Environmental Impacts of Biomass Harvesting and Wood Energy Production in Northeastern Minnesota

Using locally-grown forest biomass in community energy systems in northern Minnesota has the potential to increase the region's energy independence, lower carbon dioxide in the atmosphere, and reduce buildup of fire-prone materials in forests. This fact sheet focuses on potential environmental impacts of biomass harvest and forest sustainability guidelines needed to address such impacts. It summarizes a study by Dovetail Partners, Inc. that reviews relevant literature and testimony from forestry experts and stakeholder groups. Other fact sheets in this series describe technical and economic aspects of biomass combustion systems, woody biomass fuel demands and local supplies, and air emissions from biomass combustion. A full report of the study will be available in December, 2012.

Northern forests ecosystem

Two communities in northern Minnesota, Ely and Grand Marais, are considering construction of district heat systems, fueled by locally-grown woody biomass, for public buildings and business districts. These communities lie in the Northern Superior Uplands, a landscape dominated by fire-dependent forests and woodlands. The red and white pine forests of the past were largely cut down by the early 1900s. Today, they have been replaced by jack pine forests on drier ridges and outwash areas, and sugar maple forests (mixed with some pine, birch and cedar) in the highlands along Lake Superior. The different forest types, their ages, and relative health determine forest management decisions, including timber and biomass harvest.

The *Generic Environmental Impact Statement on Timber Harvesting and Forest Management in Minnesota* (GEIS) is an in-depth analysis of potential environmental impacts on forest ecosystems. It and subsequent guidelines and updates provide the basis for this review of potential positive and negative impacts of woody biomass harvest on these forests.

Northern Superior Upland Section

Biomass harvest operations

Woody biomass is typically removed from a forest as part of a traditional harvesting operation and can include tree tops, limbs, bark, and tree trunks (bolewood). Biomass is rarely removed as a stand-alone product because it is generally not economically viable. Because of this, environmental impacts of biomass removal are evaluated within the context of overall timber harvest and forest sustainability. Other sources of woody biomass are wildfire risk reduction treatments, wood salvaged from windstorm events, wildfire, insect or disease outbreaks, and restoration efforts. This material is often piled or burned because it is not economical to haul to markets. Tree trunks, or bolewood, are currently used for firewood and pellets. As long as viable markets for roundwood (e.g., pulp and timber markets) exist in the region, it is likely to be economically limiting to chip quality roundwood for bioenergy systems.

The current rate of timber harvest in northeastern Minnesota is significantly lower than a baseline rate (4 million cords annually statewide) found to be biologically sustainable in the GEIS. Preliminary data suggest that harvest levels for 2010 and 2011 are within the 2.6 to 2.9 million cord range. Inventory data also show that forest growth greatly exceeds wood harvest in the state. Minnesota is experiencing annual net timber growth of approximately 5.6 million cords (approximately twice as

[1] Ecological Classification System used by MDNR and USFS for managing public lands.

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Table 1. Ely and Cook County district heating systems, annual heat demand, fuel types, and biomass demands

Ely Configurations	**Heat load** *(MMBtu)*	**Fuel Type**	**Annual Biomass Demand** ***dry tons (green tons)***
Option 1: Vermillion Community College	7227	Chips/Hog	527 (878)
Option 2: Hospital, residential building, ISD 696	16,235	Chips/Hog	1,754 (2,924)
Option 3A: Option 2 plus 15 downtown businesses	21,553	Chips/Hog	2,499 (4,165)
Cook County and Grand Marais Configurations			
Option 1: Resort or small business cluster	5,200	Chips	390 (650)
Option 2: Grand Marais public buildings (north of 5th St. N and Cook County Courthouse)	11,796	Chips/Hog	940 (1,567)
Option 3: Grand Marais business district and public buildings	30,562	Chips/Hog	2,450 (4,083)
Option 4: Grand Marais Option 3 for largest users only	24,186	Chips/Hog	1,940 (3,233)

much as the current annual harvest rate). Table 1 shows estimates of annual biomass demand of optional systems being considered in Ely and Grand Marais. In 60-mile radii zones around Ely and Grand Marais, 2011 biomass harvest (tops and limbs) is estimated at 59,856 and 12,576 dry tons respectively, assuming that 50% of biomass is left on site for conservation purposes[2].

Impacts of woody biomass harvest

Ecological impacts on soils, wildlife, fire regimes, and water quality of using biomass for bioenergy depends on existing forest conditions and the timing, methods, and amount of biomass removed over a specific period. Although options being considered in Cook County and Ely demand relatively small volumes of biomass, they could alter forestry practices in procurement areas.

Positive benefits of biomass harvest for local forests and communities are numerous. In addition to providing a local renewable energy source, responsible woody biomass harvest could support hazardous fuel reduction and forest (habitat) restoration efforts. It could increase the economic value of forested areas, which can lead to better wood markets and management. The use of community trees and local wood-debris could also positively benefit community natural resources and economies.

Potential negative impacts of timber harvest were identified based on information provided in the GEIS and during meetings with expert and stakeholder groups in northern Minnesota (see sidebar).

Soil resources: Research indicates that harvesting trees once every several decades generally does not impact soil nutrients beyond rates of replenishment by annual leaf fall and nutrient cycling. Harvest on less productive sites with poor soils could have greater impacts. Loss of calcium, magnesium, and potassium greater than rates of replenishment are associated with timber harvest on coarse-textured and organic soils. Full tree harvesting (removal of the main stem of the tree as well as large and small branches), can increase calcium losses slightly compared to merchantable bole harvest (traditional timber removals). Losses for magnesium and potassium are also significantly increased under these conditions. It is for these reasons that biomass harvesting is restricted or not allowed on sites with lower nutrient (poorer) soils.

Forest health: For most forest types, insect and disease problems are closely related to age class structure and overall tree vigor. In general, the forests of northeast Minnesota are dominated by mature tree stands, including many aspen forests that are over 50 years old. For example, in a supply zone of 60-miles around Grand Marais the aspen-birch forest type occupies 415,659 acres (51% of timberland) and spruce-fir occupies 200,027 acres (25% of timberland).

[2] Becker, 2012

Of those acres, 53% and 42%, respectively, are greater than 60 years old and are either at or beyond their target harvest rotation age and are experiencing health declines. Similar data is shown for the region around Ely.

Wildlife: Impacts to wildlife are predicted based on what is known about a species' habitat requirements. The GEIS baseline harvest level is expected to have no negative impacts on sensitive or government-listed wildlife species found in the study area (Osprey, Bald Eagle, Red-shouldered Hawk, Loggerhead Shrike, Pine Marten, Timber Wolf, Wood Turtle). The less sensitive populations of non-listed species of game and non-game wildlife are unlikely to be significantly affected either positively or negatively at the baseline level of harvest, as this level of activity does not significantly alter the overall distribution of habitat types. Monitoring the population trends of more sensitive wildlife species is an important way to evaluate long-term land use impacts.

Water quality and fisheries: Depending on scale of operation, timber harvest and associated road-building can impact the quantity and rate of run-off, and increase sedimentation and water temperature. Forest management guidelines that are mandatory on public lands in Minnesota include practices related to riparian areas, buffer strips, and soil erosion from access roads and skid trails. Timber harvest that complies with these guidelines will have significantly fewer local water resource impacts than timber harvest carried out in the absence of such practices.

Recreation, aesthetics, unique resources: The GEIS found that less than one-third of the primitive and semi-primitive non-motorized areas on timberland would be significantly impacted by the base level of harvest. Timberland is forestland that is available for harvest and does not include wilderness areas such as the Boundary Waters Canoe Area. Visual impacts can occur with timber harvesting and forest management activities, however use of visual management guidelines (covering road location, use of buffers, size and shape of cut, and slash and debris disposal) can significantly reduce these impacts. A statewide database is maintained by the State of Minnesota to record unique cultural and historic sites. Land managers utilize this database in management planning and contribute to its maintenance.

Management tools and environmental safeguards

Environmental safeguards in place in Minnesota that focus directly on the sustainability of the state's forests include third party forest certification, the Minnesota Forest Management Guidelines developed by the Minnesota Forest Resources Council (MFRC), and the Minnesota Master Logger Certification program. In addition to these "Big Three," numerous programs and activities strive for long-term forest sustainability, including the MFRC Landscape Planning Committee, active MN DNR field, monitoring, and the Minnesota Sustainable Forestry Incentive Act for private landowners.

The *Minnesota Biomass Harvesting Guidelines* are recognized as an important tool for taking a precautionary approach to making use of biomass energy resources. To ensure that biomass energy systems can be responsibly maintained over the long-term, it is important that programs to implement and monitor the effective use of harvesting guidelines and other environmental safeguards be continued and more widely adopted.

Concerns about increased biomass harvesting *were identified in meetings and interviews with natural resource professionals, land managers, and community officials and citizens. Discussion of potential impacts and mitigation strategies are contained in full environmental report available at:* www.dovetailinc.org.

- *Timber harvests at sensitive ecological sites*
- *Impact on structure of native plant community, related to timing of harvests, retention of woody debris, stand structure, direct impacts, and long-term impacts*
- *Negative impacts on specific wildlife species, including Canada Lynx, Snowshoe Hare, and Timber Wolf*
- *Water quality degradation*
- *Increased harvest of bolewood for bioenergy*
- *Forest carbon storage and sequestration*
- *Noise pollution in BWCAW*
- *Air pollution (see separate fact sheet on air emissions)*
- *Ash disposal*

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Table 2. Summary of Minnesota's biomass harvesting guidelines

DO'S	DON'TS
During Biomass Harvesting:	***Avoid Biomass Harvesting:***
• Plan roads, landings and stockpiles to occupy a minimized amount of the site • Ensure that landings are in a condition to regenerate native vegetation after use, including tree regeneration • Avoid site re-entry to collect biomass after harvesting *(this reduces potential for soil compaction and damage to regeneration)* • Install erosion control devices where appropriate to reduce sedimentation of stream, lakes and wetlands • Retain and scatter at least one third of the fine woody debris on the site (50% was used in this study) • Encourage native seed mixes and avoid introduction of invasive species • Retain slash piles that show evidence of use by wildlife • Leave all snags, retain stumps and limit disturbance of pre-existing coarse woody debris	• Within 25 feet of a dry wash bank, except for tops and limbs of trees • On nutrient-poor organic soils deeper than 24 inches *(These sites typically have sparse (25-75%) cover that is predominantly (>90%) black spruce and stunted (<30 feet high).)* • On aspen or hardwood cover types on shallow soils (8 inches or less) over bedrock • On erosion-prone sites (e.g. steep slopes of 35% or more) • In areas that impact sensitive native plant communities and where rare species are present • In riparian areas or leave tree retention clumps • In a manner that removes the forest floor, litter layer or root systems; these resources must be left within the forest

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For more information about the project:

Contact: Katie Fernholz

Email: katie@dovetailinc.org

Phone: 612-333-0430

www.dovetailinc.org

Project Community Liaisons:

Cook County: Gary Atwood, 218-387-2852
biomass@boreal.org
Cook County Local Energy Project (CCLEP
www.cookcountylep.org

Ely: Gloria Erickson, 218-365-0878
gjerickson@frontiernet.net
City of Ely Alternative Energy Task Force (AETF)
http://www.ely.mn.us/

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