Promoting Ecological Sustainability in Woody Biomass Harvesting[1]

Guiding Principles[2]

Similar to any other forest management practice, ensuring the sustainability of biomass harvesting for energy will require attention to individual site conditions and consideration of multiple management objectives. Based on our review of the literature, we offer the following guiding principles that can be incorporated into biomass management activities:

1. Increase extent of forested land where feasible.
2. Adapt management to site conditions.
3. Use management guidelines.
4. Retain organic legacies for soil productivity.
5. Retain deadwood and structural heterogeneity for biodiversity.
6. Evaluate role of fertilization and wood ash recycling.
7. Use biomass harvest as a tool for ecosystem restoration.

• Increase extent of forested land where feasible.
Afforestation of agricultural, abandoned, and degraded lands can produce many ecological benefits while also providing more forestland for production of wood products and/or energy. The benefits derived from the establishment of both conventionally planted forests and short-rotation woody crops will likely vary as a result of prior land use, landscape context, species composition of the planting, and rotation length. Short-rotation woody crops in particular may help to shift intensive forest management away from natural forests while enhancing biodiversity and soil and water quality relative to past land uses (Cook and Beyea 2000, Volk et al. 2004)

• Adapt management to site conditions.
Although it is widely recognized that forest management objectives and activities need to be matched to existing site conditions, the probable intensification of harvesting to obtain woody biomass for energy underscores this fundamental adage. For example, old forests and areas of high conservation priority have inherent value because they provide essential services for biodiversity, ecosystem health, and carbon sequestration. Biomass harvesting is not suitable for many of these sites because the benefits that would be obtained from woody feedstocks are dwarfed by the ecological and social needs to manage for other ecosystem functions and services. In areas where biomass harvest is a possible management objective, the occurrence and intensity of biomass removal should consider and address potential limitations due to site productivity, soil physical properties (e.g., potential for compaction and/or erosion), presence of valuable habitat, or conflicts with other management goals.

• Use management guidelines.
A multitude of guidelines have been developed for specific aspects of forest management, such as BMPs for water quality, which contain information to prevent or minimize the effects of most harvesting activities on water resources. Recognizing the value of BMPs, additional guidelines specific to biomass harvest have been created (e.g. , MFRC 2007, PA DCNR 2008) or are in the process of being written in many states to complement existing recommendations for forest management. Where available, these guidelines should be used to better understand the challenges

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[1] *Promoting Ecological Sustainability in Woody Biomass Harvesting.* Janowiak, Maria K.; Webster, Christopher R. Journal of Forestry, Volume 108, Number 1, January/February 2010, pp. 16-23(8). http://bit.ly/b5DhiO

[2] This handout was drawn *verbatim* from the Janowiak-Webster article, and was prepared for educational purposes by John Bonitz, Southern Alliance for Clean Energy, bonitz@cleanenergy.org. Gratitude is expressed to the authors for their helpful summary of these complex and broad-ranging concerns, and for their vision in offering these guiding principles.

of biomass harvesting specific to a geographic location, as well as actions that can be taken to promote sustainability (Evans and Perschel
2009).

• Retain organic legacies for soil productivity.
Long-term impacts on site productivity will be largely reduced by keeping a portion of forest biomass on site. Preserving existing sources of organic matter, such as deadwood and the forest floor, and retaining some slash from harvesting will help to maintain adequate levels of organic matter and nutrients in the soil and to minimize compaction, rutting, and erosion (see Table 1). For example, deciduous trees can be harvested during leaf-off to allow for greater cycling of nutrients and organic matter into the forest floor. Transpiration Drying — a process where trees are cut and left on site for several months to dry — can be used to keep needles of coniferous trees and small branches on site after harvesting but needs to be balanced with threats to forest health from fire or pests (Hakkila 2002). Piling slash in windrows can also decrease productivity by concentrating the forest floor and nutrient-rich, surface mineral soil layer on a small portion of the site (Morris and Miller 1994). Dispersed slash will redistribute organic matter and nutrients and provide more uniform productivity.

• Retain deadwood and structural heterogeneity for biodiversity.
Objectives for biodiversity can be included in management and harvest planning to minimize adverse impacts. Managers will need to determine the critical threshold for key habitat features (Angelstam et al. 2002), especially snags and down deadwood. To the greatest extent possible, management should strive to promote and maintain deadwood (including standing and fallen trees), structural heterogeneity, native plants, and a healthy forest floor (Figure 4). For short-rotation woody crops, planting a variety of age classes and species will increase diversity of other plant and animal species.

• Evaluate role of fertilization and wood ash recycling.
Site-specific fertilization may be beneficial or necessary in some intensive bioenergy systems. Increased primary productivity from fertilization causes greater inputs of organic matter to soil, which can improve soil nutrient and water availability and make soil less susceptible to compaction. State and regional guidelines, including but not limited to BMPs, provide information and guidance on the use of specific site preparation and fertilization techniques. Wood ash generated as a byproduct of energy production can serve as a fertilizer for calcium, magnesium, and potassium. Although ash fertilization rates >10 tons per hectare normally will replace these cations removed during whole-tree harvesting (Vance 1996), caution is necessary to prevent negative environmental effects that could occur from ash fertilization, such as high concentrations of heavy metals and large alkaline pulses. For example, ash application rates of >5 tons per hectare have been shown to have detrimental impacts on moss and lichen communities (Pitman 2006).

• Use biomass harvest as a tool for ecosystem restoration.
Biomass harvesting may have the most positive effect on forest management if it effectively advances activities that promote forest health and function (Evans 2008). The development of a strong biomass industry may enhance the economic and operational viability of many management operations by increasing the value of the wood resource as well as increasing the availability of harvesting and transportation machinery specifically suited to conditions typical of biomass harvest (i.e., removal of small diameter trees and brush). Although the opportunities for ecosystem restoration are wide ranging, applications include fuels reduction in overstocked stands or in the wildland–urban interface, thinnings to improve tree growth and stand vigor, and invasive species removals (e.g., Neary and Zieroth 2007, Evans 2008).