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

A Policy Statement approved by Resolution
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 these debates, but other emerging uses are not immune to possible criticism.

The National Association of State Foresters (NASF) is comprised of the heads of the forestry agencies for all fifty states, the District of Columbia and the U.S. territories. Collectively, they promote the proper management and protection of state 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. 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, nearly 800 million acres. Of those acres, 56% is privately owned and can be broken down further with 38% owned by families or individuals (299 million acres) and 18% (149 million acres) by larger timber-owning/managing businesses. Of the remaining amount, approximately 33% (265 million acres) are owned by the federal government and 11% (87 million acres) by state or local governments.[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[2] – 57% from lands owned by families or individuals and 33% from larger holdings owned by business.[3] 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, with sawtimber-sized trees increasing at a higher rate than poles, saplings or seedlings in the North and South. Since the 1950's total volumes in the US have increased by over 50%.[4]

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.

Thus, though increases in volume sound good, continued increases eventually manifest themselves in a number of problematic ways. From 2008 to 2012 the equivalent of over forty million acres of forest mortality were caused by insects and diseases.[5] Though they currently are adding carbon, it is projected that the total carbon stock in US forests will begin to decline by 2040 due to a loss of forest cover and an increase in the relative age of standing timber.[6] A recent American Forest Foundation report states that in 11 western states 40% of the land that is critical to protecting water supplies, and also at high risk of extreme fire occurrence because of the lack of active management, belongs to families and individuals.[7] Additionally, where harvesting is reduced, age class distributions become skewed towards mature timber,

[1] Research Supporting Stemming the Loss of Family Forests across the United States: Section II, Butler et al, Family Forest Research Center, May 2014

[2] Forest Resources of the United States, 2012: A Technical Document Supporting the Forest Service Update of the 2010 RPA Assessment. GTR WO-90, October 2014. S Oswalt, et. al.

[3] Estimated from personal correspondence provided by Dr. Brett Butler, US Forest Service Family Forest Research Center. January 2016.

[4] 2012 RPA Board Foot Tables, US Forest Service.

[5] USDA Forest Service. 2013. *Major Forest Insect and Disease Conditions in the United States – 2012.* FS-1023, Washington DC.

[6] USDA Forest Service. 2012. *Future of America's Forests and Rangelands – Forest Service 2010 Resources Planning Act Assessment.* GTR WO-87, Washington, DC.

[7] Western Water Threatened by Fire. American Forest Foundation. 2016

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 and directly support over 3 million jobs – about 2 percent of all jobs.[8] It's estimated that 53% of the lower 48 states' drinking water originates from forests.[9] Some fourteen to fifteen percent of the nation's annual carbon emissions are offset each year by the additional carbon stored in US forests and wood products.[10] 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 management, i.e. carefully planned tree removal. 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 landowners, public and private, to provide the economic, environmental, and social benefits that we all depend on. [11] 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 of these activities can be accomplished. Other desired outcomes, such as 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.[12]

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

[8] Forest Resources of the US – 2007, Smith et al, GTR WO-78

[9] Private Forests, Housing Growth and America's Water Supply: A Report from the Forests on the Edge, Forests to Faucet Project. RMRS-GTR-327, September 2014. M. Mockrin et. al.

[10] US Environmental Protection Agency. 2013. *Inventory of US greenhouse gas emissions and sinks: 1990 – 2011.* EPA 430-R-13-001, Washington, DC.

[11] Family Forest Ownerships of the United States, 2013: Findings from the USDA Forest Service National Woodland Owner's Survey. Journal of Forestry. 2016. B Butler et. al.

[12] 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.

competitive returns are not achievable there is pressure for those lands to be converted to other uses. Virtually all of 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 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. Currently there are 87 operating manufacturing facilities in the U.S. with at least a few more under construction. Annual production capacity is just short of 12 million tons. In February of 2018 facilities purchased about 1 million tons of feed stock. 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.[13] This is an increase from very negligible production perhaps 15 years ago and projections suggest continued expansion.

Theoretically, if feedstock purchases were in the neighborhood of 15 million tons per year that would be the equivalent wood usage of approximately 10 large capacity papermills. Unfortunately, between 2005 and 2012 the U.S. lost 15 pulp mills.[14]

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.[15]

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.[16]By working biochar into the soil a

[13] Monthly Densified Biomass Fuels Report. U.S. Energy Information Administration. May 2018.
[14] The Forestry Source. Society of American Foresters. Smith & Guldin. January 2012.
[15] Presentation by Josh Schaidle, National Renewable Energy Laboratory, to NASF. February 2017.
[16] Biochar: A Home Gardener's Primer. Washington State University Extension Fact Sheet FS147E

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.[17]

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%. It's 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.[18]

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.[19]

MASS TIMBER

Mass timber is a category of mostly engineered wood building materials that are structural and can be used as floors, walls, ceilings, and beams. These products include LVL, Glulam, NailLam, Mass Plywood Panels (MPP) 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. It is lighter in weight than concrete. As such, CLT and other mass timber products can replace concrete and steel in tall structures.[20] Additional benefits include carbon storage and reduced CO2 emissions during construction. Though more commonly produced and utilized in Europe since the late 1990's it has recently gained traction in the US wood products industry with manufacturing facilities in the Pacific Northwest and a new one starting up in Alabama. Building codes across the US are being

[17] Presentation by Darren McAvoy, Utah State Biomass Resources Group, to NASF. February 2017.
[18] Biomass Technology Group website www.btgworld.com
[19] Renewable and Sustainable Energy Reviews. W. Chen et. al. Volume 44, pp847 – 866. February 2015.
[20] Advanced Wood Products Manufacturing Study for Cross-laminated Timber Acceleration in Oregon and Southwest Washington. Pacific Northwest Manufacturing Partnership. 2017

updated to handle mass timber buildings, small changes were made in 2015 and 2018 and revisions proposed for 2021 will allow for buildings taller than 85 feet.

Planned tall construction projects include a 100-story tower in London and a 40-story building in Stockholm.[21] Buildings in the US, include several office buildings in Portland, Oregon two T3 buildings (Minneapolis and Atlanta), and hotels in Alabama and New York state (new ones planned for SC and NC). The University of Arkansas has dormitories under construction and Oregon State University is building their new forestry building with CLT. The University of Massachusetts, Amhurst completed their new design building (https://bct.eco.umass.edu/about-us/the-design-building-at-umass-amherst/) with mass timber more than a year ago. Efforts are underway to develop CLT from low-value and other hardwoods.[22]

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 or workers able to safely install mass timber panels. 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.

Of course, 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 a low energy intensity during manufacturing, superior energy efficiency in mass timber structures, and better management of a renewable resource.

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

[21] First and Largest CLT Plant in Eastern US is Nearly Operational. R. Dalheim. Wood Working Network. April 2018.
[22] US Firm Developing Hardwood CLT Product. Journal of Commerce. June 2017.

and others.[23]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.

[23] Cellulose Nanomaterials – A Path Towards Commercialization Workshop Report. USDA Forest Service. August 2104.