

The Role of Forests in Energy and Climate Change—Integrating Objectives

Dave Atkins¹

Abstract—Woody biomass utilization presents a tremendous opportunity to address energy independence directly through the use of domestic wood as an energy source that offsets fossil fuel. It also works indirectly through conservation by the substitution of wood for higher embodied energy construction materials such as concrete and steel. Both the direct and indirect measures mitigate climate change by reducing greenhouse gas emissions. By integrating these goals with treatments of forests to make them more resilient to disturbances, longer term C sequestration is accomplished in the live forest on the landscape. This paper explores future and current technologies that are available to accomplish utilization and sustainable treatments in the field.

Introduction

Woody biomass utilization presents a tremendous opportunity to address energy independence directly through the use of domestic wood as an energy source that offsets fossil fuel and indirectly by the substitution of wood for higher embodied energy construction materials such as concrete and steel; moreover, it mitigates climate change by reducing greenhouse gas emissions. Integrating forest treatments that use woody biomass can also fulfill other objectives, such as creating forests that are resilient to disturbances and able to provide long-term C sequestration. In this paper, I present current and future technologies that are available to accomplish utilization and sustainable treatments in the field.

There is a need to move toward more sustainable systems over the next 30-40 years to achieve the goal of reducing C emissions. Forests are natural solar collectors that store energy and filter carbon from the atmosphere and store it in “wood batteries.” Given that forests can store carbon for long periods (decades to centuries), conducting sustainable forest management activities and techniques to insure continued forest growth and development is one method of reducing carbon emissions in addition to sequestering carbon. One measure of resiliency is the post-wildfire environment. For example, in Colorado, the 1989 Sheep Rock fuel treatment area burned more variable and moderate compared to surrounding untreated sites. Because there were more abundant live trees, these sites continue to sequester C in the trees.

Wood as a Conservation Tool

The use of wood in place of steel and concrete results in C being sequestered in the wood for the life of the building; importantly, it can also save significant amounts of fossil C from being emitted during production. Figure 1 shows an example of the net energy consumed to extract, transport, manufacture, and erect 100 square feet of interior wall using various framing materials (fig. 1a)

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¹ Northern and Intermountain Region Biomass Utilization, Program Manager.

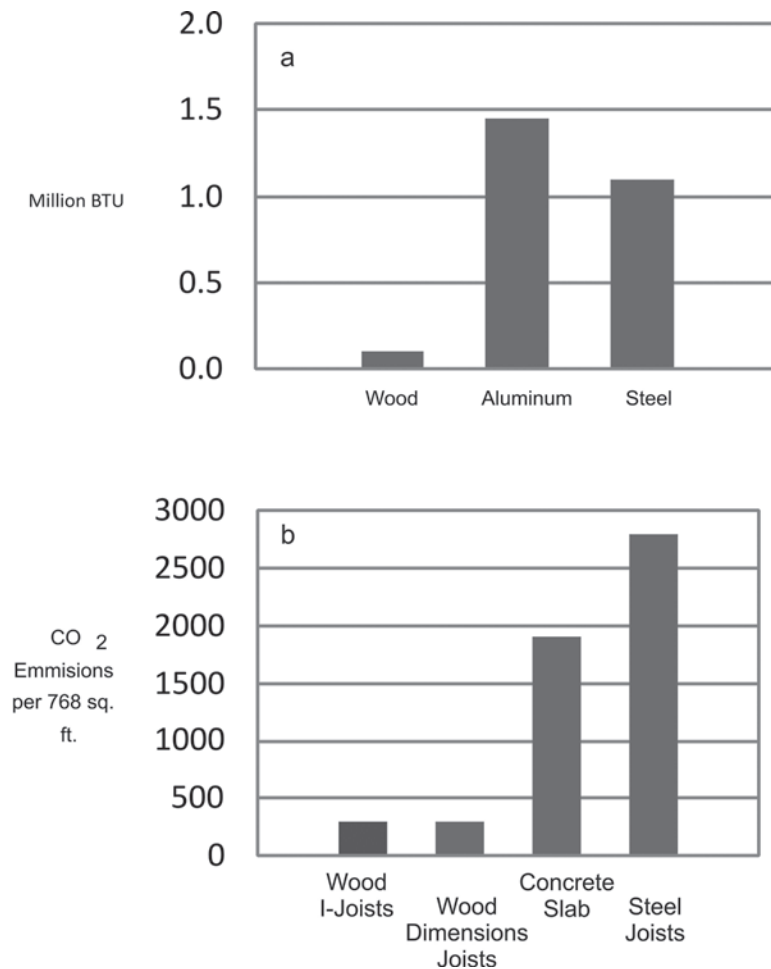


Figure 1—(a) The net energy consumed to extract, transport, manufacture, and erect an interior wall that is 100 square feet using wood, aluminum, and steel (CORRIM 1976). (b) The CO₂ emissions from floors constructed from wood I-joists, wood dimensional joists, concrete slab, and steel joists (CORRIM 2009).

and CO₂ emissions from different materials used for floor construction (fig. 1b). Products created from small wood, such as Glulam beams, and the use of wood for flooring, furniture, and engineering trusses are ways to store C and reduce energy consumption.

Energy Technologies With Wood

There are numerous technologies under research and development at various stages, such as fast pyrolysis to make bio-oil and biochar, gasification to liquid fuels, fermentation processing of ligno-cellulose to liquid fuel, and small-scale gasification for producing heat and power for power plants. However these new products are not commercially available. Because of a lack of existing markets for the product, they are untested in the marketplace; thus there is reluctance on the part of buyers to convert to the new product. Most significantly, the volatile nature of fossil fuels results in these products being more competitive during times when the price of fossil fuels is high compared to when it is low. Therefore, investors

are reluctant to make large investments given the risk that the low price times will kill the viability of the product. Along with a move towards a more sustainable set of energy sources, the efficiency of various uses of woody biomass should be considered. Current policies in the United States provide incentives to electrical and liquid production that are only 25 and 40 percent, respectively, efficient at converting the energy in the wood to useable energy for the consumer. On the other hand, thermal and combined heat and power are 65-90 percent efficient, yet have no incentives at the federal level. Policies to encourage efficient use of energy would certainly be better in the long-run.

Efficient Production and Transportation of Fuel

Slash and small trees have traditionally been viewed as a disposal problem; a cost problem rather than a potential product and revenue stream. The negative value of the material results in it being treated like trash with dirt and rocks being mixed into the fuel. While industrial systems can tolerate the dirt and rocks, albeit with a higher operating and maintenance cost, smaller commercial and institutional systems often cannot handle the low quality fuel without significant costs. Chipped material is preferable to ground material because it is more efficient in smaller combustion systems. However, chipping is typically more expensive than grinding, road systems to access many projects that generate potential fuel cannot handle highway chip vans, and chipping and grinding in the woods can be expensive due to significant lost production while moving to and from concentrations of slash. Many different methods and types of equipment are being developed and tested to improve the efficiency of production and transportation of material.

Conclusion

Wood utilization by an integrated industry can provide a wide range of products from solid wood and composites that can conserve energy as a result of lower energy content compared to concrete, steel, and plastics. It can provide a direct substitution for fossil fuel and thus reduce fossil C emissions. The sustainable use of forest products can provide for greater resilience of the forest to disturbances and thus continue to sequester more C in live forests as well as in forest products. The integration of management objectives for watershed protection, wildlife habitat enhancements, reduction of the potential for greater severity of wildfires in the context of climate change, and production of renewable energy adds to the considerations a silviculturist must make in developing landscape and stand level prescriptions. To achieve this level of integration requires consideration and communication of the various trade-offs.

References

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