are frequent collaborators in the management of federally owned forests. NASF ascribes to the view that benefitting from the economic value of forests does not threaten environmental and social values as much as it is key to supporting the delivery of environmental and social benefits.

Keeping forestland as working forests is paramount to the ability of our forests to provide the economic, environmental, and social benefits that are essential to society. In order to retain and properly care for their forests, landowners need sources of revenue. Though forests can provide other forms of economic return - such as from recreation, appreciated land values and ecosystem services - harvesting trees for wood products is the predominate source of revenue for forest owners. This has the added benefit of generating economic opportunities for businesses, whose earnings are often re-invested in the forest. These businesses are the economic foundation for many local communities. For this reason, NASF believes it is important to support the research and development of new markets for wood fiber. Having highly diverse markets increases the options for management by allowing the landowner to remove those trees of a certain size and/or species under plans that are more likely to result in improved health and vigor.

Within this view, NASF also believes that the institutions and enterprises that provide forest management expertise are equally critical to ensuring sustainability. Wood should be harvested in a carefully planned manner using best management practices that embody sound science, represent community values, continue to provide important environmental benefits, and reflect responsible economics. Research and teaching institutions, private landowners, natural resource agencies, consulting foresters, forest owning/managing businesses, natural resource related non-profits and certification bodies all play an important role that must evolve and grow as demand for wood may well increase when new uses emerge.

The Role of Active Management: Economic, Environmental, and Social Benefits to Society

Approximately one-third of the United States is forested, about 765 million acres. Of those acres, 58% is privately owned and can be broken down further with 36% owned by families or individuals (272 million acres) and 24% (156 million acres) by larger timber-owning/managing businesses. Of the remaining amount, the federal government owns 31% (238 million

acres),and states, local governments, tribes and other private entities such as land trusts own 13% (99 million acres.)[1]

Contrasting these percentages is the fact that, of the estimated 12 to 13 billion cubic feet of wood removed from US forests annually, 90% derive from privately owned lands – 57% from lands owned by families or individuals and 33% from larger holdings owned by business.[2] The total volume removed reflects a continuing downward trend from a 1986 high of nearly 20 billion cubic feet. The standing volume of timber in the US continues to increase by some 25 billion cubic feet per year Since the 1950's total volumes in the US have increased by over 50%.[3]

Volumes increase as stands of trees grow from seedling to sapling to pole and then sawtimber. With these increases, individual trees in the stand face greater competition for water and nutrients. Competition naturally thins a stand to some extent, but not enough to prevent overall tree growth from stagnating as individuals become over-crowded. This over-crowded condition creates stress in a tree, making them more vulnerable to disease and insect problems. Highly dense stands also increase the likelihood of more destructive wildfires and these occurrences have been further exacerbated by climate change.

Thus, though increases in standing volume sound good, continued increases eventually manifest themselves in a number of problematic ways. At roughly 10 billion cubic feet annual mortality currently is nearly equal to annual harvests. Though they currently are adding carbon, it is projected that the total carbon stock in US forests will begin to decline by 2070 due to a loss of forest cover and an increase in the relative age of standing timber.[4] Additionally, where harvesting is reduced, age class distributions become skewed towards mature timber, negatively impacting wildlife species that are dependent on the brush-dominated, high sunlight habitat produced in recently harvested areas.

The values at risk are substantial. Standing timber in US forests represent a critical natural resource for providing the nation's wood and paper products industry – an industry that contributes 4% of the nation's manufacturing GDP. It's estimated that 53% of the lower 48 states' drinking water originates from forests.[5] Approximately 11% of the nation's annual carbon emissions are offset each year by the additional carbon stored in US forests and wood

[1] US Forest and Management, In Focus Report, Congressional Research Service. December 16, 2021.
[2] Estimated from personal correspondence provided by Dr. Brett Butler, US Forest Service Family Forest Research Center. January 2016.
[3] Forest Resources of the United States, 2017: A Technical Document Supporting the Forest Service Update of the 2020 RPA Assessment. GTR WO-97, March 2019. S Oswalt, et. al.

4 Future of America's Forests and Rangelands – Forest Service 2020 Resources Planning Act Assessment. GTR WO-102, Washington, DC.
[5] https://www.fs.usda.gov/research. July 2023https://www.fs.usda.gov/research. July 2023.

products.[6] Recreational opportunities, wildlife habitat and scenic landscapes are also important public benefits derived from forests.

Historically, forest disturbances have created very dynamic, ever-evolving forest ecosystems, and have served to maintain densities and volumes at healthier levels. These disturbances included floods, wind events, lightning-caused fire and human-caused fire. Flood control has sharply curtailed the influence of water. Today's human population density and the negative impact that fire has on high value forest products limit the amount of acceptable prescribed burning and role of wildfire. Obviously, we can't stop wind events. In lieu of these natural disturbance factors, the best method available for controlling stand density and balancing age classes is active forest management (e.g., carefully planned tree removal and prompt regeneration). The question then becomes does the landowner benefit most from a commercial harvest or non-commercial means.

The Value of Commercial Harvest: Strong Timber Markets Create Opportunities

Commercial harvests make long-term forest sustainability possible. Strong timber markets create opportunities for private and public landowners, to provide the economic, environmental, and social benefits that we all depend on. Yet, their desired outcomes – wildlife habitat, forest health, tree species diversity, fire risk reduction – are often best accomplished through tree removal and where tree removal generates revenue more harvest and reforestation activities can be accomplished. Other desired outcomes, such as carbon storage, access and recreational developments, could benefit from a source of revenue as well. Successful outreach to landowners that brings them in contact with trusted forestry advice are 13% to 17% more likely to intend to harvest timber in the next 5 years. And landowners who have harvested timber are more likely to have improved wildlife habitat on their land.[7]

Businesses owning timberland want to realize a competitive rate of return on their investment. Diverse, robust markets are an absolute necessity for achieving this objective. Where competitive returns are not achievable there is pressure for those lands to be converted to other uses. Virtually all the largest landowners are certified to either the Sustainable Forestry Initiative Inc. standard, or the Forest Stewardship Council standard. Either certification program requires land management activities that provide for environmental protections and social accountability. Given this fact, NASF views these lands as appropriately and sustainably managed. The presumption is that these lands will remain as forests as long as businesses can achieve their objective of competitive returns.

NASF supports budget and policy changes that accelerate the scope and scale of active management on federal lands in order to restore health, reduce fire risk and become a more meaningful contributor to the economies of local communities. Unfortunately, even though

[6]Forest Resources of the United States, 2017: A Technical Document Supporting the Forest Service Update of the 2020 RPA Assessment. GTR WO-97, March 2019. S Oswalt, et. al.

[7] Evaluation of the Effectiveness and Reach of the Educational Programs and Technical Assistance Activities of the U.S. Forest Service, Forest Stewardship Program. Technical Report. June 2013. B Butler et. al.

there is more broadscale agreement around those objectives, federal land managers in some regions are challenged by a lack of markets. Without markets commercial harvests are not feasible. Often, markets for the smaller material that needs removal are lacking, but increasingly there is a lack of markets for the kind of large timber that can be found on many public lands. This greatly limits the extent to which active management can be implemented since most activities generate cost rather than at least some off-setting revenue.

Emerging Markets: Opportunities for Sustainable Commercial Harvests

Emerging markets for wood can serve to complement traditional forest products, thus expanding wood demand and offering landowners more opportunities for active management through commercial harvests. Following are brief descriptions of several promising new uses for wood that have the potential to ultimately result in the improved management of the Nation's forests.

Demand for these new products is driven by a number of factors that likely will become even more prominent in the future. These include:

- Subsidized power production in Europe where government policy is focused on eliminating coal-fired operations over a period of time
- Environmental concerns over the longevity of plastics and their continued accumulation in oceans and landfills
- A desire for building materials that effectively sequester carbon and often generate a smaller carbon footprint during manufacture and use.
- Desires to reduce dependence on fossil fuels in favor of renewable sources to meet transportation needs.

WOOD PELLETS PRODUCTION

The production of densified wood pellets, particularly for energy generation, has grown dramatically in response to public policy objectives to lower dependence on fossil fuels. A small percentage of pellets are used for wood fired heating. Pellet manufacturing facilities in the U.S. continue to expand, despite ongoing challenges from specific interests as to whether using pellets for fuel is carbon neutral. A recent article from the journal *Scientific Reports* states that **"Our estimates offer robust evidence that the wood pellet industry has met the overall condition of forest carbon neutrality."**[8]

About 18% of the feedstock would be characterized as pulpwood or roundwood and the remaining represented some form of residual material, for example sawdust from a sawmill. About 80% of the pellet production is exported.[9]

[8] 14 November 2022 Impacts of the US southeast wood pellet industry on local forest carbon stocks Francisco X. Aguilar , Houston Sudekum, Ronald McGarvey, Benjamin Knapp, Grant Domke & Consuelo Brandeis Scientific Reports 12, Article number: 19449 (2022)

[9]Monthly Densified Biomass Fuels Report. U.S. Energy Information Administration. May 2018.

CELLULOSIC BIOFUELS

The US uses over 133 billion gallons of gasoline, 42 billion gallons of diesel and 22 billion gallons of jet fuel every year. Though gasoline consumption is expected to decline over time because of the increasing presence of electric vehicles, the demand for jet fuel is expected to increase and the demand for diesel is projected to remain somewhat constant because of its use in trains and large vehicles. It has been estimated that, potentially, 1 billion tons of sustainably grown biomass could produce enough fuel to replace 25% to 30% of US demand.

Currently, cellulosic biomass feedstock costs outcompete average crude oil costs, but refining costs are substantially higher. As a result, there are only a limited number of operational facilities as research continues on processes that economically refine cellulose, hemicellulose and lignin into fuel. It is presumed at this point that successful wood-based processes will focus on jet fuels and the incidental production of marketable by-product chemicals.[10]

BIOCHAR

A by-product from the production of biofuels manufactured through pyrolysis, biochar is a very fine charcoal-like material used to improve soil characteristics. Pyrolysis involves heating wood to extremely high temperatures without oxygen, as the presence of oxygen would cause wood to burn, In this instances it converts into mostly pure carbon. The best biochar is produced at temperatures above 350 degrees centigrade. As a soil amendment it lowers acidity and tightly binds undesirable metals so that they are not taken up by plants or leached from the soil. It can also increase soil porosity in tight clays or reduce porosity in soils that drain too quickly such as sand. It creates a favorable medium for the production of micro-organisms that are beneficial to trees.

Importantly, biochar is principally carbon that is near permanently stored. As such its greatest potential may be its use for long term carbon sequestration.[11]By working biochar into the soil a source of nearly pure carbon is being incorporated that is not subject to micro-biological activity. When, for example, wood or some other organic material is incorporated into the soil micro-organisms will eventually break that material down into other compounds, including carbon dioxide which can be released back into the air during soil disturbance.

Where readily available, it has developed market value. Reclamation of oil drilling sites and as a soil amendment for high value crop operations are common uses. Current research is focused on mobile kilns that can be used on site at projects conducting needed thinning of low value timber.[12]

[10] Presentation by Josh Schaidle, National Renewable Energy Laboratory, to NASF. February 2017.
[11] Biochar in the Forest, 2023 https://forestry.umn.edu/events/biochar-forest-update
[12] Presentation by Darren McAvoy, Utah State Biomass Resources Group, to NASF. February 2017.

STORED CARBON AS A CRITICAL COMMODITY

As the need to address climate change becomes more and more, the role of carbon sequestered by trees has become an important part of the solution. Nearly half of the volume by weight in dried wood is carbon. A recent report states that "Between initial construction and likely repairs, the wood-based components in an average-sized US home can store nearly 100 metric tons of CO2." Given that there are approximately 140 million homes in the US, these buildings could be storing roughly 14 billion metric tons of CO2, and that should only increase as the population of the US continues to grow.[13] Given the multitude of products made from wood, though admittedly some products remain intact longer than others, opportunities to create wood products from sustainably managed forests and woodlands must be considered a viable component to addressing climate change.

TORREFACTION

Torrefaction is also a pyrolysis process, conducted at lower temperatures than for biochar, that yields a product similar to coal. It makes wood a more practical substitute for coal by being easier to grind, simplifying storage and eliminating moisture uptake issues. Though the weight loss in the process is 30%, the energy loss is only 10%. Its energy profile is improved by the fact that torrefaction generates a combustible gas that can be recirculated back into the system and burned to provide heat.[14]

It has the potential to produce a renewable source of fuel for gasification processes used to make biofuels. Analysis has shown that it could also be a more economical alternative for the densified pellet market in places where that market is still developing.[15]

MASS TIMBER

Mass timber is a building system that uses mostly engineered wood building materials that are structural and can be used as floors, walls, ceilings, and beams. These products include Laminated Veneer Lumber (LVL), Glulam, Nail or Dowel Laminated Timber (NLT or DLT), Mass Plywood Panels (MPP), Veneer Laminated Timber (VLT), and Cross Laminated Timber (CLT). CLT is produced in large panels by assembling successive layers of boards perpendicular to one another. The result is a product that rivals steel in strength and fire resistance. MPP and VPT are similar panels, just beginning with veneers and not boards. Mass timber is lighter in weight than concrete. CLT and other mass timber products can replace concrete and steel in tall structures.[16] Additional benefits include carbon storage and reduced CO2 fossil carbon emissions during manufacturing and construction. Though more commonly produced and utilized in Europe since the late 1990's these products are rapidly gaining ground in the United States with more than 2000 buildings or homes constructed or planned since 2010. The US

[13] John Green. *America's Forests and Its Forest Products Can Store Carbon for Decades*. Forests2Markets.October 5, 2022.
[14] Biomass Technology Group website www.btgworld.com
[15] Renewable and Sustainable Energy Reviews. W. Chen et. al. Volume 44, pp847 – 866. February 2015.
[16] Advanced Wood Products Manufacturing Study for Cross-laminated Timber Acceleration in Oregon and Southwest Washington. Pacific Northwest Manufacturing Partnership. 2017

wood products industry now has manufacturing facilities in the Pacific Northwest and the Southeastern US.

The International Code Council's (IBC) codes across the US were updated to handle mass timber buildings, with small changes made in 2015 and 2018, and major revisions were included in 2021 for buildings taller than 85 feet. These codes may or may not be accepted in every state or jurisdiction. However, since they are published, their content may provide an "alternate means" of acceptance with building code officials in jurisdictions where the codes are not yet accepted.

The tallest mass timber building in the US in 2023 is the Ascent building in Milwaukee, Wisconsin which is 25 stories tall;some of the lower stories are concrete. However, most mass timber buildings are much lower than the Ascent. Mass timber buildings are being planned or already constructed in every state.

While widespread use of mass timber is good news for the economies in timber-producing regions of the country, it also promises some distinctive benefits for builders, communities and the environment.

Builders, pressured by persistent labor shortages, are finding a wider pool of workers able to install mass timber panels safely. They also report significant labor savings and more efficient and safe job sites. Construction times are reduced by "just-in-time" delivery to job sites and quick installation of panels.

It is important to note that building with mass timber systems is different from normal construction, and not all designers, engineers, or construction firms are comfortable with the new system. Substantial resources are available for free to all parties, from developers down to subcontractors to ensure anyone interested can be trained in the design and safe installation of mass timber projects.

With mass timber building systems communities experience less noise and dislocation during construction and, by avoiding the usual stockpile of dimension lumber on site, fire risks are reduced. The positive environmental attributes of mass timber buildings include low energy intensity during manufacturing, superior energy efficiency in mass timber structures, and better management of a renewable resource. While mass timber products are wood and therefore combustible, they have high fire resistance.

There are also efforts underway, in Georgia for example, that are evaluating the value of carbon sequestered in these buildings and whether there is a market or credit system for sequestered carbon stored in the building for the long term.

NANOTECHNOLOGY

There are two different categories of cellulose nanomaterials; cellulose nanocrystals and cellulose nanofibrils, that are produced through different processes. The processes produce microscopically small particles that can be assembled into materials with highly desirable properties. They are lightweight, strong, stable and stiff. Potential applications include use as a material in paint, coatings, adhesives, a cement additive, lightweight packaging, cell phones manufacturing, composites that can replace plastics in many uses, wound covering hydrogels and others.[17]Adding nanocrystals to concrete mixes can reduce the volume of cement needed by 15% because of the final material's added strength.

Conclusion

Markets for wood are critical to maintaining the health and sustainability of forests in the United States. They enable the economic, carefully planned harvest of trees to control stand density and create forests that have a more balanced diversity of age classes, which is important to wildlife habitat diversity, forest resilience and providing a more even flow of sustainable wood fiber for harvesting. As harvest levels continue to decline nationally and the resultant increased volumes pose forest health problems, it is important to support the research and development of emerging wood markets, accompanied by growth and evolution of institutions that support science-based sustainable management.

A number of new uses are being pursued and NASF is encouraged that they have the potential to increase wood demand and thereby increase the options for active forest management. Though most are not currently being produced by "production-level" operations these new uses can, at some point, be scaled up to an industrial level that generates consistent and substantial wood fiber markets.

[17] Cellulose Nanomaterials – A Path Towards Commercialization Workshop Report. USDA Forest Service. August 20144.