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Comments on the Vermont Comprehensive Energy Plan

July 13, 2011

The Partnership for Policy Integrity (PFPI)—a New England-based organization using science, policy analysis and strategic communications to promote integrity in public policy—applauds the State of Vermont for devising its Comprehensive Energy Plan. It is our hope that this plan will help Vermont transition into a clean, renewable energy future, while protecting the environment, improving public health, providing quality jobs, and strengthening the local economy.

While there are many important aspects of this Plan, PFPI will focus its comments on the issue of wood "biomass" energy. PFPI acknowledges that biomass energy may have a small role in Vermont's energy portfolio. We are submitting comments to ensure that the Public Service Board understands that biomass energy has very real limits and exceeding those limits will directly impact Vermont's ability to reduce greenhouse gas emissions from the power sector. Further, exploitation of forests for biomass fuel can have significant impacts on many other forest uses including: clean air and water, topsoil production, erosion and flood control, regional and global climate regulation, fish and wildlife, wild culinary and medicinal plants, tourism and recreation, lumber and furniture, veneer, composite board, mulch, and firewood. Biomass energy is perhaps the lowest use of a tree.

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Using biomass as fuel increases carbon dioxide emissions

While the Vermont's prior energy plans and working copy of the current plan allocate considerable space to the discussion of the need to reduce carbon emissions and the intricacies of greenhouse gas accounting, they make no mention of the carbon impacts of harvesting forests for fuel, even repeatedly referring to biomass energy as a "carbon neutral" technology. This is not in line with current science and understanding. We offer the following background on the current state of understanding on this issue as context for our comments on the role of biomass in Vermont's energy future.

Biomass carbon accounting framework

It is generally accepted that carbon dioxide emissions from stand-alone electricity-generating biomass facilities are around 50% greater than from a coal plant, and 300 – 400% those at a natural gas plant. The problem arises partly because fossil fuels contain more energy per unit carbon than wood and because wood is about 50% water by weight. Before "useful energy" can be generated, the water must be heated and driven off, which consumes energy and degrades facility efficiency. Biomass burners that are operated for combined heat and power (CHP) or thermal only operate at efficiencies closer to those of fossil fuel burners, but the higher efficiency of these smaller biomass burners can be due in part to their using wood pellets or other dried wood as fuel. Drying this fuel and making pellets is an energy-intensive process which itself emits greenhouse gases.

Since it is not controversial that burning biomass for energy emits more CO2 than coal, oil, or natural gas, why is burning biomass for energy so frequently referred to as "carbon neutral?" There are two main arguments:

1. *The "waste" argument for forestry residues*: since the tops and limbs of sawtimber left in place after a harvest decompose and emit CO_2 over time, why not burn that material and generate energy? Leaving aside the fact that the emissions from burning are instantaneous, while decomposition CO_2 is emitted over several years, eventually, the emissions from the two scenarios can be considered equivalent.

2. *The "re-sequestration" argument*: if we cut and burn trees for fuel, thereby releasing carbon, more trees will grow back and tie up the same amount of carbon from the atmosphere that was released.[1] Obviously, however, there is a huge time lag of decades between burning a tree and emitting the carbon, and growing the tree back; additionally, had the tree *not* been cut for fuel, it could have continued to grow and sequester carbon out of the atmosphere. This "carbon sink" effect of forests is recognized in the greenhouse gas inventories published by the EPA and the State of Massachusetts.

The Manomet Study

The State of Massachusetts commissioned the Manomet Study, which included personnel from Vermont's Biomass Energy Resource Center as participants, to explore the forest cutting and carbon implications of increasing biomass energy generation. The Manomet Study compared the scenarios above to determine carbon impacts from biomass power, utilizing a U.S. Forest Service model of forest growth. The model treated carbon emissions from burning forestry residues ("waste" wood) for energy as if they would be equivalent to decomposition emissions after about ten years, if that material had been left onsite to decompose. However, recognizing the amount of wood required to fuel biomass development in Massachusetts far exceeded the amount available as forestry residues, the Manomet team also calculated

[1] An incorrect version of carbon accounting for biomass assumes that cutting and burning trees does not represent a net emission of carbon because some other part of the forest somewhere else is still growing and taking carbon dioxide out of the atmosphere and thereby compensating for the carbon emitted by biomass burning. The Manomet Study has been criticized for not taking this "landscape-level" perspective into account. However, this carbon uptake by the forest "elsewhere" is happening in the same way whether CO2 is being generated by burning biomass, or by burning fossil fuels, and therefore it has no net effect on carbon emissions. Cutting and burning trees over *here* does nothing to make forests over *there* grow faster to compensate. Another way to think about this is by using biofuels as an example. Say the food supply of a town is met by growing 100 acres of corn every year. If one year 25% of that corn is instead used for ethanol production, then only 75 acres are left to feed the town, and people will go hungry. Stating that forests "elsewhere on the landscape" will sequester the carbon released by biomass burning and thereby reduce net carbon emissions to zero is like saying that even if 25% of the corn in the town is used to make ethanol, the food supply will stay the same.

the net carbon emissions from biomass energy when new trees are cut to provide biomass fuel. This situation also pertains in Vermont – as the energy plan itself points out, existing sources of mill waste are already allocated for energy generation, and logging residues are also limited. According to the U.S. Forest Service, the *total* amount of "forestry residues" in Vermont is only between 500,000 and 600,000 green tons. We discuss biomass availability in more detail below.

The Manomet model calculated and compared carbon emissions from biomass with carbon emissions from fossil fuels by examining two scenarios:

1. A "business-as-usual" scenario where forests are cut for sawtimber only and power is generated from fossil fuels.

2. A "biomass" scenario where some biomass power replaces fossil fueled power. Under this scenario, forests are cut for sawtimber and then additional "low value" trees are harvested for biomass fuel, along with partial collection of the tops and branches generated in the harvest.

A key element of the Manomet approach, and part of what makes it scientifically valid, is the acknowledgement that forests are *currently* growing and *currently* sequestering carbon, and this baseline level of carbon sequestration must be taken into account. Thus, in both the biomass and business-as-usual scenarios, the carbon dioxide emitted by energy generation is taken up by forests as they re-grow after cutting. Because using biomass to generate energy emits more carbon than fossil fuels, this creates an initial "carbon debt." Eventually, after a period of several years or even decades, enough of the additional carbon emitted by burning biomass has been recaptured so that "net" emissions for the biomass scenario <u>are the same</u> as net emissions in the fossil-fuel, business-as-usual scenario. Only after this threshold has been achieved – which may take decades – can biomass begin to show a lower net emission of carbon than fossil fuels.

Manomet's calculations[2] of the time required for biomass energy to show equivalent emissions with energy produced from fossil fuels are presented below. As expected, the carbon "payback" times are much shorter when the fuels are confined to "residues that would decompose anyway," as opposed to mixed wood, which is a combination of residues and additional whole tree harvesting. Note that even when replacing an oil thermal system, it still takes 15 – 30 years for biomass emissions under the mixed wood scenario to just achieve parity with emissions from oil. This is not "carbon neutrality" – this is simple equivalence with fossil fuels. When replacing a gas thermal system, the switch to biomass represents greater net carbon emissions for 60 – 90 years.

[2] Walker, Thomas. Manomet & Biomass: Moving Beyond the Soundbite. Presentation to USDA Bioelectricity and GHG Workshop, November 15, 2010.

Massachusetts Carbon Recovery Summary
Emissions from Continuous Operation

Years to Achieve Equal Flux with Fossil Fuels				
Harvest Scenario	Fossil Fuel Technology			
	Oil (#6), Thermal	Coal, Electric	Gas, Thermal	Gas, Electric
Mixed Wood	15-30	45-75	60-90	>90
Logging Residues Only	<5	10	10	30

The State of Massachusetts' response to the Manomet Study

Recognizing that promoting forms of energy that emit more carbon than fossil fuels was incompatible with the State's mandated goals of reducing emissions from the power sector below 1990 levels, Massachusetts responded to the findings of the Manomet Study by proposing regulations that would restrict the eligibility of biomass power for renewable energy credits. The draft regulations provide that lifecycle emissions from eligible biomass, estimated over a twenty-year period, should be no more than 50 percent those of a new natural gas plant. Massachusetts policy recognizes that cutting trees for fuel does not provide carbon neutral or even "low carbon" energy. We hope that the final draft of the Vermont Energy Plan will also acknowledge that over-development of biomass energy threatens goals for reducing greenhouse gas emissions in a timeframe that is meaningful to addressing climate change.

Wood availability is limited in Vermont

"Energy security" is a major argument cited by biomass power proponents, who note that 78% of Vermont is forested.[3] Less frequently mentioned is that much of Vermont's forest is off-limits to biomass energy due to inaccessibility, federal and state protections, and social constraints (people not wanting to log their forests). Potentially countering this in the short term is the fact that a slow housing market and subsequent lower demand for lumber[4] has resulted in less timber sales in Vermont and New England. However this, in turn, means there are fewer "integrated harvest" operations from which to obtain biomass.

Two main sources of biomass have been identified in Vermont: logging residues and "low-grade" trees cut specifically for fuel.[5]

[3] Vermont Woodlands. http://www.vermontwoodlands.org/forestry-facts.asp
[4] University of Vermont Extension. *Stumpage Price Data*, 2011. http://stumpage.uvm.edu/
[5] Some mill residues are used for fuel by existing biomass plants in Vermont, but it is generally accepted that this material often has higher value uses. USFS data indicate that Vermont generates around 200,000 tons/yr.

1) Logging residues consist of the tops, branches, and cull trees left over after commercial timber harvesting. US Forest Service data for Vermont show that the state generates about 522,000 green tons of logging residues annually. At most, one-half[6] of these may be available for use as fuel, or 261,000 tons.
2) Biomass Energy Resource Center's recent analysis[7] of "net available low-grade growth" in Vermont estimates that 894,900 green tons are available annually, after firewood and other uses taken into account.

However, as demonstrated in the following figure, demand for energy wood from existing and proposed facilities in Vermont (proposed demand is actually higher than in this figure) actually far exceeds supply, meaning forest cutting will need to increase dramatically to meet demand. Demand for biomass fuel will far exceed even commercial sawtimber harvests in Vermont.

Wood demand at proposed facilities in Vermont exceeds supply; demand at existing and proposed facilities is more than *double* the supply

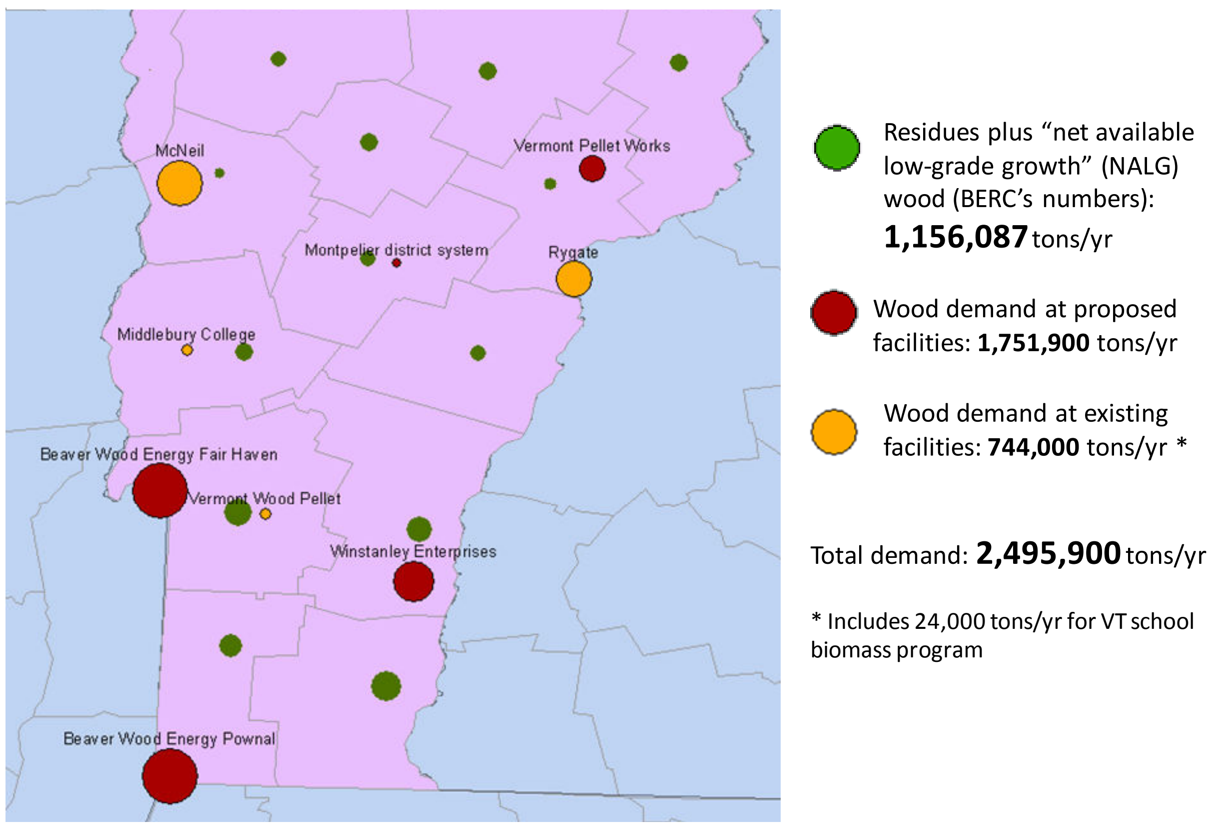

Figure 1. Wood demand at existing and proposed biomass facilities in Vermont compared to county-level estimates of biomass availability provided by the Biomass Energy Resource Center. Circles are scaled to represent demand and supply of wood comparatively. It is important to note that the "net available low-grade growth" supply represents cutting new trees that would not otherwise be cut but for energy wood demand and, as such, represent the biomass fuel source that the Manomet Study identified as having the highest net carbon emissions.

[6] It is important to retain low-diameter material on-site, to maintain soil nutrient stocks and build soil carbon. For nutrient-poor soils, much more than one-half of residues should be retained.
[7] Biomass Energy Resource Center. *Vermont Wood Fuel Supply Study*, 2010. http://www.biomasscenter.org/images/stories/VTWFSSUpdate2010_.pdf

Logging whole trees that would not otherwise be logged is already standard practice for the biomass industry in Vermont – for instance, the McNeil facility states that it uses low-value trees as fuel.[8] If new biomass power facilities were to come online, whole tree harvesting would inevitably play an even larger role. Yet this is exactly the kind of biomass harvesting – even when sourced from "low value" trees – which the Manomet Study identified as having the greatest carbon emissions.

The fact that Vermont already sources a portion of its biomass from out of state does not offer real relief to the question of wood availability. Vermont's neighbors are simultaneously expanding their own biomass energy use, and in some cases are looking to Vermont's forests as a potential fuel source.

Vermont forests are already near carrying capacity for harvesting

A new report from the Cary Institute of Ecosystem Studies (co-authored by Thomas Buchholz, of University of Vermont's Rubenstein School of Environment and Natural Resources) suggests that current estimates of "low grade wood" potentially available as biomass fuel are likely overstated. [9] Some conclusions from the Cary Institute report include:

- The magnitude of the sustainable forest biomass supply is far smaller than most previous studies have suggested.
- Overharvesting would lead to degradation of northeastern forests and actually release more carbon to the atmosphere than would comparable energy production from fossil fuels.
- Total carbon storage in the forests would be expected to continue to increase for many years as carbon stocks in the "reserved" (legally or otherwise) lands continued to increase, but any increase in harvests above current levels would come at the expense of a decline in the total stock of forest biomass in the working forests.
- The current harvest regime over the entire Northeast is very close to (if not greater than) a sustainable rate, when limited to the available land base.

A key factor distinguishing the Cary Institute report is that it does not simply evaluate forest harvest and mortality versus forest growth over the whole landscape, but acknowledges that some forests are heavily utilized, and others less so. This leads the report to come to much more grave conclusions than other studies, such as those of BERC, about the ability of Northeastern forests to meet emerging energy wood demand.

Choices must be made whether to prioritize efficient uses of biomass

Whether or not a Vermont resident heats his home over the winter can be matter of critical importance, but a few extra kilowatt-hours rarely are. The McNeil generating station burns 30 cords of wood an hour at low efficiency to provide electricity for less than the City of Burlington.[10] A Vermont family can be kept warm through the winter in a well-insulated home on three cords a year. As more large-scale biomass burning facilities come online, there is a real danger that availability and affordability of domestic firewood will be reduced.

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[8] Burlington Electric Department. https://www.burlingtonelectric.com/page.php?pid=75&name=mcneil
[9] Cary Institute of Ecosystem Studies. *Forest Biomass and Bioenergy: Opportunities and Constraints in the Northeastern United States,* 2011. http://www.ecostudies.org/report_biomass_2011.pdf
[10] Burlington Electric Department. https://www.burlingtonelectric.com/page.php?pid=75&name=mcneil

Heating with wood is not only more essential than electricity, it is also more efficient. Large-scale, stand-alone electricity generation from biomass ranges from 20-27% efficiency, while some heating applications can exceed 90%.[11] Biomass power effectively wastes three out of every four trees burned.

It is very likely that wood heating will expand in Vermont and across New England, with an increase in wood and pellet stoves, district heating, and combined-heat-and-power (CHP) facilities. However, too great an increase in wood heating will have significant impacts on the environment and human health. A simultaneous expansion of electricity generation from wood biomass, in addition to wood heating, would have enormous impacts. While it seems likely that use of wood for domestic heating could increase, this can not be sustained indefinitely, and must simply act as a bridge to non-combustion technologies such as solar hot water radiant heating and radically expanded home insulation.

Biomass energy is a significant source of conventional air pollutants

The biomass industry insists biomass should be considered a "clean" source of energy. In fact, replacing fossil fuels with biomass doesn't just increase carbon pollution—it emits particulate matter, nitrogen oxides, and carbon monoxide at similar or higher levels than from oil and coal burning, and emissions far exceed those from natural gas. The McNeil generating station is already a significant source of air pollution, and another four facilities are proposed in the state that will significantly add to the state's air pollution burden.

EPA's "boiler rule" standards, issued as a legal requirement under the Clean Air Act, demonstrate just how polluting biomass combustion really is. The EPA emission standards are based on the "best performing" (lowest emitting) facilities that already exist. Nonetheless, they recognize that burning biomass emits as much pollution as coal, with emission standards for utility-scale biomass that are identical to or higher than those for coal for filterable particulate matter, carbon monoxide, hydrogen chloride, mercury, and dioxins.

Actual data from the air permit issued to the We Energies/Domtar biomass electricity plant in Rothschild, Wisconsin, illustrate the pollution profile of even large-scale facilities with sophisticated emission controls. The facility proposes to install two new boilers, one to burn biomass and one to burn natural gas. Comparing the emissions from the two boilers reveals that with the exception of nitrogen oxides, emissions from the biomass boiler are substantially greater than emissions from the natural gas boiler.[12]

Pollutant (emission rate)	Natural gas boiler	Biomass boiler	biomass as % natural gas
total particulate matter (PM2.5; lb/mmbtu)	0.0076	0.024	316%
sulfur dioxide (SO_2; lb/mmbtu)	0.0006	0.2	33333%
nitrogen oxides (NO_x; lb/mmbtu)	0.2	0.1	50%
carbon monoxide (CO; lb/mmbtu)	0.06	0.12	200%
volatile organic compounds (VOC; lb/mmbtu)	0.06	0.12	200%
carbon dioxide (CO_2; lb/MWh)	508	3,050	600%

[11] Biomass Energy Resource Center. *Biomass Energy in Vermont: Opportunities, Issues and Challenges*, 2010.
[12] The relatively high NOx rate from the Domtar gas boiler is likely due to its size and comparative lack of controls; NOx emission rates from the gas combustion turbine at the proposed Pioneer Valley Energy Center in Westfield, MA, would be 0.052 lb/mmbtu, about one quarter the rate at the Domtar plant gas boiler

Per unit energy, emissions from small-scale burners such as those installed at schools and other institutions are even higher, as emissions controls are too costly for these small facilities. Far from being a "clean" source of energy, therefore, biomass burning represents a significant health threat. So much so, in fact, that the newly issued energy policy from the American Lung Association states that the organization "strongly opposes the combustion of wood and other biomass sources at schools and institutions with vulnerable populations."[13] Likewise, the Massachusetts Medical Society has stated that emissions from biomass facilities represent an "unacceptable health risk."[14] Surely, Vermonters expect more from their "clean" energy than biomass power combustion.

Conclusion

The goal of the Vermont Comprehensive Energy Plan is to move the state towards developing energy sources that, unlike fossil fuels and nuclear power, are abundant, safe, and healthy, and above all, do not exacerbate climate change. Biomass energy—biomass electricity in particular—does not meet these criteria. While all energy generation has impacts, no other "alternative" energy source has the potentially immense footprint of biomass energy.

- Instead of providing an inexhaustible supply of "renewable" energy, Vermont's biomass energy demand already exceeds its supply.
- Instead of reducing greenhouse gases, an expansion of biomass energy will increase carbon dioxide emissions over the timeframe meaningful to addressing climate change.
- Instead of protecting the environment, an expansion of biomass energy will threaten the many invaluable ecosystem services forests provide, as well as fish and wildlife, and tourism and recreation dollars.
- Instead of safeguarding public health, biomass combustion emits similar or greater amounts of harmful air pollutants than fossil fuel combustion.

We urge the Public Service Board to consider that biomass power is already playing a major role in Vermont. The state already has two large-scale electricity generating biomass power plants, and a number of smaller facilities. Despite their substantial resource use and emissions, the McNeil and Ryegate generating stations provided just 5.4% of Vermont's total electricity generation in 2009 - yet even this was almost 34 times more power than was generated from wind that year.[15] Energy projects with smaller environmental and health footprints, such as solar and appropriately sited wind and micro-hydro, along with radically expanded efficiency measures, will demonstrably decrease the carbon and pollutant impacts of energy generation. If the Vermont Public Service Board takes these issues into account, the Vermont Comprehensive Energy Plan can act as a model to set the high bar for national energy policy.

Thank you for the opportunity to comment,

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13 http://www.pfpi.net/wp-content/uploads/2011/06/ala-energy-policy-position.pdf
14 http://www.pfpi.net/wp-content/uploads/2011/03/Massachusetts-Medical-Society-_-Massachusetts-Medical-Society-Adopts-Policy-Opposing-Biomass-Power-Plants1.pdf
15 U.S. Energy Information Administration. *2009 generation by state.*