THE NATURAL RESOURCE FOR THE FOREST PRODUCTS INDUSTRY

FOREST PRODUCTS JOURNAL

VOL. 62, NO. 4 2012

Special Issue
Environmental Performance of Wood-Based Biofuels

FOREST PRODUCTS JOURNAL ■ VOLUME 62, NUMBER 4, 2012

Introduction to Special Issue

Evaluating the Environmental Performance of Wood-Based Biofuels

Bruce Lippke
Richard Bergman
Adam Taylor
Maureen E. Puettmann

The nonprofit Consortium for Research on Renewable Industrial Materials (CORRIM) has been developing comprehensive environmental performance information on wood building materials consistent with life-cycle standards (http://www.corrim.org/). The articles published in this Special Issue of the *Forest Products Journal* extend the research by the CORRIM group on the environmental performance of wood products to include the impacts from the uses of wood as a source for bioenergy.

The earlier work, published in two special issues of *Wood and Fiber Science* (CORRIM 2005, 2010), developed the inputs and outputs for each stage of processing wood products through the final use of building materials. Life-cycle inventory (LCI) tables were produced for forest regeneration and harvesting in the Pacific Northwest, Southeast (SE), Northeast/North Central (including both softwoods and hardwoods), and Inland Northwest, carried through to the production of softwood and hardwood lumber, hardwood flooring, plywood, oriented strand board (OSB)–SE, glulam beams, laminated veneer lumber (LVL), I-joists, and trusses. The processing LCIs were based on primary data surveys of a sample from mills in each region. Two large-volume, nonstructural products, particleboard and medium-density fiberboard, were also included. An LCI for US-produced resins used in engineered wood and composite products was also developed and is being used to update the LCI for products using resins. The primary product database was uploaded to the US LCI database managed by the National Renewable Energy Laboratory (NREL), where the LCI data for nonwood materials as well as CORRIM's data on wood materials can be accessed (NREL 2011).

The earlier work also included life-cycle assessments (LCAs) for the use of wood products in residential framing, providing a useful comparison for the efficiency of using wood in construction products to reduce carbon emissions as a contrast to using biofuels to reduce emissions (http://www.corrim.org/pubs/articles/2006/FPJproductSubs.pdf, http://www.corrim.org/pubs/articles/2004/FPJ_Sept2004.pdf).

In this issue of the *Forest Products Journal,* the research findings are reported for a range of potential biofuel uses of wood in conjunction with the production of products. Biofuels and wood products are generally coproducts of sustainable forest management requiring consideration for their relative efficiencies under different production alternatives. Because operational-scale production facilities do not yet exist for liquid biofuels, the data have been derived from processing models instead of primary mill surveys. University cooperators customized NREL processing models and incorporated models of biofuel feedstock collection based on CORRIM's prior work to measure the impact of collecting industrial roundwood. There are many different woody biomass feedstock options and processing methods. To obtain the best input for the boundaries and scope of the project within the available financial resources, a planning workshop attended by experts in the field was held in October of 2008. A scope of work and work plan was developed that provided a range of the more important collection and processing options.

The planning workshop determined the following woody biomass feedstock options to be most important:

- Short rotation woody crops (SRWC) to demonstrate the impact of high yields
- Forest residuals (forest waste) generated in conjunction with harvesting for products

The authors are, respectively, Professor Emeritus, College of Environment, School of Environmental and Forest Sci., Univ. of Washington, Seattle (blippke@uw.edu [corresponding author]); Research Forest Products Technologist, USDA Forest Service, Forest Products Lab., Madison, Wisconsin (rbergman@fs.fed.us); Associate Professor and Wood Products Extension Specialist, Univ. of Tennessee, Knoxville (AdamTaylor@utk.edu); and Consultant, WoodLife Environmental Consulting, LLC, Corvallis, Oregon (maureen.puettmann@q.com). This paper was received for publication in February 2012. Article no. 12-00014.
©Forest Products Society 2012.
Forest Prod. J. 62(4):244–246.

- Whole tree handling of thinnings
- Thinnings for high fire-risk areas
- Customized equipment technologies to reduce the cost of collection
- Pellets production important to smaller scale collection use or for processing with long transportation hauls

Processing options are as follows:

- Three liquid fuel alternatives
  - Biochemical fermentation to ethanol compared with gasoline
  - Thermochemical gasification to ethanol compared with gasoline
  - Pyrolysis to biofuel compared with residual fuel oil
- Cogeneration of electricity compared with fossil fuel feedstocks
- Increased biofuel use in wood processing mills to displace natural gas for drying
- Pellet production impacts on heat and power efficiency relative to other feedstocks

SRWC were used in fermentation processing because it is a wet process and is best aligned with the high moisture content of the feedstock. Whole tree handling of commercial thinnings was evaluated with gasification and pyrolysis. Collection of forest residuals was evaluated with gasification because this process was expected to be robust to the wider quality range of the feedstock.

CORRIM research guidelines require conformity to life-cycle protocols including specification of purpose, functional unit, boundaries, data categories, collection procedures, and quality assessments (http://www.corrim.org/pubs/reports/2005/Phase1/CORRIMResProtocents.pdf). CORRIM's board and invited experts in the field provided technical reviews on the research plans. CORRIM's Web-based research reports were reviewed by international LCI/LCA experts for consistency with CORRIM's research guidelines and standards (http://www.corrim.org/pubs/reports/2005/Phase1/MainRepAugust24.pdf). Peer reviews have also been completed for all journal publications. CORRIM's biofuel research has continued to require strict adherence to life-cycle protocols.

CORRIM's LCI research on products and biofuels has been largely focused on developing a database and evaluation methods for determining options for environmental improvement. We believe that this information should now be made available, and made useful, for educators, policy makers, and industry. With this in mind, interactive videos covering many of these research projects were collected from presentations at the Forests Product Society's International Convention (http://www.corrim.org/presentations/video/2011/FPS_Biomass/index.asp).

Early steps in helping to translate LCI research for broader audiences include providing hands-on uses of LCI data for business and consumers who are not familiar with life-cycle analysis but are interested in making the right environmental product choice. It is expected that the advent of Environmental Product Declarations (EPDs), a third-party verified eco-label for (wood) products and fuels based on life-cycle data, will contribute to educating the consumer (http://www.environmentalproductdeclarations.com/). EPDs for wood and competing products require not only LCI data for wood uses but also for sustainable forest management. EPDs show credible and transparent information summarizing a product's environmental impacts. Similar to food labels, EPDs are attached to the product being sold. Therefore, depending on the end-market, e.g., business or consumer, the label is readily available to make a decision at the time of purchase (Bergman and Taylor 2011).

Another communication effort was recently conducted with support from the US Department of Agriculture Forest Service Wood and Education Resource Center. The project resulted in a brochure describing the carbon impact of wood products with respect to nonwood alternatives. The brochure provides detailed results on the carbon impacts associated with wood building products: cradle-to-gate manufacturing, woody biomass, carbon storage in the final product, and the substitution of wood for nonwood products (http://www.wwpinstitute.org/documents/CIWPpub.pdf).

Webinar training sessions to familiarize users with the data have also been promoted (http://www.forestrywebinars.net/webinars/the-carbon-impact-of-forest-products/?searchterm=None).

Because of widespread interest on reducing carbon emissions, CORRIM has in earlier articles tracked carbon impacts for functional units (e.g., houses and specific products) and for forest acres used to supply wood products. These latter, forest-supply analyses include a wide range of stands supporting sustainable regeneration, harvest, production of wood products, product use, end-of-life disposal, or recycling. This Special Issue includes articles that integrate the impact of producing wood products and biofuels (coproducts from the forest) to sustainable forest resource management and production based on the findings from other articles in this issue covering biofuel feedstock collection and processing alternatives. Consistent carbon impact measures per unit of biofuel produced or per hectare of supply are reported. This closes one of the important research gaps identified in prior research: the failure to account for the potential carbon benefits from using wood residuals as well as the benefits from using wood products.

With the data presented here, it becomes possible to quantify the benefits of the additional use of biofuel sources such as logging residues, thinnings, and short rotation crops. A continued need for LCI/LCA is expected because it provides a way to scientifically measure environmental burdens; however, the growing use and need for LCI/LCA may lead to new applications and requirements. The Energy Independence and Security Act of 2007 (EISA 2007) now requires biofuels to achieve minimum federal standards in displacing fossil fuels. These emission standards, based on LCA, will likely support the use of cellulosic ethanol over alternative fuels. More importantly, these standards will likely generate substantial change in how environmental data are developed and how carbon markets and other incentives are framed.

The carbon mitigation impact from using woody biomass is lower for highly processed (e.g., liquid) fuels than for most other uses (e.g., solid products or direct combustion). However, using woody biomass for liquid fuels will contribute to greater energy independence by substituting for imported petroleum. This raises the issue of the relative value of carbon mitigation and other goals. Currently there is no accepted method to measure the potential tradeoffs between carbon mitigation, energy independence, or other forest-derived values. Value tradeoffs are important to policy and will need to be better understood to effectively pursue carbon mitigation and energy independence goals.

Literature Cited

Bergman, R. and A. M. Taylor. 2011. EPD—Environmental product declarations for wood products—An application of life cycle information about forest products. *Forest Prod. J*. 61(3):192–201.

Consortium for Research on Renewable Industrial Materials (CORRIM). 2005. Documenting the environmental performance of wood building materials. *Wood Fiber Sci*. 37(CORRIM Special Issue). 155 pp. http://www.corrim.org/pubs/reports/2005/swst/index.asp.

Consortium for Research on Renewable Industrial Materials (CORRIM). 2010. Extending the findings on the environmental performance of wood building materials. *Wood Fiber Sci*. 42(CORRIM Special Issue). 164 pp. http://www.corrim.org/pubs/reports/2010/swst_vol42/index.asp.

Energy Independence and Security Act (EISA). 2007. Energy Independence and Security Act of 2007. Public Law 110-140. US Government Printing Office, Washington, D.C. pp. 1491–1801.

National Renewable Energy Laboratory (NREL). 2011. Life-cycle inventory database project. NREL. http://www.nrel.gov/lci/. Accessed June 27, 2012.