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Design and analysis of biothermal energy generation from forest and agriculture feedstocks

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This research seeks to quantify the biomass energy potential and ecological effects of composting forest and agricultural residues for Northern Forest enterprises. Composting transforms food waste, manures and woody biomass into stable soil amendments, generating heat as a by-product. In compost recipes, woody biomass provides porosity, dry matter, substrate and carbon. Decentralized biothermal energy processes would keep nutrients in close proximity to their point of extraction, thus sustaining farm and forest soil resources, while displacing fossil fuel demand for heat. Preliminary research has uncovered data from previous applications of biothermal energy generation from composting. Jean Pain, a French farmer and researcher, developed techniques for composting forest residues to produce high-quality compost while generating substantial quantities of heat. An experimental 100 yd^3 brushwood compost mound yielded an average 1 gal/min of 60^0C (140^0F) water for 18 months (620 Mbtu, captured heat). Replication of Pain's methods, however, has not been reported in scientific literature. Since 2005, a commercial-scale biothermal energy generation system has been operating in Sheldon, VT. The estimated energy generation rate for this system, as 50-60^0C hot water for tap use and radiant flooring, is 1000 btu/hr/ton of active compost. Current research involves assessment of scenarios for integrating composting with heating agricultural, residential and municipal buildings within the Northern Forest region. Results will be reported as estimated cash flow, energy demand and carbon dynamics of biothermal energy applications. Promising results will motivate pilot-scale research projects with local community partners.

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