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Executive Summary

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Life-cycle Inventory of Wood Pellet Manufacturing in Wisconsin

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Executive Summary

In the long view of American history, wood served as the preeminent form of energy for about half of the nation's history. This trend faded as the extraction of fossil fuels for energy production intensified, but regained interest whenever fossil fuel costs rose sharply. Direct combustion for space heating is by far the most efficient way to extract energy from wood as modern stoves can realize over 95% efficiency (USDA, 2009). Wood, as it exists in the forest, is not cost effective as a main fuel source due to its low energy density, low bulk density, and the fact that it is 50% water by weight. However, once the wood is dried and densified through the pelletization process, the energy content per unit volume approaches that of coal and allows for more economical shipping (USDA, 2009).

The purpose of this study was to determine the environmental impacts of “premium” wood pellets manufactured in Wisconsin through a cradle-to-gate life-cycle inventory. The system boundary began with growing and harvesting timber and ended with product (wood pellets) leaving the mill complex. The functional unit was the mill complex, which produces wood pellets from a variety of feedstocks. Three groups of pellet manufacturers were identified based on feedstock: those who utilize green co-product (>35% moisture on a wet basis), those who utilize dry co-product (<35% moisture on wet basis), and those who harvest their own timber. Some mills utilize a combination of feedstocks using processing steps including log and/or co-product handling, chipping, hammer milling, drying, and pelletization.

The mill data was weight averaged on a per unit basis of 1.0 short ton of “premium” wood pellets, and the burdens for all substances and energy were allocated among the products on a wet mass basis. Using the LCI modeling software package SimaPro 7.2, environmental impacts were measured based on emissions to air and water, solid waste, energy consumption, and resource use.

Results indicate that the majority of fuel consumed on-site in the manufacturing of wood pellets is green wood fuel (~65%), followed by electricity (~32%). On-site energy consumption for producing wood pellets from source-dried co-product was ~65% less than using co-product dried in-situ and producers who harvest their own timber. However, when considering the cradle-to-gate material and energy inputs, wood pellets produced from whole logs harvested by the manufacturer use 32-35% less energy and have a much lower environmental impact.