NW Energy Coalition

for a clean and affordable energy future

Forest Biomass Guidance for Use in Electricity Production

Introduction

The use of forest biomass for energy generation has received increased attention in recent years. While forest biomass has potential as a useful source of renewable energy generation, improperly designed projects can harm human health and the environment.

The NW Energy Coalition is committed to reducing greenhouse gases in ways that are consistent with a predominance of scientific opinion and advance a clean energy economy. We understand that all energy generation, including renewable energy resources, has impacts and must be developed in the most environmentally responsible manner possible. Because producing energy with forest biomass utilizes a resource that provides other competing ecosystem benefits and services for our region, we recommend a more thorough life cycle analysis than the Coalition has provided for other renewable resources in the past.

Accordingly, the Coalition has developed a proposed set of principles, guidelines and policy recommendations for the responsible development of forest biomass projects. This document does not address the use of agricultural biomass resources or the creation of biofuels, nor does it address which end use application (electricity, liquid fuels, thermal heat) constitutes the preferred use of forest biomass material. It has been crafted by Coalition staff with input from Coalition members and community stakeholders.

NWEC Definitions

Ecological restoration is management activity that restores local characteristic forest and aquatic conditions to support resilience to natural disturbances.

Forest biomass for power generation should only include unutilized byproducts of ecologically based forestry, such as materials from mill residuals, forest residues and other non-merchantable debris removal from timber management or ecological restoration efforts (e.g. invasive species removal, wildfire mitigation).[1]

Agricultural waste and residuals are byproducts from other activities.

Forest refers to any land subject to forest practices regulations, which may vary over time and from state to state.

Conversion efficiency compares the useful energy output to the potential energy contained in the fuel.

NW Energy Coalition
www.nwenergy.org
(206) 621-0094 • nwec@nwenergy.org

[1] "Ecologically based forestry" refers to practices outlined in the 'Forest Health' section of this document.

I. Principles

Energy generated from forest biomass resources is a component of the Northwest's energy system. The Coalition is committed to assuring that electricity produced from new or refurbished forest biomass projects is done in ways that:

- Protect natural resources and landscapes
- Protect air quality
- Preserve water quality
- Maintain public health
- Reduce carbon impacts on climate
- Maximize efficiency

II. Guidance for Project Evaluation

Since each forest biomass project presents a unique array of features, all must be evaluated on a case-by-case basis. These guidelines are designed to help decision-makers, advocates and local communities weigh the advantages and disadvantages of specific projects. To adhere to the principles outlined above, forest biomass projects must be designed with the following considerations in mind:

1. Scale. In general, projects should be sized to support sustainable feedstock supplies consistent with the definition of forest biomass. Appropriately sized projects would not place undue pressure on feedstocks nor draw biomass resources away from other important existing uses and allow for maintenance of forest health. Smaller projects appear to be more sustainable but each project is different and the appropriate size will depend on a host of factors, some of which are identified in this paper.

2. Sustainability and Lifecycle Impact Assessment. Maintaining air, water, land and habitat quality are critically important. Because forest biomass use can have a significant impact on forest health, NWEC recommends that each project's full lifecycle impacts be evaluated and compared to those of alternative uses and of taking no action. Full lifecycle accounting depends upon many factors including:

- What would have been done with the forest material if not used for energy generation (including considerations related to emissions and forest health)
- The existence value of undisturbed forestlands
- The condition of the forest (including soil quality) before harvest
- Type of forest(s) and the growth and regeneration potential
- Amount of material from the forest that is used for energy generation
- Efficiency of the energy conversion technology

- Types of fuel replaced by biomass electricity production[2]
- Management of the forest after harvest
- Transportation of the feedstock to power generation site
- Long-term economic viability of the project, including availability of long-term, sustainable fuel source
- Net greenhouse gas (GHG) emissions as detailed in subsection A below
- Net consumptive water use, and streamflow and riparian impacts.

A. Greenhouse Gas Emissions. Calculation of net greenhouse gas emissions is one of the most complex components of the lifecycle assessment (LCA) and as such requires more detail.

Most atmospheric scientists agree that the next few decades are critical for greenhouse gas emissions abatement. While the use of forest biomass may be considered carbon neutral over the long-term, this timeframe does not automatically make forest biomass combustion carbon neutral within the 20-30 year period for making needed reductions in GHG emissions. Accordingly, the life cycle analysis of the biomass plant should result in lower emissions of GHGs within 20-30 years than what a utility or industrial customer would otherwise be using. In other words, emissions should be lower than the entity's marginal resource or fuel that would be displaced.

Determining the net GHG emissions of a project will depend on calculations for and comparisons of all of the items listed above including any fossil fuels displaced with biomass, transportation emissions and what would have happened to the biomass if not used for energy. LCA science is rapidly evolving and further research is needed to clarify the most appropriate approaches to modeling GHG emissions from forest biomass combustion.

B. Forest Health.[3] Feedstock sourcing is critical to determining the impacts of forest biomass projects because of its potential implications in terms of forest and ecosystem health, productivity and habitat.

Use of forest biomass for energy production must be weighed against the value of leaving the material in the forest to support forest health. And use of forest biomass should not detract from other benefits these materials may currently provide to forest health (e.g., soil enrichment, ecosystem productivity, wildlife habitat, aquatic habitat enhancement, overall ecosystem productivity) or to the forest products industry (e.g., compost, paper and wood products).

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[2] System dispatch models used by the Northwest Power and Conservation Council should be used to estimate fuel displacement when an existing generator is not being replaced, or the capacity is being increased. Alternative emissions and efficiency profiles must be evaluated to determine whether the use of biomass fuel provides a comparative benefit.

[3] All guidelines in this section apply the definitions outlined on p.1.

Forest biomass removal must be consistent with sustainable, native species silviculture practices and should neither impair the functions, processes or composition of forest ecosystems on public or private lands, nor interfere with critical ecosystem restoration or biological corridor protection. It should not affect old growth or other rare habitat, wild or native forests, or roadless areas. Biomass removal should not incent conversion of native forests to other forest types and/or other land uses.

Forest biomass removal must be consistent with State adopted forest practice rules (see Policy Recommendations below) and habitat conservation plans. Where applicable, use of forest biomass that has third-party forest management certification (such as Forest Stewardship Council or superior, but not including the Sustainable Forestry Initiative) is recommended.

3. Public Health. Site selection and biomass combustion/utilization must be done in an environmentally responsible way that protects public health and places no excessive burdens on economically disadvantaged communities. The impacts of ultrafine particulates (100 nanometers or smaller) and NOx are of serious concern and as such local air pollution impacts must be carefully evaluated, particularly when a project is near or upwind of a highly populated area. The combustion efficiency of a project impacts its NOx and particulate emissions. However, as with all impacts, a projects air impacts must be evaluated against the air pollution from existing uses of the biomass and existing generators being displaced.

All projects must, at a minimum, meet local air permit requirements to protect public health. In addition:

- Retrofits to existing systems should result in fewer overall air pollutants.
- New facility emissions must meet all Clean Air Act requirements, and should take into account all parts of the fuel cycle, including harvest, transportation and fuel preparation.
- In addition to meeting existing and future air regulations it may be necessary to minimize health damage from ultrafine particulate emissions (100 nanometers or smaller) for projects near or upwind of populated areas.

4. Power Generation Efficiency. Facility design components are key considerations that may vary widely from project to project. Plant sizing (MW) and planned utilization (capacity factor) should be optimized to make efficient and sustainable use of available feedstock and to not place unreasonable burdens on feedstock, water supplies or airsheds.

The technologies used to convert forest biomass to generate electricity can vary greatly in efficiency and emissions. The power generation system used should be designed to maximize system efficiency. To the extent possible, thermal heat should be fully utilized through a combined heat and power (CHP) system.

Mini Technology Primer

- The *net plant heat rate* tells a lot about plant efficiency; the lower the heat rate, the more efficient the plant. In addition, the *capacity factor* affects both plant efficiency and annual net output and should be as high as possible.
- *Direct combustion systems* burn feedstocks in a boiler to make steam to turn an electric turbine. This type of system has a conversion efficiency of 15-35% because the excess heat not used to make steam is lost.
- *Fluidized-bed direct combustion systems* are more efficient and produce less SO_2 and NOx. In a fluidized bed system, the biomass is mixed with sand, silica, ceramic or some other non-combustible material and then hot air is injected at high speed into the mixture to suspend the biomass and increase heat transfer which improves efficiency.
- *Combined heat and power* (CHP, or co-generation) systems are more efficient than stand-alone direct combustion. A CHP system captures more of the waste heat to produce electricity and steam with a conversion efficiency as high as 85 or 90%. Small-scale biomass CHP systems using Stirling engines to capture and use excess thermal energy are very promising but are not yet commercially viable. CHP systems in the 1-3 MW range utilizing Organic Rankine Cycle heat recovery are just now entering the marketplace. Direct combustion systems operating at high temperatures work well for forest biomass.
- *Gasification systems* use thermochemical conversion to convert feedstocks into a mixture of elemental gases called synthesis gas, or “syngas.” The syngas is cleaned and separated then sent through a turbine. There are different types of gasifiers that produce different byproducts and require different levels of moisture in the biomass feedstock.
- *Fluidized-bed systems* have pros and cons but in general are more efficient than direct combustion and produce less air pollutants. However, the technology is complex and still very expensive.
- *Close-coupled gasification-boiler systems* are more readily available than other gasification technologies but still being tested for biomass use. Utilizing CHP with gasification systems further improves efficiency and energy conversion.

It is important to point out that generation system and site selection may have contradictory impacts. Close-to-forest locations may reduce air pollution impacts and lower transportation costs but increase transmission losses and reduce CHP options. Close-to-load center locations may increase health impacts and lengthen feedstock transportation, but increase CHP options, etc.

The most efficient current biomass-to-electricity technologies involve gasification systems and direct combustion boilers coupled with combined heat and power systems. However, new technologies now in the R&D phase promise even greater efficiency and pollution control and should be considered when they become commercially available.

5. Additional factors. In order to ensure the environmental and economic sustainability of the project and to avoid any future use of materials with a higher

potential product class, it is preferable for a majority of the site's contracts to be in place or clearly identified prior to facility permitting.
Biomass feedstock availability may be the most important issue in terms of the economics and long-term sustainability of a project, therefore projects that can utilize a reliable, onsite supply of fuel, such as mill residues, may have a distinct advantage.

Although a project application may indicate that only forest biomass as defined in this document will be used in the project, over time the biomass feedstocks could come from a broader set of materials. Projects may require the use of secondary fuel sources in order to provide operational flexibility and ensure affordable, reliable electricity generation for utility customers. Therefore:

- Projects should clearly document the use of secondary feedstocks and whether they have sufficient access to byproducts and/or residual forest biomass supplies over time to ensure they do not rely on non-compliant forest biomass feedstocks. The choice of feedstock sources must be consistent with the forest practices and conditions identified earlier.
- Project documents should be examined for indications of treated woods, which typically should not be included.
- Urban tree trimmings and agricultural waste, such as orchard residues, could be appropriate secondary sources.

III. Policy Issues

The Coalition offers the following policy recommendations and comments:

- State forest practices rules that apply to sustainable forest biomass removal for use in biomass energy projects must be developed and/or regularly updated.
- States should engage in comprehensive planning for biomass energy generation. Permits should not be issued in isolation, and cumulative regional impacts must be considered.
- Ultrafine particulate emissions are a significant source of public health impact. Emissions from biomass facilities include ultrafine particulates, as do emissions from coal plants, diesel automobiles and trucks, and industrial boilers. Local, state and federal air regulators should develop regulations to monitor and address ultrafine particulate emissions. Targeting these regulations to the largest (or most harmful to human health) sources of ultrafine particulates is further recommended.
- The EPA is urged to move more quickly on finalizing a biomass carbon accounting scheme for inclusion in greenhouse gas reporting regulations.
- Many factors are driving the rate of regional forest harvest levels, including domestic economic conditions and market demand from foreign nations. Natural gas prices also affect the market for energy produced from forest biomass. Because rates of harvest fluctuate over time and are influenced by many factors, it is difficult to determine if sales of biomass for energy production are ever a principal driver of profitability in a forestry operation. That said, the removal of biomass for energy production should only occur at

levels that sustain ecologically based forestry, as defined in the 'Forest Health' section of this document. This amount should also be tied to regional sustainable feedstock supply assessments to ensure cumulative impacts are managed.