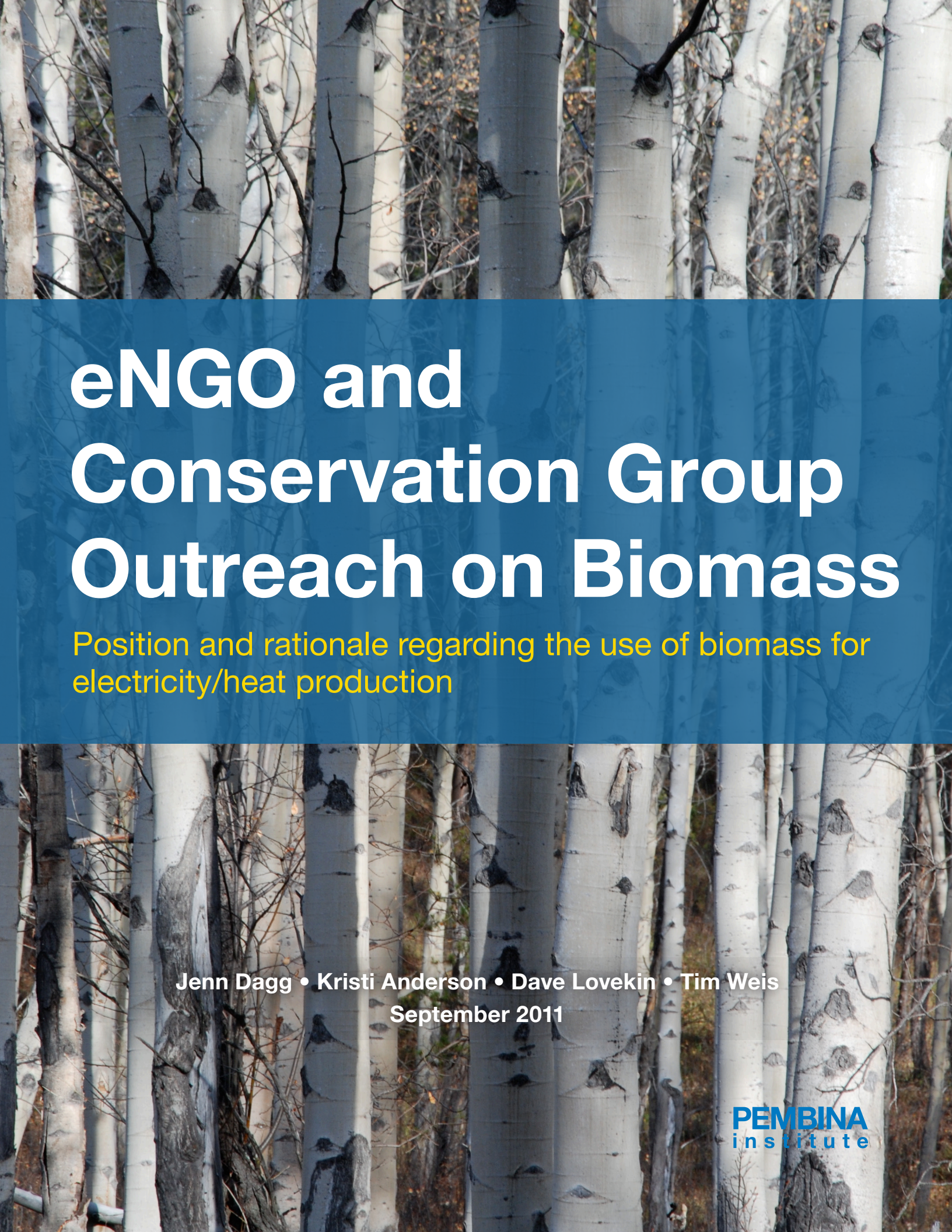

eNGO and Conservation Group Outreach on Biomass

Position and rationale regarding the use of biomass for electricity/heat production

Jenn Dagg • Kristi Anderson • Dave Lovekin • Tim Weis

September 2011

PEMBINA institute

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FINAL REPORT

Revision B

Jenn Dagg • Kristi Anderson • Dave Lovekin • Tim Weis

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the PEMBINA institute

Sustainable Energy Solutions

ENGO and Conservation Group Outreach on Biomass
FINAL report - rB

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About the Pembina Institute

The Pembina Institute is a national non-profit think tank that advances sustainable energy solutions through research, education, consulting and advocacy. It promotes environmental, social and economic sustainability in the public interest by developing practical solutions for communities, individuals, governments and businesses. The Pembina Institute provides policy research leadership and education on climate change, energy issues, green economics, energy efficiency and conservation, renewable energy, and environmental governance. For more information about the Pembina Institute, visit www.pembina.org or contact info@pembina.org. Our engaging monthly newsletter offers insights into the Pembina Institute's projects and activities, and highlights recent news and publications. Subscribe to Pembina eNews: http://www.pembina.org/enews/subscribe.

Disclaimer

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The views, statements, and conclusions expressed and the recommendations made in this report are therefore entirely those of the authors and should not be construed as statements or conclusions of, or as expressing the opinions of Environment Canada or Natural Resources Canada, Canadian Forest Service.

eNGO and Conservation Group Outreach on Biomass

Position and rationale regarding the use of biomass for electricity/heat production

Contents

List of Tables

Executive Summary

Environment Canada is leading and coordinating an interdepartmental Federal Advisory Committee to complete a full life cycle analysis (LCA) of biomass feedstock for the end-use of electricity/heat production. An important component to this work is a thorough understanding of the benefits and sensitive environmental issues and aspects associated with utilizing biomass from crown land forests, private woodlots and agricultural bioenergy crops for the purpose of electricity/heat production.

Environmental non-governmental organizations (eNGOs) and conservation groups hold critical perspectives on the use of forest-based biomass for energy production. This report summarizes the opinion and feedback from a spectrum of Canadian eNGOs and conservation organizations focusing on energy, climate and forest conservation issues. The focus of this report is primarily on forest-based biomass with some research into opinions on the use of agriculture biomass. Of equal importance are the socio-economic benefit and concerns related to forest-based bioenergy; however this area is not researched in this work.

The information was collected from a range of eNGOs and conservation groups across Canada using on-line research of public opinion, one-on-one interviews and an on-line survey. Each organization brings specific regional context and opinions on biomass for energy production. This work identifies overall themes on benefits and relative levels of concern for specific issues, level of awareness and research gaps across the breadth of issues.

Support and benefits of biomass

We found:

- Support for small-scale, distributed, high combustion efficiency biomass systems.
- Support for utilizing a local energy resource as opposed to importing fossil fuels. The environmental benefit is reduced transportation emissions, especially for rural and remote communities.
- Support for end-of-life biomass resources including wood diverted from landfill, sawmill and pulpmill waste. These sources are considered more of a waste than other biomass sources and provide the benefit of reduced fossil fuel consumption and associated GHG reductions.
- Support for grass and short-rotation woody crops on crown lands, private lands and marginal agriculture lands, provided there is are acceptable certification and regulatory standards. The benefits of utilizing short-rotation woody crops include a favourable GHG emissions profile and efficient use of marginal agricultural lands which in turn could reduce the demand for forest-based biomass.

- Support for exploring stem-only harvesting specifically in the Great Lakes – St. Lawrence region of Ontario. This harvest could take advantage of abundant low-grade biomass and could lead to improved silviculture practices in the region.

Support for utilizing stems versus slash as a biomass resource was mixed. There was more support for harvesting and utilizing the trunks (i.e., stems) of trees compared to forest residue; however there were some opposing views on this. As the trunks of trees contain more energy than forest slash, the benefit of harvesting trunks only compared to forest residues is that less forest land would be disturbed.

Concerns and issues – main themes

Three main environmental themes emerged as the most significant:

- Biodiversity, wildlife habitat and endangered species issues
- Soil fertility and forest productivity
- Carbon accounting frameworks and GHG emissions

The first two themes, biodiversity/wildlife and soil productivity, are closely related and the central point for both issues is the acceptable amount of residues that remains in the forest after harvesting. Both issues have their unique and specific challenges and are very site-specific, and there is support from organization for further research to determine this threshold of nutrient-rich forest slash that must remain before there are negative ecological impacts. This forest slash provides habitat for wildlife as well as a source of decaying carbon for dead organic matter pools.

Specifically for biodiversity and wildlife, the highest concern was around the impact on caribou and migratory birds and that current policies around protecting these species are not adequate. For forest productivity, the concerns were around soil acidity, soil erosion and the important role coarse woody debris plays in microbial populations and healthy soils.

The theme of carbon accounting frameworks and an adequate planning horizon to accurately capture GHG emissions associated with the full impact of biomass usage was also mentioned as a critical issue. Concern was repeatedly expressed over the false understanding of carbon neutrality from biomass.

Other notable and related concerns were the overall effect of increasing pressure on forests from an additional biomass industry; the effect climate change will have on Canada's forests; whether current forest management practices are considered sustainable; impacts on water; air emissions; and the conversion of primary forests to managed forests.

Data and research gaps

The most commonly identified scientific research gap specific to Canada was the impacts on soil nutrients, fertility and forest productivity resulting from biomass and forest residue removal. Many references citing impacts to Europe's forests were provided, and it was emphasized that this effect is not well understood and that much more research is needed in Canada. Several examples were provided highlighting the research that is occurring at Canadian universities and

government organizations, including the University of Toronto and the Ontario Ministry of Natural Resources.

Main observations

The main observations from this work are summarized as follows:

- Strongest support was expressed for the use of biomass in small-scale, distributed, high combustion efficiency processes used to produce heat or heat and electricity.
- Sawmill waste, pulpmill wastes and municipal solid wastes were the top priority wastes to be considered as viable biomass resources.
- The three most significant environmental issues expressed among organizations were biodiversity / wildlife habitat, soil fertility / forest productivity and carbon accounting frameworks for forest-based biomass used for energy generation.
- There is great concern amongst organizations on the assumption that biomass combustion is carbon neutral. Organizations noted that reductions in GHG emissions depend very much on the carbon account framework used, and the circumstance of biomass resource extraction, processing and utilization.
- There are varying views and differences of opinion on the harvesting of stems for bioenergy, and leaving slash on-site.
- It is the opinion of many organizations that forest residue is not an acceptable biomass resource. This material is essential for biodiversity, wildlife habitat, soil fertility and forest productivity.
- Much more research, planning and regulations are encouraged for site-specific and stand-level impacts of forest harvesting and residue retention as they relate to biodiversity, wildlife habitat and soil fertility. A better understanding of residue removal and identification of nutrient-poor sites and stand-level retention targets are also encouraged.
- There was little information received on the tradeoffs between biomass for energy and other forms of energy – fossil fuels or other renewable energy options. It can be summarized that the general opinion was that biomass for energy has less environmental impacts that coal and potentially less environmental impacts than natural gas; however rationales and justifications for these opinions were not received.
- The use of forest-based biomass for energy is relatively new in Canada, and therefore the environmental concerns, along with the knowledge and research being conducted, are also new relative to the situation in other jurisdictions, specifically Europe.
- The environmental concerns related to forest-based biomass in Canada, the knowledge and research being conducted in Canada is new relative to the situation in other jurisdictions – specifically Europe. Many organizations expressing concern appear to be doing so based on a more precautionary approach and stressed the need for further research in Canada.

1. Introduction

1.1 Overview and scope

Environment Canada received funding from Natural Resources Canada's Clean Energy Fund in the fall of 2010 to lead, co-ordinate and manage an interdepartmental Federal Advisory Committee to complete a full life cycle analysis (LCA) of biomass feedstock for electricity/heat production. This work is focused on identifying environmental impacts and benefits of biomass use as it relates to ecosystem and resource sustainability, with respect to crown land forests, private woodlots and agricultural bioenergy crops.

An important component to this work is a thorough understanding of the sensitive environmental issues and aspects associated with utilizing biomass for electricity/heat production. Key stakeholders including eNGOs and conservation groups hold critical perspectives and an environmental understanding of the benefits and issues around forest-based biomass. Biomass for liquid biofuel production is not included in the scope of this work.

The research contained herein is focused on gathering the spectrum of eNGO and conservation groups' opinions on the benefits and concerns of using biomass for electricity/heat generation. The focus is primarily on forest-based biomass, with some research into opinions on the use of agriculture biomass. Because there were no discernable trends, this report does not regionally categorize the opinions or differentiate the opinions based on the method of information collected, that is, public opinion polling, one-on-one interviews and an online survey. Rather, this report pulls together the opinions on biomass from all sources in order to make meaningful conclusions and observations that Environment Canada can use for the LCA project and beyond.

This research focuses on national and provincial Canadian eNGO and conservation groups that work in the fields of energy, climate change and forest conservation. The intersection of these categories and the environmental benefits/issues related to forest-based biomass for energy production are of key interest. Of equal importance are the socio-economic benefits/issues related to forest-based bioenergy; however, this area has not been researched in this work.

When possible, the views and opinions are summarized with respect to comparing the environmental benefits, concerns and tradeoffs of biomass to fossil fuels. However, the focus of this report is to understand the concerns that eNGO and conservation groups have with respect to practices surrounding the use of biomass for energy. The comparison and tradeoffs between biomass and fossil fuels are not necessarily direct. Understanding and addressing concerns with respect to biomass will help situate its use when compared to these energy alternatives.

1.2 Project objective

The objective of the project is to provide Environment Canada detailed information about the environmental sustainability issues that are considered to be of particular relevance to environmental groups. This will help to inform the scope of the larger life cycle analysis project. The information collected, compiled and summarized is intended to help ensure that the

environmental and sustainability benefits as well as the concerns related to biomass for electricity/heat are adequately understood and addressed. This work identifies overall themes and relative levels of concern for specific issues and the level of awareness as well as the gaps that are present across this breadth of issues amongst stakeholders in order to inform LCA and metric developments related to forest-based biomass use for electricity and heat production.

1.3 Outline of report

This report has six chapters:

- Chapter 2 provides a summary of the methodology used in the research work to collect and compile the information presented in this report.
- Chapter 3 discusses and summarizes the literature review of researched eNGOs/conservation groups that have made their opinions or positions public on the use of biomass for electricity and/or heat generation.
- Chapter 4 discusses and summarizes the information collected through one-on-one interviews.
- Chapter 5 summarizes the results of the online survey
- Finally, Chapter 6 provides a summary of key findings and themes on the main environmental benefits and issues related to biomass use for electricity/heat generation. The chapter concludes with a series of observations that should be considered when developing metrics on the use of biomass for heat and/or electricity production, and recommendations for further research.

2. Methodology

The information collected and presented for this project was compiled through a literature review (Chapter 3), phone interviews (Chapter 4) and an online survey (Chapter 5) of key eNGO and conservation organizations that have an understanding of the use of biomass for electricity and/or heat production in Canada. The methodology for these three steps is outlined below.

2.1 Literature review

Publicly documented positions with respect to the use of biomass for electricity and/or heat production were reviewed from a broad range of eNGOs, conservation groups and human rights and/or First Nations organizations.

The sources of information that were reviewed for this phase include:

- Websites;
- Reports;
- Press releases; and
- Statements to government committees.

The full list of eNGOs and conservation groups surveyed in the literature review can be found in Appendix A.

2.2 One-on-one interviews

Representatives from eNGO and conservation organizations were contacted for one-on-one interviews to discuss their understandings of potential benefits and concerns associated with the use of biomass for heat and/or electric power in Canada.

2.2.1 Rationale for choices

The organizations were selected based on their level of experience and engagement in the fields of energy, climate change and forest conservation as well as the Pembina Institute's previous interactions with them and knowledge of their activities. Attempts were made to have interviews with a broad mix of representatives from regional and national organizations as well as the three areas of forest conservation, energy and climate change.

2.2.2 Interview questions

Below is the list of interview questions that were used when interviewing individual representatives from eNGOs and conservation organizations.

Preamble

The Pembina Institute is conducting research on environmental and conservation organizations' views on the benefits and impacts on the use of biomass for energy production (electricity/heat) for Environment Canada. This information will be compared against existing knowledge to help identify areas where further research is needed and to help inform the federal government in developing bioenergy policies. This research is focused on the benefits and impacts from harvest of forest biomass and cultivation of agricultural bioenergy crops (i.e. not biofuel production).The research is focused on environmental factors only and does not include social and economic factors.

For each of the questions listed below, it would assist us greatly if you could provide scientific references and resources to support your responses.

Please note that participation in this project is not a substitute for, or a pre-emption of any need for a later public consultation process with respect to potential government policies or programs that may be developed.

Responses from all survey participants will be synthesized. You or your organization may remain anonymous if you desire. We may request a follow-up phone conversation to answer any information provided that requires clarity.

We welcome any further information by email if you would like to take more time to answer any of these questions.

General

1. *Does your organization have a stated position or a policy on the use of forest biomass (and, to a lesser extent, agricultural biomass) for generating energy? Can you direct us to these resources?*

2. *If biomass can be sourced in such a way that the environmental impacts are acceptably managed, what are your 'top of mind' and most significant benefits of using biomass for energy compared to using fossil fuels?*

3. *What are the 'top of mind' and most significant concerns of using biomass for energy compared to using fossil fuels?*

Forest biomass

1. *What do you think are the biggest environmental impacts and benefits of using whole tree forest biomass for energy production (trunk only)? This can include impacts and benefits associated with harvest, transportation, combustion, silviculture, etc.*
    a. *Can you rank these impacts and benefits in order of importance?*
    b. *Are there local issues, recent studies, or practices that have made any of these issues particularly important in your region?*

2. *What do you think are the biggest environmental impacts and benefits of using tree tops and branches from existing forestry operations (tops and branches used for bioenergy, trunk used for other purposes) for energy production?*
    a. *Can you rank these impacts and benefits in order of importance?*
    b. *Are there local issues, or recent studies, or practices that have made any of these issues particularly acute in your region?*

3. *Are any of the concerns or benefits noted above specific to biomass from private lands as compared to crown land?*

4. *How do you think forest management guidelines/practices and conservation initiatives affect the impacts noted above (i.e.do protected areas or good management practices contribute to mitigation of the impacts from harvesting)?*

5. *What research needs or information gaps do you believe need to be addressed to better understand the impacts and benefits of sourcing of forest biomass?*

Agricultural bioenergy

1. *What do you think are the biggest environmental impacts and benefits of cultivation of agricultural bioenergy crops for energy production? (Crops include fast growing perennial grasses like switchgrass, and tree species like hybrid poplar or willow.)*
    a. *Can you rank these impacts and benefits in order of importance?*
    b. *Are there local issues, or recent studies, or practices that have made any of these issues particularly important in your region?*

Overall sustainability (apply both to forest and agriculture)

1. *How does scale of harvest/cultivation of biomass influence your opinion of the severity of the impacts and benefits noted above? What scale is appropriate in your region?*

2. *How does the planning horizon (timeline) of harvest/cultivation biomass influence your opinion of the severity of the impacts and benefits noted above? What is an appropriate planning horizon in your region if carbon neutrality is to be assumed?*

3. *Are you aware of any innovations/technologies measures that can help reduce the environmental impacts of using biomass for energy production (i.e. harvesting / silviculture techniques, biochar, pyrolysis, carbon capture and storage)?*

4. *In your opinion, if we are going to harvest biomass, what is the most optimal use of biomass? What makes this choice optimal (i.e. electricity, heat, fuels, pulp and paper, high value forest products)?*

5. *What criteria should be used to evaluate the environmental sustainability of use of biomass for heat/electricity production?*

a. *Could you suggest the 3 most important criteria in your opinion?*
b. *Below these questions you will find a table of criteria developed from a literature review of various certification schemes and guidelines from other organizations. Could you choose the top 5, and the second top 5 criteria in terms of importance, and provide comments about the criteria or additional criteria that you find are lacking?*

6. *How would you rank biomass for energy in terms of overall environmental impacts compared to other forms of energy (e.g., coal, natural gas, oil, nuclear, geothermal, solar, wind, tidal, wave)? It would be helpful if you could give some explanation of the rationale for your ranking.*

Policy development

1. *How do you suggest these environmental impacts and benefits be considered in the development of policies regarding biomass for energy production? (whole life cycle)*

2. *Are there examples of biomass policies in Canada or internationally that you think are good policies, or that address your specific concerns of yours?*

2.3 On-line survey

In order to gather as much information as possible, an online survey was prepared after the one-on-one interviews, and was then sent to additional eNGOs and conservation groups to get more feedback from individuals that were not interviewed. The online survey was conducted using the web service WebMonkey[1].

[1] www.webmonkey.com

3. Literature Review

This chapter summarizes a literature review from forest conservation, climate change/energy and human rights/First Nations groups.

3.1 Conservation organizations

A total of 15 conservation groups (listed below) representing national or regional interests were reviewed for public positions on biomass for electricity and/or heat production. Eight of these organizations (53%) had stated positions on the use of forest biomass for energy and seven (47%) organizations did not.

The list of conservation organizations researched for public opinion on the use of biomass for electricity and/or heat production include:

- Canadian Parks and Wilderness Association
- Algonquin Wildlands League
- Canadian Boreal Initiative
- Environment North
- Bird Studies Canada
- Alberta Wilderness Association
- Yukon Conservation Society
- Ivey Foundation

The following conservation groups had no public opinion on the use of biomass for electricity and/or heat production:

- Nature Canada
- Manitoba Wildlands
- Nature Saskatchewan
- Friends of the Earth Canada
- Nature Conservancy of Canada
- Wildlife Habitat Canada
- Ecosuperior

Some groups provide information that discusses the carbon sequestration of forests and how carbon storage may be impacted by additional biomass harvesting for electricity/heat production, while a few of the organizations discussed other issues around carbon management by the forestry industry. In particular, the issue of burning sawmill waste is discussed. The Canadian Parks and Wilderness Society (CPAWS) express that burning sawmill waste helps to reduce the

use of fossil fuels by the forest industry.[2] However, the Algonquin Wildlands League, a chapter of CPAWS, express that "energy derived from any of the *waste* material taken off of the forest, or generated in the mill, is referred to by some as being *carbon neutral*, but to the atmosphere, burning this material is still an input – more carbon dioxide is more carbon dioxide".[3] The Canadian Boreal Initiative published a report to highlight the importance of carbon retention in the boreal forest. The report points out that boreal forests store more carbon than any other terrestrial ecosystem on earth – twice as much per area as tropical forests.[4]

Regarding carbon accounting, CPAWS makes the recommendation that companies should document the impact of woody bioenergy on greenhouse gas emissions, paying attention to the impact on carbon sequestration in forest soils and carbon emissions incurred during logging and transportation.[5] The Canadian Boreal Initiative makes an even stronger statement: "accounting for all anthropogenic impacts to forest and peatland carbon should be mandatory, and biotic carbon projects should be required to have a positive or neutral effect on biodiversity and ecosystem services."[6] Another issue around carbon accounting discussed by the Algonquin Wildlands League is the allocation of carbon emissions by sector. They state that "accounting rules typically place secondary emissions from hauling wood and products into the 'transportation sector'. This lumps them in with everything else on the road and rails, hiding the true carbon footprint from sight. This is particularly important in Canada's boreal forest, where haul distances are much greater than most other jurisdictions."[7]

CPAWS identifies the issue of air emissions as a concern related to biomass combustion. "Burning woody biomass may harm human health depending upon the technology used and the location of the burning. Precaution is warranted."[8]

The issues of forest site productivity and the use of harvesting residue is also raised by CPAWS: "increasing the removal of woody biomass increases the risks already posed by current practices. Woody biomass serves important ecological functions and the forest needs more of it, not less. Using the woody biomass left behind after logging — such as live trees and standing dead trees as well as dead and decaying downed trees, tree tops and limbs — for bioenergy conflicts with

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[2] Canadian Parks and Wilderness Society, "Logging to save the planet? "Woody bioenergy" and climate change", Fact Sheet, http://www.cpaws.org/files/facts_woody-bioenergy.pdf

[3]Trevor Hesselink, Director, Forests Program, "Can't See the Forest for Trees", Letter to the Editor, Toronto Star, November 2, 2007, http://www.wildlandsleague.org/display.aspx?pid=43&cid=297 (accessed March 28, 2011).

[4] Carlson, M., Wells, J., Roberts, D. 2009. The Carbon the World Forgot: Conserving the Capacity of Canada's Boreal Forest Region to Mitigate and Adapt to Climate Change. Boreal Songbird Initiative and Canadian Boreal Initiative, Seattle, WA, and Ottawa. 33 pp. http://www.borealbirds.org/resources/carbon/report-full.pdf (accessed March 28, 2011)

[5] Canadian Parks and Wilderness Society, "Logging to save the planet? Woody bioenergy and climate change", Fact Sheet, http://www.cpaws.org/files/facts_woody-bioenergy.pdf

[6] Carlson, M., Wells, J., Roberts, D. 2009. The Carbon the World Forgot: Conserving the Capacity of Canada's Boreal Forest Region to Mitigate and Adapt to Climate Change. Boreal Songbird Initiative and Canadian Boreal Initiative, Seattle, WA, and Ottawa. 33 pp. http://www.borealbirds.org/resources/carbon/report-full.pdf (accessed March 28, 2011)

[7]Trevor Hesselink, Director, Forests Program, "Can't See the Forest for Trees", Letter to the Editor, Toronto Star, November 2, 2007, http://www.wildlandsleague.org/display.aspx?pid=43&cid=297 (accessed March 28, 2011).

[8] Canadian Parks and Wilderness Society, "Logging to save the planet? "Woody bioenergy" and climate change", Fact Sheet, http://www.cpaws.org/files/facts_woody-bioenergy.pdf

ecosystem-based management. It supports a wide diversity of small organisms from insects to fungi to moss, which work to break down the wood and return nutrients to the soil. It protects the soil from erosion into streams and serves as a source of nutrients and moisture for the growth of new trees."[9]

A few organizations (i.e. CPAWS, Environment North, Bird Studies Canada and Alberta Wilderness Association) discuss the importance of forests for wildlife habitat and the contribution to biodiversity. CPAWS specifically discusses these issues around use of forest biomass. They point out that the woody biomass left in the forest after traditional logging operations provides habitat for birds, such as woodpeckers and owls, and animals, such as pine marten.[10]

Although not directly related to use of forest biomass for energy, peat is sometimes used as a fuel. Environment North cautions that extraction and use of peat as an alternative fuel source is incompatible with the government's intent to conserve biodiversity and address climate change.[11]

Bird Studies Canada emphasized in a report the importance of the boreal region to the well-being of many species of North American waterfowl, shorebirds, waterbirds and landbirds. The report goes on to state that nearly half of all North American birds (325 species) rely on the boreal region. Over 300 of those species regularly breed in this region and among these 50 per cent or more of the entire breeding populations occur within the Boreal Forest Region for at least 96 species.[12] The Alberta Wilderness Association (AWA) recommends establishing large, interconnected, protected forests as ecological benchmarks to protect critical wildlife habitat.[13]

Regarding forestry practices and management, the AWA advocates for the use of the Forest Stewardship Council (FSC) National Boreal Standard as a minimum, which they note was developed with broad national input.[14] The Algonquin Wildlands League suggests that FSC is currently the only independent and credible certification scheme in the market.[15]

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[9] Canadian Parks and Wilderness Society, "Logging to save the planet? "Woody bioenergy" and climate change", Fact Sheet, http://www.cpaws.org/files/facts_woody-bioenergy.pdf

[10] Canadian Parks and Wilderness Society, "Logging to save the planet? "Woody bioenergy" and climate change", Fact Sheet, http://www.cpaws.org/files/facts_woody-bioenergy.pdf

[11] http://www.environmentnorth.ca/Docs/Peat%20Policy%20Letter%20June%202010%20FINAL.pdf

[12] Blancher, P., and J. Wells, The Boreal Forest Region: North America's Bird Nursery, Boreal Songbird Initiative, Bird Studies Canada and the Canadian Boreal Initiative, April 2005. http://www.bsc-eoc.org/download/Blancherborealnurseryrpt2005.pdf (accessed March 28, 2011).

[13] Alberta Wilderness Association, "Precaution and Protection Needed to Thwart Ecological Nightmare in Alberta's Forests", News Release, March 22, 2006, http://albertawilderness.ca/issues/wildlands/forests/archive/2006-03-22-awa-news-release-precaution-and-protection-needed-to-thwart-ecological-nightmare-in-alberta2019s-forests/at_download/file (accessed March 28, 2011).

[14] Alberta Wilderness Association, "Precaution and Protection Needed to Thwart Ecological Nightmare in Alberta's Forests", News Release, March 22, 2006, http://albertawilderness.ca/issues/wildlands/forests/archive/2006-03-22-awa-news-release-precaution-and-protection-needed-to-thwart-ecological-nightmare-in-alberta2019s-forests/at_download/file (accessed March 28, 2011).

[15] Behind the logo: An environmental and social assessment of forest certification schemes, http://www.wildlandsleague.org/attachments/behindthelogo.pdf (accessed March 28, 2011).

Bird Studies Canada identifies loss of habitat and changing land use patterns as factors affecting migratory birds at all stages of their life cycle.[16] The Algonquin Wildlands League specified the need to manage our forests carefully. The group suggests doing so by protecting intact ecosystems and wildlife, preserving traditional lifestyles and livelihoods as well as by balancing the public interest in public forests with resource activities like mining, hydroelectric power generation, logging and road building.[17]

The Canadian Boreal Initiative expresses a conservation approach to forest management to maintain ecosystem services and provide resilience: "Protection of intact forest ecosystems and sustainable forest management will not only maintain globally significant carbon stores, but also maintain the capacity of the boreal region to resist and adapt to climate change. This approach is embodied in the Boreal Forest Conservation Framework, which calls for the establishment of a network of large interconnected protected areas covering at least half of the Canadian Boreal Forest and the use of leading-edge sustainable development practices in the remaining areas".[18] The Ivey Foundation echoes this approach, stating that the Foundation is focused on protection and sustainable use for conserving forests and forest values in Canada. The Ivey Foundation asserts that there needs to be an adequate amount of protected forest, including representative and intact ecosystems at adequate scale and that best practices for sustainable forest management need to be adopted across Canada.[19]

CPAWS offers a number of recommendations relating to the use of biomass for energy production, including advice about forestry management:[20]

- Conduct an environmental assessment of the life-cycle impacts of woody bioenergy production;
- Test the collection of woody biomass in a pilot program that will monitor and evaluate its environmental impacts;
- Incorporate the demand for woody biomass arising from woody bioenergy production into wood supply calculations;
- Regulate downed wood retention targets;
- Regulate site soil-disturbance thresholds;
- Ensure industry pays the public a fair market value for this new use of our public forests and to ensure that it is used efficiently to produce energy;

[16]Audrey E. Heagy and J.D. McCracken, Monitoring the State of Ontario's Migratory Landbirds, Bird Studies Canada 2004. http://www.bsc-eoc.org/download/StateofONbirds.pdf (accessed March 28, 2011).

[17]Caring for the Forest, New: 22 Nov. 2006 - Energy Subsidy Falls Short of the Mark. http://www.wildlandsleague.org/display.aspx?pid=43&cid=43 (accessed March 28, 2011).

[18] Carlson, M., Wells, J., Roberts, D. 2009. The Carbon the World Forgot: Conserving the Capacity of Canada's Boreal Forest Region to Mitigate and Adapt to Climate Change. Boreal Songbird Initiative and Canadian Boreal Initiative, Seattle, WA, and Ottawa. 33 pp. http://www.borealbirds.org/resources/carbon/report-full.pdf (accessed March 28, 2011)

[19]Conserving Canada's Forests, Program Guidelines, Revised January 2009,http://www.ivey.org/programs/ccforests.html

[20] Canadian Parks and Wilderness Society, "Logging to save the planet? "Woody bioenergy" and climate change", Fact Sheet, http://www.cpaws.org/files/facts_woody-bioenergy.pdf

- Regulate stand-level retention targets for logged areas, including the retention of standing dead-trees and representative patches of live-trees
- Regulate the planning of woody biomass collection to require the identification of sites where collection is to occur within forest management plans; and
- Require the assessment of a nutrient budget for each woody biomass collection site.

Five of the groups had published material discussing appropriate or inappropriate sources of biomass. A common theme was on the emphasis of using sawmill waste as a fuel source. The Canadian Boreal Initiative suggests that, "strategies such as burning wood waste to power forestry mills have substantial [GHG] mitigation potential due to the high proportion of forestry emissions related to forest product processing, transport, and disposal."[21] CPAWS advocates for the use of sawmill waste, such as sawdust, and pulpmill waste, and black liquor left over from the pulping process, as excellent feedstocks for bioenergy.[22]

The Yukon Conservation Society states that biomass projects could produce heat in the winter season and could also provide opportunities for electricity cogeneration. However, they offer the caveat that each biomass project would have to be carefully evaluated to ensure it meets clean criteria and green certification. This group specifies that for biomass, this would include fuel sourced only from waste and that rigorous emission standards would have to be applied.[23]

The Algonquin Wildlands League expresses concern that the current models used to estimate allowable cut in Ontario are based on unsubstantiated assumptions.[24] Thus by extension, harvesting biomass up to the level of the currently approved allowable cut would be unacceptable for this group. However, the League states that "there are opportunities for the forest industry to become net energy producers under the province's open market energy system and to earn greenhouse gas reduction credits as well if they can make significant cuts to emissions by increasing efficiency or developing low or no emission power sources."[25]

In an article on biofuels, Environment North warns against using willow or switchgrass as they are invasive species.[26]

A few groups provide statements relating to bioenergy and electricity policy or forestry management practices. CPAWS provides comments regarding bioenergy policy and the concept

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[21] Carlson, M., Wells, J., Roberts, D. 2009. The Carbon the World Forgot: Conserving the Capacity of Canada's Boreal Forest Region to Mitigate and Adapt to Climate Change. Boreal Songbird Initiative and Canadian Boreal Initiative, Seattle, WA, and Ottawa. 33 pp. http://www.borealbirds.org/resources/carbon/report-full.pdf (accessed March 28, 2011)

[22] Canadian Parks and Wilderness Society, "Logging to save the planet? "Woody bioenergy" and climate change", Fact Sheet, http://www.cpaws.org/files/facts_woody-bioenergy.pdf

[23] Anne Middler, Energy Coordinator, Yukon Conservation Society, Re: Independent Power Production and Net Metering – Developing a Policy for Yukon, http://www.yukonconservation.org/energydocuments/YCS%20comments%20on%20IPP%20discussion%20paper.pdf (accessed March 28, 2011).

[24] Pearce, D. and T. Hesselink, Ontario's logging levels may be wishful thinking, http://www.wildlandsleague.org/attachments/harvest_levels_press_release_final.pdf (accessed March 28, 2011).

[25] Wildlands League, The future of Ontario's Forests: Wood, jobs and wilderness. http://wildlandsleague.org/attachments/Wood%20Jobs%20and%20Wilderness.pdf (accessed March 28, 2011).

[26] Scott Harris, Biofuels: Proceed with Caution, http://www.environmentnorth.ca/Docs/biofuels.jpg

of carbon neutrality. In response to a policy document introduced by the Western Climate Initiative, CPAWS comments that the policy failed to recognize the real emissions that result from logging and burning natural forests to produce electricity by treating them as carbon neutral.[27] CPAWS goes on to say that creating a market to burn natural forests for electricity could result in much greater pressures to log these forests and accelerate clear cutting of northern pristine boreal forests.[28]

In a statement on the Ivey Foundation's website, Chris Henschel, an expert on forests and climate change for CPAWS states that "the problem is that it can take more than a hundred years for a natural forest to take the carbon back from the atmosphere, if it ever does. In the meantime, switching to woody bioenergy actually increases emissions in the short-term when reductions are most urgently needed".[29]

The Algonquin Wildlands League published a report that made several recommendations regarding policy for forest management practices. The policy reforms suggested are:

- Accelerate the adoption of alternative silviculture approaches within a well-defined adaptive-management framework that is supported by research.
- Revise information requirements for forest resource inventories and permanent sample plots to include measures of habitat structure.
- Revise harvest-modeling approaches to incorporate alternatives to clear-cutting and their potential effect on the allowable cut.

3.2 Energy/Climate organizations

A total of 16 organizations, whose primary focus with respect to biomass is on energy/climate, are listed below. They were reviewed for public positions on biomass for electricity and/or heat production. Nine of these organizations (56%) have stated positions on the use of forest biomass for energy while seven organizations (44%) do not.

The list of energy/climate organizations researched for public opinion on the use of biomass for electricity/heat production include:

- WWF Canada
- Sierra Club
- David Suzuki Foundation
- Greenpeace Canada
- The Ecology Action Centre
- The Conservation Council of New Brunswick

[27]CPAWS accuses Western Climate Initiative of ducking a burning issue, September 24, 2008, http://cpaws.org/news/archive/2008/09/cpaws-accuses-western-climate.php (accessed March 28, 2011).

[28]CPAWS accuses Western Climate Initiative of ducking a burning issue, September 24, 2008, http://cpaws.org/news/archive/2008/09/cpaws-accuses-western-climate.php (accessed March 28, 2011).

[29]Conserving Canada's Forests, Program Guidelines, Revised January 2009, http://www.ivey.org/programs/ccforests.html

- The Pembina Institute
- Saskatchewan Environmental Society
- Conservation Council of New Brunswick

The following groups do not have a public opinion on the use of biomass for electricity/heat production:

- Association Québécoise de lutte contre la pollution atmosphérique
- British Columbia Sustainable Energy Association
- Climate Action Network (CAN) Canada
- Ecology North
- Environmental Defence Canada
- Equiterre
- International Institute for Sustainable Development

A number of groups have concerns regarding carbon storage and the claim of carbon neutrality of biomass. WWF expresses concerns that poorly managed biomass harvesting or cultivation could lead to a net increase of carbon to the atmosphere, [30] and that it is acceptable to use biomass for energy only if there are no negative impacts to critical carbon storage functions of natural ecosystems.[31] The Ecology Action Centre (EAC) states concerns that large-scale production of biomass for energy will lead to increases in short-term atmospheric carbon.[32]The David Suzuki Foundation states that it is in favour of use of biomass if it can achieve overall reduction of GHG emissions.[33] Greenpeace Canada believes that whole-tree harvesting (i.e., stem + tops + branches) and combustion of biomass will never achieve carbon neutrality due to the time horizon for regeneration and upstream energy inputs required for transportation and energy losses for inefficient electricity generation.[34]The Pembina Institute discusses the potential of biomass (including forest-based biomass) to replace the use of fossil fuels as a way to reduce greenhouse gas emissions.[35]

A few groups express concerns about the impacts of forest-based biomass harvest on site productivity. The David Suzuki Foundation states that removal of tree branches and leaves will

[30]WWF Position Paper on Bioenergy (2008)
http://assets.panda.org/downloads/wwf_position_paper_on_bioenergy_291107.pdf

[31] WWF, *Position Paper on Bioenergy* (2008)
http://assets.panda.org/downloads/wwf_position_paper_on_bioenergy_291107.pdf

[32] Ecology Action Centre, *Direct Evidence for UARB Hearing CI 39029* (2010)
http://www.nsuarb.ca/NSUARB_Exhibits_JOOMLA/get_document.php?doc=N-17&no=1315

[33] David Suzuki Foundation, *Comments on Metro Vancouver's Draft Regional Growth Strategy* (2009)
http://www.metrovancouver.org/planning/development/LRSPreview/LRSPDocs/DavidSuzukiFoundation.pdf

[34] Statement by Nicolas Mainville, Greenpeace, to the Standing Senate Committee on Agriculture and Forestry June 3, 2010 http://www.parl.gc.ca/40/3/parlbus/commbus/senate/com-e/agri-e/06evc-e.htm?Language=E&Parl=40&Ses=3&comm_id=2

[35] Pembina Institute, "Energy Source: Bio-energy" http://www.pembina.org/re/sources/bio-energy (accessed March 21, 2011).

disrupt carbon and nutrient cycling.[36] Greenpeace has concerns regarding impacts on soil pH, loss of carbon from forest soils after harvest,[37] and impacts on soil productivity from removal of forest slash and woody debris from the site.[38]

WWF and the Sierra Club both convey concerns about the impacts of production of bioenergy on water. WWF has stated that the production of biomass (in particular, cultivation of agricultural biomass) will decrease the availability of water for ecosystems and human consumption, and lead to hydrology changes and increased salinization of soil.[39] The Sierra Club believes that water use could have impacts on aquatic environments and human consumption.[40]

A few organizations discuss the potential impact of forest bioenergy on wildlife habitat and biodiversity. The Sierra Club states that it is opposed to all projects that contribute to the destruction of existing forests, or to the conversion of native forest to non-native species, and that harvesting of forest biomass and cultivation of agricultural biomass will undermine biodiversity.[41] The David Suzuki Foundation notes that it is in favour of the use of biomass for energy if there are net benefits for native biodiversity.[42] WWF Canada advocates for the use of biomass for energy only if there are no negative impacts to natural ecosystems that have high conservation value.[43] The David Suzuki Foundation provides comments that tree branches must be left in the forest to maintain carbon and nutrient cycling processes and to provide wildlife habitat.[44] The Pembina Institute discusses environmental impacts that can be associated with unsustainable biomass production including impacts on land, water and forests.[45]

A few groups voice concerns that bioenergy harvest could lead to negative impacts from forestry practices and management**.** The Sierra Club believes that the harvesting of forest biomass and

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[36] David Suzuki Foundation, *Smart Generation: Powering Ontario with Renewable Energy* (2004) http://www.davidsuzuki.org/publications/downloads/2004/Smart_Generation_full_report.pdf

[37] Greenpeace Canada, *Response to the "Proposed Framework to Modernize Ontario's Forest Tenure and Pricing System* (2010) http://www.greenpeace.org/canada/Global/canada/report/2010/7/Greenpeace%20Response%20to%20Proposed%20Tenure%20Reforms.pdf

[38] Greenpeace Canada, *Response to the "Proposed Framework to Modernize Ontario's Forest Tenure and Pricing System* (2010) http://www.greenpeace.org/canada/Global/canada/report/2010/7/Greenpeace%20Response%20to%20Proposed%20Tenure%20Reforms.pdf

[39] WWF, *Position Paper on Bioenergy* (2008) http://assets.panda.org/downloads/wwf_position_paper_on_bioenergy_291107.pdf

[40] Sierra Club, "Biomass Guidance" http://www.sierraclub.org/policy/conservation/biomass.aspx (accessed March 27, 2011).

[41] Sierra Club, "Biomass Guidance"http://www.sierraclub.org/policy/conservation/biomass.aspx (accessed March 27, 2011).

[42] David Suzuki Foundation, *Comments on Metro Vancouver's Draft Regional Growth Strategy* (2009) http://www.metrovancouver.org/planning/development/LRSPreview/LRSPDocs/DavidSuzukiFoundation.pdf

[43] WWF *Position Paper on Bioenergy* (2008) http://assets.panda.org/downloads/wwf_position_paper_on_bioenergy_291107.pdf

[44] David Suzuki Foundation, *Smart Generation: Powering Ontario with Renewable Energy* (2004) http://www.davidsuzuki.org/publications/downloads/2004/Smart_Generation_full_report.pdf

[45] Pembina Institute, "Energy Source: Bio-energy" http://www.pembina.org/re/sources/bio-energy (accessed March 21, 2011).

cultivation of agricultural crops for bioenergy could lead to poor forest management practices.[46] The EAC is concerned that electricity production from biomass will contribute to the already high level of environmental impacts from the forestry activity occurring in Nova Scotia.[47] The Saskatchewan Environmental Society briefly mentions forest biomass as a source of energy and states that, in order to be sustainable, the rate of removal of wood must not exceed the rate of replacement.[48]

A few groups express concerns about a lack of knowledge of the impacts of biomass harvest. The EAC's stated concerns include a lack of knowledge about impacts of biomass harvest on wildlife and biodiversity[49] and a lack of knowledge about appropriate scale of harvest and renewability of harvested forest resources.[50] Greenpeace has stated that they are concerned with the inadequate level of knowledge about carbon cycling and the lack of application of the precautionary principle by governments.[51]

Several groups provide statements regarding appropriate use of biomass. Greenpeace Canada has stated that large-scale electricity production is not an appropriate use of biomass, but rather only appropriate for a small number of applications, including heat production for buildings currently using oil.[52]Similarly, the EAC express concerns about use of biomass for electricity, and has called for a moratorium on production of electricity from biomass in Nova Scotia.[53] The EAC supports forest harvested wood in small-scale applications to offset oil and electric heating.[54]The Conservation Council of New Brunswick states that they are in favour of energy generation from biomass only if it is small-scale, decentralized and highly efficient.[55]

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[46]Sierra Club, "Biomass Guidance"http://www.sierraclub.org/policy/conservation/biomass.aspx (accessed March 27, 2011).

[47] Ecology Action Centre, "Ecology Action Centre calls for moratorium on forest biomass for renewable electricity" http://www.ecologyaction.ca/content/ecology-action-centre-calls-moratorium-forest-biomass-renewable-electricity (accessed March 16, 2011).

[48] Saskatchewan Environmental Society, *Energy Report* (2007)http://www.environmentalsociety.ca/energy_report.pdf

[49] Ecology Action Centre, "Ecology Action Centre calls for moratorium on forest biomass for renewable electricity" http://www.ecologyaction.ca/content/ecology-action-centre-calls-moratorium-forest-biomass-renewable-electricity

[50] Ecology Action Centre, *Forest biomass energy statement* (2010) http://www.ecologyaction.ca/files/images/file/Energy/Biomass_Energy_statement.doc

[51] Statement by Nicolas Mainville, Greenpeace, to the Standing Senate Committee on Agriculture and Forestry June 3, 2010, http://www.parl.gc.ca/40/3/parlbus/commbus/senate/com-e/agri-e/06evc-e.htm?Language=E&Parl=40&Ses=3&comm_id=2

[52] Statement by Nicolas Mainville, Greenpeace , to the Standing Senate Committee on Agriculture and Forestry June 3, 2010, http://www.parl.gc.ca/40/3/parlbus/commbus/senate/com-e/agri-e/06evc-e.htm?Language=E&Parl=40&Ses=3&comm_id=2

[53] Ecology Action Centre, "Ecology Action Centre calls for moratorium on forest biomass for renewable electricity http://www.ecologyaction.ca/content/ecology-action-centre-calls-moratorium-forest-biomass-renewable-electricity accessed March 21, 2011).

[54] Ecology Action Centre, *Direct Evidence for UARB Hearing CI 39029* (2010) http://www.nsuarb.ca/NSUARB_Exhibits_JOOMLA/get_document.php?doc=N-17&no=1315

[55]Conservation Council of New Brunswick, *Roadmap to a Self-Sufficient Energy Future* (2007) http://www.conservationcouncil.ca/files/PDF/Roadmap_English.pdf

A few groups provided policy statements related to the production and use of bioenergy. WWF advocates for the use of biomass for energy that maximize the use of the resource with the most efficient combustion technologies and use of resources.[56] The Sierra Club states opposition to biomass energy projects that use federal or provincial Crown lands, but may support small-scale biomass for energy projects on private lands provided that monitoring and certification requirements are in place.[57] The EAC supports sustainably produced grass and short-rotation woody crops from existing marginal farm or agricultural lands.[58] The Pembina Institute promotes production of biomass from waste over cultivations/harvest from dedicated lands.[59] The Ontario Sustainable Energy Association website discusses benefits of using biomass for energy from waste products only but does not mention harvest or cultivation of biomass.[60]

Association Québécoise de lutte contre la pollution atmosphérique, British Columbia Sustainable Energy Association, CAN Canada, Ecology North, Environmental Defence Canada and Equiterre did not have any publically stated positions. Representatives for Association Québécoise de lutte contre la pollution atmosphérique as well as Equiterre both noted that this was an issue of emerging importance in Quebec and that a position statement may be forthcoming.[61]CAN Canada, as a coordination body for climate groups, does not create position statements on various issues but their website does host materials from a member organization that does reference forest biomass.[62]A representative from Ecology North noted that this was not yet an issue of high importance in the North West Territories. A representative of Environmental Defence Canada stated that forest biomass was not an area of focus for them.[63]

3.3 Human Rights/First Nations organizations

The list of human rights/First Nation organizations researched for public opinion on the use of biomass for electricity/heat production include:

- KAIROS
- The Assembly of First Nations
- The Centre for Indigenous Environmental Resources
- Oxfam Canada

[56]WWF Position Paper on Bioenergy (2008) http://assets.panda.org/downloads/wwf_position_paper_on_bioenergy_291107.pdf

[57]Sierra Club *Energy Policies*(nd)http://www.sierraclub.org/policy/conservation/energy.pdf

[58] Ecology Action Centre, *Direct Evidence for UARB Hearing CI 39029*(2010) http://www.nsuarb.ca/NSUARB_Exhibits_JOOMLA/get_document.php?doc=N-17&no=1315

[59]Pembina Institute, "Energy Source: Bio-energy" http://www.pembina.org/re/sources/bio-energy (accessed March 21, 2011).

[60]Ontario Sustainable Energy Association," Sustainable Energy Biomass" http://www.ontario-sea.org/Page.asp?PageID=122&ContentID=903 (accessed March 15, 2011).

[61] Pers Comm. Steven Guilbeault, Equiterre (March 24, 2011); pers comm. Patrick Bonin, AQLPA (March 24, 2011).

[62]For example, material from CPAWS (a CAN member) that mentions forest biomass for energy can be found on the CAN website (http://www.climateactionnetwork.ca/e/publications/boreal-forest-2001.pdf)

[63]Pers Comm. Gillian McEachern, Environmental Defence(March 24, 2011).

Of the four organizations surveyed, none have strong position statements on the use of forest biomass for energy, but two mentioned the topic.

KAIROS (Canadian Ecumenical Justice Initiatives) states that they support "some forms of biomass such as its use in smokeless, efficient cooking stoves" and the use of "modern biomass" for energy, though the qualifications for efficient and modern were not fully stated.[64]

The Assembly of First Nations identifies biomass as one option for "clean energy" in First Nations Communities and states that biomass must be "harvested and used in ways that does not damage and/or significantly alter natural systems." [65]

The Centre for Indigenous Environmental Resources and Oxfam Canada do not have mention biomass for energy on their website or in publications.

3.4 Summary of public opinion

Table 1 summarizes the main benefits that eNGOs and conservation groups have publically stated on the use of biomass for heat/electricity generation.

Table 1. Summary of main benefits related to biomass for electricity/heat production from literature review

Support	Benefit	Count of organizations citing benefit
Small-scale biomass for heat and electricity production.	Reduces fossil-fuel heating and coal-fired electricity.	●●●●●
Biomass use for cogeneration of heat and electricity.	Maximizes efficiency.	●●
Could play a role in the transition away from carbon-intensive fossil fuels.	Reduces fossil-fuel consumption.	●
Using sawmill waste products only, that is, sawmill waste, pulpmill waste, non-forestry waste.	Reduces the use of fossil fuels, particularly by the forest industry.	●●●●
Use of FSC forest certification scheme.	Reduces environmental impact and increases forest stewardship	●●●
Support for sustainably produced grass and short rotation woody crops.	Reduces environmental impacts.	●

[64] KAIROS *Pumped Up: How Canada subsidizes fossil fuels at the expense of green alternatives* (2008) http://www.kairoscanada.org/fileadmin/fe/files/PDF/EcoJustice/Oil-conflct/KAIROSStudyPaper_oilSubsidies_PumpedUp_April08.pdf

[65] Assembly of First Nations, "Honoring Fire" http://www.afn.ca/index.php/en/honoring-fire#3 (accessed March 25, 2011).

Table 2 summarizes the main issues that eNGOs and conservation groups have publically stated on the use of biomass for electricity/heat generation.

Table 2. Summary of main issues related to forest-based biomass usage

Issue	Count of organizations citing issue as important
Forest management	
Further negative impacts from poor management practices	●●●
Forest ecosystems	
Negative impacts to natural ecosystems and forest productivity	●●●●●
Negative impact on soil and nutrient cycling	●●●
Water issues	●●
Use of peat as a biomass resource	●
Current allowable cuts in Ontario are not considered sustainable	●
Land-use change and related environmental implications	●
Biodiversity and wildlife issues	
Negative impact on wildlife habitat and biodiversity	●●●●●●●
Negative impact on species-at-risk	●
Carbon accounting / air emissions	
Increase in air emissions from biomass combustion	●
Net increase in atmospheric carbon	●●●●●
False claim of carbon neutrality and carbon cycling	●●●●
Biomass upstream GHG emissions	●●
Combustion of biomass to produce electricity only is an inefficient use of resource, that is, the overall amount of energy extraction is low	●●●

4. eNGO / Conservation Group Interviews - Summary

Table 3 summarizes the eNGOs that were contacted for the one-on-one interviews.

Table 3. List of eNGOs and conservation organizations interviewed

Group	Region	Area of Expertise	Website
WWF	National	Energy, Climate Change	http://wwf.ca/conservation/
Ecology Action Centre	East	Energy, Climate Change and Conservation	http://www.ecologyaction.ca
Equiterre	Quebec	Energy, Climate Change	http://www.equiterre.org/en/
Ivey Foundation	National	Conservation	http://www.ivey.org/
Environment North	National	Conservation	http://www.environmentnorth.ca/
Forest Ethics	West	Conservation	http://forestethics.org/
Yukon Conservation Society	North	Energy, Climate Change and Conservation	http://www.yukonconservation.org/
Conservation Council of New Brunswick	North	Energy, Climate Change and Conservation	http://www.conservationcouncil.ca/
Ecology North	North	Energy, Climate Change and Conservation	http://ecologynorth.ca/oldsite/
Pembina Institute	National	Energy	http://www.pembina.org/

4.1 Observations of impacts and benefits of biomass for energy

4.1.1 Established biomass for energy policy

The following question was asked regarding biomass energy policy:

Does your organization have a stated position or a policy on the use of forest biomass (and, to a lesser extent, agricultural biomass) for generating energy?

The majority of the interviewed organizations do not have a specific policy on biomass for energy. A few organizations support small-scale, high efficiency combustion for heat only. Three organizations support using only biomass sourced from waste products (sawmill waste, transmission line, oil and gas right-of-ways and other waste streams that are currently handled poorly (i.e. forest slash that is burned at roadside)), and do not support whole-tree harvesting of any kind for any bioenergy, except for potentially disease infected and post-fire trees. There is also support for using marginalized agriculture land for agriculture biomass production.

One organization supports the development of globally consistent independent certification systems for bioenergy and drew on the Roundtable on Sustainable Biofuels[66] as an example of such a system.

4.1.2 Benefits of biomass energy

The following question was asked regarding benefits of biomass energy:

If biomass can be sourced in such a way that the environmental impacts are acceptably managed, what are your 'top of mind' and most significant benefits of using biomass for energy compared to using fossil fuels?

Almost all of the organizations interviewed suggest that the most significant benefit of using biomass was the potential reduction of GHG emissions compared to other fossil fuels, most noticeably coal. However, it was noted that the reduction of GHGs is very dependent on the fuel being replaced, combustion efficiency, biomass harvesting practices/methods and a complete full lifecycle assessment. Other benefits cited included:

- If biomass can be sourced locally, there could be a further reduction in GHG emissions related to transportation as compared to imported fossil fuels (especially for isolated/remote communities)
- Biomass can be used in cogeneration facilities to produce both heat and electricity in order to maximize the efficiency of the system
- There is a possibility for a reduction in other air emissions and pollutants if the lifecycle analysis shows air emissions can be reduced compared to fossil fuels
- Biomass could be used as a transition fuel to shift away from fossil fuel if properly sourced.
- Biomass may have fewer land and water impacts compared to the extraction of fossil fuels, but this is very dependent on harvesting and forest management practices

4.1.3 Environmental Impacts of use of biomass for energy

The following question was asked regarding concerns of biomass energy:

What are the 'top of mind' and most significant concerns of using biomass for energy compared to using fossil fuels?

[66] http://www2.epfl.ch/energycenter-jahia4/page65660.html. Accessed May 18, 2011

Of the environmental impacts raised by the organizations interviewed, issues related to biodiversity, endangered species and impacts to wildlife were the most noted. An increase in short-term GHG emissions was also noted as important and some organizations challenged whether biomass combustion is carbon neutral[67]. Organizations stated there is misconception and lack of understanding that biomass can be considered carbon neutral and does not release any more carbon into the atmosphere since the carbon that is released will be re-sequestered by forests. It was also stated that there is a misunderstanding that biomass is less carbon intensive than fossil fuels and there were some statements that there is more environmental impacts compared to the exploration and production of coal and other fossil fuels, although this was not substantiated.

Long-term decline of forest productivity (soil carbon, forest carbon and forest structure) as a result of possible unsustainable forest practices and an increase in harvesting pressure on old growth and primary forests is also mentioned as a significant concern. GHG impacts as a result of soil disturbance and harvesting was also mentioned.

Impacts to forest composition as a result of harvesting were also raised by a few organizations – one organization mentioned that managed forests were much more susceptible to climate change than natural forests, and this is especially valid in the Boreal northwest region of Ontario. A few organizations mentioned that additional sourcing of biomass for energy production could encourage destructive forest practices (specifically encouraging or promoting the removal of forest waste for bioenergy, which is vital to forest ecosystems) and could result in increased disturbance of the forest. Specifically, increased road construction can lead to greater access to the forest and wildlife for humans and predators and result in a disturbance to high conservation value forests. Harvesting mountain pine beetle trees in BC was mentioned and the understanding that there are plans to harvest not only beetle-killed trees but also living trees in the mountain pine beetle affected areas. This is a concern as, for these organizations, it is not acceptable to completely remove all trees from the area.

Other concerns raised, but not as prevalent, include air quality (specifically particulate matter from combustion) as well as pesticide and fertilizer use from cultivation of forests and changes to water quality.

4.1.4 Benefits and Impacts of using only stems for bioenergy

The following question was asked regarding harvesting:

> *What do you think are the biggest environmental impacts and benefits of using <u>whole tree</u> forest biomass for energy production (trunk only)? This can include impacts and benefits associated with harvest, transportation, combustion, silviculture, etc.*
>
> *a. Can you rank these impacts and benefits in order of importance?*
> *b. Are there local issues, recent studies, or practices that have made any of these issues particularly important in your region?*

If existing forest harvesting in an area is considered high, then additional harvesting was not considered acceptable for any sort of biomass for energy because of the additional environmental

[67] G. Zanchi, N. Pena, N. Bird, "The upfront carbon debt of bioenergy", *Joanneum Research, 2010*

impacts. However, some organizations are not opposed to whole-tree harvesting for bioenergy, as long as this additional harvesting is part of the annual allowable cut (AAC) and does not increase overall harvest rates. One view expressed was that there is a benefit in using the trunk of the tree instead of forest slash (tops and branches of a tree) since forest residues contain the majority of the nutrients and are thus critical to soil nutrient cycling and support biodiversity by providing habitat. Because the trunk of the tree has a higher energy content compared to the tops and branches, less forest area would be needed to provide the same amount of energy which is a benefit – a smaller disturbed area would result in less environmental impacts. Some organizations however stated that using stems of trees that could be used in higher value-add products and is not an economically sustainable use of forest resources and should not be considered. One organization is completely opposed to harvesting stems for bioenergy because it removes biomass which has benefit for the soil and takes away habitat and food for various species.

Diseased and salvage trees from post-fire sites are preferred sources if whole-tree harvesting is considered. These trees would most likely have lower moisture content (so less drying is required) and their removal could reduce the threat of further forest fires.

Another opinion expressed is that if a new bioenergy sector creates a market for previously non-merchantable tree species, there could be a new focus on silviculture and this could change in forest composition – whether that could be a benefit or drawback would be very specific to the situation. It was mentioned that a new focus on silviculture in the Great Lakes – St. Lawrence forest region could be a benefit to the region by having a market for the lower quality biomass.

If tree stems are to be used, many organizations expressed the need for accurate carbon accounting and GHG analysis of using trees that are significant carbon stores.

4.1.5 Benefits and Impacts of using slash/harvesting residue biomass

The following question was asked regarding using slash/residue material from existing forest harvesting operations:

> *What do you think are the biggest environmental impacts and benefits of using tree tops and branches from existing forestry operations (tops and branches used for bioenergy, trunk used for other purposes) for energy production?*
>
> a. *Can you rank these impacts and benefits in order of importance?*
> b. *Are there local issues, or recent studies, or practices that have made any of these issues particularly acute in your region?*

It was widely expressed among organizations that logging slash/residue should not be considered a "waste" product. Forest residue plays an incredibly important function in soil structure, nutrient cycling and wildlife habitat – all which are key to a functioning and diverse forest. As stated above, the forestry slash contains the majority of a tree's nutrients and removing this slash would have a tremendous impact on forest ecosystem. Slash removal also takes away protection for seedlings and small plants to become re-established. Another organization stated that there is no ecological benefit of removing slash – only a detriment. One organization stated that current harvesting practices where slash is brought or created at roadside is not considered best or acceptable practice and management practices need to evolve to address this.

Removal of slash is an especially important issue for nutrient-poor sites. There has been some long-term site management research conducted by the Ontario Ministry of Natural Resources and results show a degree of impact on nutrient poor sites from slash removal.

It was also expressed that there may be some circumstances where *some* forest residue removal could be acceptable, but the quantity and the conditions for removal is one of the most critical challenges to understand and is an area of active research.

Soil degradation and soil erosion as a result of exposed and dry soil resulting from slash removal were other important environmental impact mentioned.

If forest slash is to be considered a biomass resource, some groups expressed concern that this would create a further incentive to bring slash to roadside which could exacerbate the situation.

4.1.6 Considerations for private lands/crown lands

The following question was asked regarding sourcing biomass from private lands:

> *Are any of the concerns or benefits noted above specific to biomass from private lands as compared to crown land?*

The lack of forest management oversight, sustainable forestry requirements and regulations on private lands was a top concern amongst organizations. This lack of harvesting regulation has significant implications on the overall sustainability of these lands. Some organizations were of the opinion that more regulation and education is needed to promote and encourage good stewardship of private lands.

An increase in demand of biomass from private lands could lead to wide-scale harvesting, clearcutting and denuding of forests, especially in central areas that are close to markets.

Almost all organizations would like to see some level of forest management certifications (i.e. FSC certification) on private lands similar to provincial standards, or, at minimum some basic regulations such as restricting clearcutting, harvesting only at certain times to avoid rutting and a requirement to plant certain trees to restrict "weedy species" (willow and alder) from overtaking woodlots.

4.1.7 Forest management and conservation

The following question was asked regarding forest management guidelines and conservation initiatives:

> *How do you think forest management guidelines/practices and conservation initiatives affect the impacts noted above? Do protected areas or good management practices contribute to mitigation of the impacts from harvesting?*

The most important message from organizations are that current regulations and guidelines in their respective provinces (Ontario, Nova Scotia, British Columbia), if they exist, do not adequately deal with current harvest levels (AAC) and are therefore are not adequate to handle and increase in biomass harvest for energy. If additional biomass harvesting is going to occur, then it is of the opinion that the AAC needs to account for both harvesting for traditional forest products and bioenergy. It was mentioned that the size and scale of the AAC is the main driver

behind the environmental impacts from forestry operations and other efforts to minimize impacts (i.e. harvesting techniques, upstream mitigation efforts) are not as effective as properly sizing the AAC based on the region. This feedback on sustainable harvest levels were opinion and no direct references on harvest level were provided to support these opinions.

Although helpful, forest management practices and standards are not a 'silver bullet' and do not replace regulations. Some organizations express concern that although there are regulations, monitoring and enforcement of these regulations continue to be a challenge. For example, whole-tree harvesting and skidding is a prevalent practice in some regions in Ontario and this creates significant environmental issues, including the creation of roadside slash piles. These slash piles are often burned rather than re-distributing the slash back onto the forest floor which by many organizations, are not considered good practices.

4.1.8 Information gaps

The following question was asked regarding information gap of using biomass for electricity/heat production:

> *What research needs or information gaps do you believe need to be addressed to better understand the impacts and benefits of sourcing of forest biomass?*

The most frequently identified area of research and information gaps was carbon accounting principles of utilizing biomass for electricity/heat. Specifically, organizations expressed the need for:

- Better understanding, definition and education on the *carbon neutrality* of biomass
- Accounting for climate change in forests and how this affects carbon stores. This is especially true for the boreal forest
- More accurate modeling of forest carbon and the growth and decline of carbon over time, specifically soil carbon storage
- Full lifecycle GHG comparison of biomass and fossil fuels taking into account changes in forest carbon
- Better understanding of the climate implications of activities in the boreal forest.

It was mentioned that little is known about the impacts of microbial/decomposition and fungal communities and how they are affected by removal of slash[68,69]. Tree stumps and roots also play a key role in microbial communities and this relationship is not well understood. After years and years of intensive forestry operations including the removal of biomass for energy, Europe, that has been logging forests for 100 years longer than Canada, is dealing with degraded forest systems (lower ecosystem productivity and biodiversity issues) and this problem needs to be avoided in Canada altogether.

If harvest of biomass for energy occurs, it must be understood whether there will be a redistribution of the AAC or an increase in the AAC and what additional environmental pressure and impacts there would be with an increased AAC.

[68] H. Berglund, B. Jonsson, 2009. Assessing the extinction vulnerability of wood-inhabiting fungal species in fragmented northern Swedish boreal forests, Biological Conservation 141: 3029-3039

[69] R. Penttila¨, M. Lindgren, O. Miettinen, H. Rita and I. Hanski, "Consequences of forest fragmentation for polyporous fungi at two spatial scales", *OIKOS*, (2006) 114: 225 - 240

4.1.9 Benefits and impacts of agricultural bioenergy

The following question was asked regarding benefits and impacts of agricultural bioenergy:

> *What do you think are the biggest environmental impacts and benefits of cultivation of agricultural bioenergy crops for energy production? (Crops include fast growing perennial grasses like switchgrass, and tree species like hybrid poplar or willow.)*
>
> a. *Can you rank these impacts and benefits in order of importance?*
> b. *Are there local issues, or recent studies, or practices that have made any of these issues particularly important in your region?*

A few organizations suggested that there is benefit in using marginalized agricultural land for bioenergy crops as it utilizes lands that would otherwise not be used. If marginalized agriculture lands were used for biomass for energy, this in return could reduce the pressures on utilizing forest-based biomass.

Land-use conversion and the associated environmental impacts were the top concern of organizations with regards to agricultural bioenergy. Some stated that agricultural land should not be used to produce anything other than food and that bioenergy cultivation creates unnecessary competition for this land. Habitat disturbance when converting natural habitat to cultivated land was mentioned, as was fallow field conversion to croplands having an impact on birds and wildlife (which often benefit from the natural succession of croplands back to forests). Impacts on biodiversity and the issues associated with monocultures and crops such invasive species were also mentioned. Another impacts mentioned were the pesticides and fertilizer inputs used to control of invasive species promote growth of bioenergy crops. Finally, it was mentioned that focusing on fast-growing agriculture crops could create further issues related to genetically modified seeds and agriculture practices.

Release of GHGs associated with land-use changes, as well as significant fossil fuel based chemical inputs was also mentioned. It was felt that the full GHG lifecycle emissions of agriculture bioenergy crops may not be any less than the full GHG lifecycle emissions than fossil fuels.

Water usage was also mentioned as a concern as typically bioenergy crops require more water than traditional crops.

4.2 Overall sustainability

4.2.1 Scale of harvest

The following question was asked regarding the scale of harvest:

> *How does scale of harvest/cultivation of biomass influence your opinion of the severity of the impacts and benefits noted above? What scale is appropriate in your region?*

The scale of harvest is key to assessing and planning for sustainability. It was suggested that small-scale planning and distributed harvesting over the landscape is preferred over local intensive harvesting which will have less of an impact and change to ecosystem functioning. That said, the cumulative impacts of more distributed planning and harvesting must be taken into

consideration. It was also mentioned that the volume of harvest is not necessarily the right criteria – harvesting can be done right on a small scale and then transformed to a larger scale.

As mentioned in Section4.1.4, organizations suggested that there be strict rules and guidelines around altering or increasing the AAC and scale of harvest if there is a new bioenergy industry demanding more biomass resources.

4.2.2 Planning horizon

The following question was asked regarding planning horizon:

> *How does the planning horizon (timeline) of harvest/cultivation biomass influence your opinion of the severity of the impacts and benefits noted above? What is an appropriate planning horizon in your region if carbon neutrality is to be assumed?*

All organizations stated that the planning horizon cannot be short and must properly take into account the natural growth of forest. It was mentioned that even current guidelines between 100 to 200 years could be considered far too short compared to the natural growth of forests. For example, in B.C., old growth forests 1500 years old are harvested on an 80-year rotation and therefore forests will never return to their initial carbon sequestration level, i.e. the carbon stock in the forests is permanently reduced. It was also mentioned that regrowth is longer in colder climates and this needs to be integrated into forest management plans.

Other than the above feedback, there was little direction, input and guidance provided on an adequate planning horizon, and is an indication that further research and education on this important management is needed.

4.2.3 Mitigation of impacts

The following question was asked regarding mitigation of impacts:

> *Are you aware of any innovations/technologies measures that can help reduce the environmental impacts of using biomass for energy production (i.e. harvesting / silviculture techniques, biochar, pyrolysis, carbon capture and storage)?*

Most organizations cited combustion efficiency standards and combined heat and power requirements to be the most beneficial way to mitigate the environmental effects. These technologies allow utilization of a greater amount of energy per unit of biomass, thus increasing the overall return on energy invested.

Others mentioned technologies such as gasification, pyrolysis and CCS as potential technology solutions to reduce impacts associated with biomass usage.

There were some mentions of the need for improved harvesting technologies to lessen impacts around cutting, stripping and hauling and reduction in the amount of forestry roads. Transportation alternatives, from a GHG perspective need to be considered considering the possible long distances or export potential of biomass.

Finally, genomics was mentioned as a strategy to minimize water requirements and lessen disease from insects. Genomics is not genetic modification, but rather based on natural selection of seeds that show certain environmental beneficial qualities.

4.2.4 Optimal use of biomass

The following question was asked regarding the optimal use of biomass:

> *In your opinion, if we are going to harvest biomass, what is the most optimal use of biomass? What makes this choice optimal? I.e. electricity, heat, fuels, pulp and paper, high value forest products.*

A few organizations were clear that the most optimal use of biomass is to 'leave it in the forest' because of the essential contribution of ecosystem goods and service forests provide. Others had opinions that it is important to maximize the economic value of each tree harvested and maximize the benefits per unit of wood harvested.

Utilizing sawmill waste was mentioned as an optimal use of biomass for energy. Combined heat and power and using biomass for heat-only applications were selected as other optimal uses of biomass.

4.2.4.1 Environmental criteria for sustainability

The following question was asked regarding environmental criteria for biomass sustainability:

> *What criteria should be used to evaluate the environmental sustainability of use of biomass for heat/electricity production?*
>
> *a. Could you suggest the 3 most important criteria in your opinion?*
> *b. Below these questions you will find a table of criteria developed from a literature review of various certification schemes and guidelines from other organizations. Could you choose the top 5, and the second top 5 criteria in terms of importance, and provide comments about the criteria or additional criteria that you find are lacking?*

Table 4 summarizes the top 3 most important environmental criteria as received during the one-on-one interviews. Of the organizations questioned during the one-on-one interviews, there were not adequate responses on ranking the criteria to make any meaningful contribution to the results.

Table 4. Summary of 3 most important environmental criteria

Environmental Criteria	Number of organizations rating it as one of the top 3 important criteria
Biodiversity, wildlife habitat	••••••
Maintenance of healthy water systems	•
Maintenance of healthy soil and forest productivity	•••••
Air quality	•
Carbon neutrality / GHG emission	•••••

Sustainable harvest levels	•
Efficient and optimal use of resource	•

4.2.5 Biomass for energy as compared to other types of energy

The following question was asked regarding ranking biomass for energy compared to other forms of energy:

How would you rank biomass for energy in terms of overall environmental impacts compared to other forms of energy (e.g., coal, natural gas, oil, nuclear, geothermal, solar, wind, tidal, wave)? It would be helpful if you could give some explanation of the rationale for your ranking.

From a GHG perspective, opinion on how biomass ranks amongst fossil fuels was fairly consistent among organizations, where the majority stated that biomass is probably preferable compared to coal and oil, with one organization expressed uncertainty whether biomass combustion is preferable to natural gas. However, these comparisons are very dependent on the end efficiency use of the biomass. If biomass is used for electricity production, it was questionable whether there would be an advantage against fossil fuels, and only if the biomass is used in a combined heat and power or heat only application would the benefits of biomass rank above fossil fuels. As for comparing the other environmental impacts, most organizations felt it was too difficult to rank biomass against fossil fuels.

Comparing to other renewable energy technologies, most organizations agreed that biomass ranked below most forms of renewables including solar, wind, small-scale hydro, geothermal. Some organizations stated they were uncertain whether it compared favorably to large-scale hydro.

With these rankings, however, most organizations provided caveats that all assessment of impacts are dependent on the methods of growing and harvesting of biomass and the scale at which it is undertaken as well as (environmental impacts on fossil fuels).

4.3 Policy development

4.3.1 Suggestions for policy development

Organizations were asked how they suggest these environmental impacts and benefits be considered in the development of policies regarding biomass for energy production.

There was a wide mix of policy recommendations regarding biomass for energy production, which mostly spanned harvesting and the end-use of biomass. Below is a summary of the suggested policies:

Overall Sustainability

- Integrating policy approaches looking at the environmental as well as socio-economic elements that incorporate the well-being of local communities.
- Policies to maximize the high-value of forests and the products they provide.

Forestry

- Policies to ensure no new forests are cut for biomass and policies around integrating biomass harvest volumes into *existing* AAC and not extending the AAC.
- Policies to restrict the removal of residues and slash from forests whether it be for the current forest industry or for harvesting for bioenergy.
- Regulations around restricting clear-cutting under certain circumstances.
- Policies around harvest guidelines, management plans and land-use planning.
- Policies around protecting nutrient-poor sites and ensuring they are not targeted.
- Policies to include spatial variations and the intensity level of harvesting
- Policies to further protect biodiversity.
- Policies to further protect wildlife habitat and endangered species.

Water

- Policies to advance the protection of water

GHG accounting

- Policies and accounting frameworks to accurately calculate the full GHG emission footprint of biomass
- Policies and modelling frameworks to accurately model changes in forest carbon from biomass harvesting

End-use

- Standards for minimum combustion efficiency
- Policies to promote energy saving and maximize return on energy
- Certification schemes –with the FSC standards as a minimum
- Regulatory and financial incentives to support small-scale, high efficiency projects

4.3.2 Examples of good policies

Groups were asked to provide examples of biomass policies in Canada or internationally that are good policies, or that address your specific concerns of yours.

There were a few examples of biomass policies cited. In Canada specifically, Quebec was mentioned as having good policies for herbicide use on crown land. The Silva Forest Foundation[70] in British Columbia was mentioned as having developed strong criteria around harvesting, and the FSC was also mentioned.

In the U.S., Maine was cited as having strong restriction on clearcutting and Vermont and Massachusetts were mentioned has having minimum standards for electricity efficiency. The

[70] http://www.silvafor.org/

Manomet[71] study was also cited as good policy around the carbon implications and policy requirements around full-tree harvesting.

European countries were cited as having admirable policies around burning of slash or sawdust to ensure the resource is used for energy generation. The U.K. was mentioned as having feed-in-tariffs for heat production.

[71] Manomet Centre For Conservation Sciences. *Massachusetts Biomass Sustainability and Carbon Policy Study: Report to the Commonwealth of Massachusetts Department of Energy Resources*. Brunswick, Maine, 2010. Brunswick, Maine.

5. On-line Survey Results

The on-line survey was sent to the following organizations:

- Sierra Club Canada
- Friends of the Earth Canada
- Nature Conservancy
- Wildlife Habitat Canada
- International Institute of Sustainable Development
- Centre for Indigenous Environmental Resources
- Toronto Environmental Alliance
- Conservation Ontario
- Evergreen
- Ontario Nature
- Canopy

There were a total of eight responses from six organizations, and not all responses were complete. Below is the summary of individual responses.

5.1 Benefits of using biomass for energy

The benefits of using biomass for energy varied amongst organizations, with no one benefit clearly outweighing other benefits.

If biomass can be sourced in such a way that the environmental impacts are acceptably managed, please evaluate the following benefits of using biomass for energy compared to fossil fuels: (1-Not a significant benefit to 5-Very significant benefit)					
	1 – Not a significant benefit	**2**	**3**	**4**	**5 – Very significant benefit**
Use in large-scale electricity production		●●●	●●	●	
Use small-scale decentralized energy systems			●●●	●	●●
Potential for GHG reductions	●	●	●●	●	●
Use in high-efficiency systems (i.e. combined heat and power, heat only)			●●●	●	●
Air emission reductions		●●●	●	●	●

Use as a transition fuel away to shift away from fossil fuels		••		•••	•

5.2 Biomass and carbon neutrality

The most common response was in-line with most feedback and information received from other organizations – in that biomass carbon neutrality depends very much on how the biomass is sourced. There were some views that biomass is no more carbon neutral than other fossil fuels.

What is your view on biomass being carbon neutral? Please check more than one answer if you feel it is appropriate.			
Biomass, because it is part of the biogenic cycle, can be considered carbon neutral	It depends on how the biomass is sourced and used	Biomass is no more carbon neutral than other fossil fuels	Biomass is actually worse than fossil fuels
	••••••	••	

5.3 Environmental issues with bioenergy from stems or from slash

When asked about the impacts of using slash for bioenergy, carbon and the GHG impacts associated with biomass were the most significant issue highlighted by survey respondents, but other environmental issues such as soil fertility, biodiversity and wildlife and endangered species were also ranked highly. Air emissions were noted as not as significant an issue.

Please evaluate, in your opinion, the importance of the environmental issues associated with using forestry slash (bark, tops and branches) for energy: (1- Not a significant issue to 5- Very significant issue)					
	1 – Not a significant issue	**2**	**3**	**4**	**5 – Very significant issue**
Soil fertility, nutrient cycling and forest ecosystems				••••	••
Biodiversity			•	•••	••
Wildlife and endangered species			•	•••	••
Water quality and hydrology		•		•••	••
Carbon and GHG impacts	•			••	•••

Air emissions		••	•	••	•

Are there any other environmental issues associated with using forestry slash that you think are important to note?

There was a comment that clearcut logging is grossly unsustainable and hence forestry slash should not be considered a sustainable source of bioenergy. Also mentioned was the critical importance of protecting primary and old growth forests.

When asked about the impacts of using the main trunk of the tree for bioenergy, all environmental issues received similar concern from organizations.

Please evaluate, in your opinion, the significance of the following environmental issues associated with using the main trunk of the tree (with branches or tops left at the site) for energy: (1-Not a significant issue to 5-Very significant issue)					
	1 – Not a significant issue	**2**	**3**	**4**	**5 – Very significant issue**
Soil fertility, nutrient cycling and forest ecosystems			•••	•	••
Biodiversity			••	••	••
Wildlife and endangered species			••	••	••
Water quality and hydrology			••	••	••
Carbon and GHG impacts		•	•	••	••
Air emissions		•	•	•••	•

5.4 Biomass sources

Similar to the public position of organizations and from one-on-one interviews – sawmill waste was ranked as the best forest-based biomass resource. Interestingly, trunks of non-commercial, low-grade trees from crown-land forests did not receive as much support as logging residues from crown-land forests and trees from private woodlots. The discrepancy between the difference of opinion between these results and public opinion was not investigated.

In your opinion, which of these sources is the best forest-based source of biomass for energy? Please rank the following:					
	1 – Poor source	**2**	**3**	**4**	**5 – The best source**
Trunks of non-commercial, low-grade trees from crown-land forests	●●●		●●	●	
Disease-infected trees or post-fire salvage trees		●			●
Sawmill waste					●●●
Logging residues from crown-land forests (tops of trees, limbs, bark, etc.)			●●●	●●	●
Trees from private woodlots	●	●●	●●●		

Can you explain your choice of source?

Respondents mentioned that wildlife species depend on the dead and dying trees hence forest residues are not an accepted source of biomass. There was a lack of support for cutting any trees for bioenergy.

5.5 Private lands

If private lands/woodlots were to be considered for sourcing forest-based biomass, what, in your opinion, are the most significant environmental issues?

Respondents noted concerns about little or lack of regulation of reforestation or silviculture . Respondents stated that private woodlots must be managed sustainability such that there is no loss of biodiversity if harvest for bioenergy should take place. Other environmental concerns mentioned the effects on habitat, forest ecosystem, species conversion and site damage associated with unrestricted clearcutting.

5.6 Research gaps

Of the research gaps identified in the list below, all were considered as being considerable and significant. Carbon accounting and accurate assessment of upstream lifecycle GHG impacts were rated as the most significant gaps, and impacts on biodiversity, wildlife habitat and soil micro-fauna were also highly ranked.

Please evaluate, in your opinion, the biggest gap in terms of understanding the environmental impacts of sourcing biomass from forests: (1-Not a significant gap to 5-Very significant gap)					
	1 – Not a significant gap	**2**	**3**	**4**	**5 – Significant gap**
Carbon accounting frameworks and how to properly evaluate the carbon and GHG implications of harvesting biomass from forests			•	••••	••
Effects of climate change and how this affects the role and growth of forests			••	•••	••
Upstream lifecycle impacts of biomass harvesting			•	••	•••
Impacts on biodiversity			•	•••	••
Impacts on wildlife habitat, endangered species and aquatic life		•	•	••	•••
Understanding of micro-fauna in soils, decomposition communities and the effects of biomass removal			•	•••	•••

What other research gaps do you think exist? How do these compare to the gaps listed above?

Harvesting methods and whether the biomass resource can be considered a waste product were raised as other knowledge gaps that need addressing.

5.7 Agriculture crops

Do you see any benefits with growing and using bioenergy crops (i.e. willow, hybrid poplar, switchgrass) compared to forest-based biomass?

It was mentioned that select bioenergy crops are fast-growing and can thus generate quickly and also have the potential advantage in that they provide habitat for many bird species if they are harvested after the breeding season. However, one respondent stated a caveat that bioenergy crops can also have negative impacts on local wildlife and biodiversity if not regulated properly.

The top environmental concerns associated with bioenergy crops were land-use conversion, habitat disturbance, control of invasive species and impacts on aquatic life from fertilizers.

Please evaluate, in your opinion, the significance of the following environmental impacts associated with agriculture crops (e.g. willow, hybrid poplar, switchgrass): (1-Not a

significant impact to 5- Very significant impact)					
	1 – Not a significant impact	**2**	**3**	**4**	**5 – Significant impact**
Land-use conversion			•	••	•••
Habitat disturbance when converting natural habitat to cultivated cropland				•••	•••
Habitat disturbance when converting foul/brown fields to cultivated croplands		••	••	••	
Biodiversity and issues associated monoculture crops		•	•	•	•••
Control of invasive species using chemical inputs			•	••	•••
Full lifecycle GHG impacts associated with land-use conversion and use of fossil fuel-based chemical				••••	••
Aquatic impacts from fertilizer use or use of freshwater resources				•••	•••

5.8 Mitigation impacts

When asked about mitigation of impacts, harvesting was ranked as being the most effective/appropriate mitigation measure, followed by efficiency standards and technologies.

What, in your opinion, are the most effective, appropriate mitigation measures to reduce the environmental impacts associated with biomass for energy: (1-Not an effective/appropriate mitigation measure to 5-Very effective/appropriate mitigation measure)					
	1 – Not an effective/ appropriate mitigation measure	**2**	**3**	**4**	**5 – Very effective/ appropriate mitigation measure**
At harvest – harvesting techniques to minimize environmental impacts		•	•		•••
Transportation – minimizing haul costs, transportation technologies to minimize emissions associated with transportation			•••	••	•
Technologies – different biomass-to-energy technologies – such as gasification, pyrolysis or CCS	•		•	••••	
Efficiency – combined heat and power, minimum efficiency standards, heat-only applications		•	•	•••	•

5.9 Optimal use of biomass

What, in your opinion, is the optimal use of biomass for energy?

Highly efficient uses of biomass, such as co-generation applications, were mentioned as the most optimal use of biomass. Forestry waste from selectively-cut forests was also mentioned as an optimal use.

5.10 Biomass policy suggestions

Regulations around clearcutting, harvesting guidelines, management plans and land-use planning were mentioned as important policies for a sustainable bioenergy policy. Integrating policy approaches for maximum environmental and socio-economic dimensions and policies to maximize high-value forest products were also cited as very important. If additional harvesting for bioenergy is to occur, respondents wanted to see a policy that incorporates this harvest into the existing AAC and not be additional to the AAC.

Overall sustainability- What policies relating to overall sustainability are most important to advance in order to minimize the environmental impacts and promote the benefits of biomass for energy?(1-Not an important policy, 5-Very important policy)					
	1 – Not an important policy	**2**	**3**	**4**	**5 – Very important policy**
Integrating policy approaches looking at the environmental as well as socio-economics elements that incorporate the well-being of local communities			●	●	●●●●
Policies to maximize high-value forests and the products they provide			●	●	●●●●
Policies to ensure no new forests are cut for biomass and policies around integrating biomass harvest volumes into existing AAC and not extending the AAC				●●●●●	●
Policies to restrict the removal of residue and slash from forests		●	●●	●●	●●
Regulations around restricting clear-cutting under certain circumstances				●●	●●●●●
Policies around harvest guidelines, management plans and land-use planning			●	●	●●●●●
Policies around protecting nutrient-poor sites and ensuring they are not targeted		●	●	●●●	
Policies to further protect biodiversity		●		●	●●●●●
Policies to further project wildlife habitat and endangered species					●●●●●●

With regards to GHG accounting, both policies mentioned below were cited as very important.

GHG Accounting and carbon neutrality – What policies relating to GHG accounting and carbon neutrality are most important to advance in order to minimize the environmental impacts and promote the benefits of biomass for energy? (1-Not an important policy, 5-Very important policy)					
	1 – Not an important policy	**2**	**3**	**4**	**5 – Very important policy**
Policies and accounting frameworks to accurately calculate the full upstream GHG emissions of bioenergy				••	••••
Policies and modelling frameworks to accurately model changes in forest carbon from biomass harvesting			•	••	•••

For minimizing bioenergy impacts, policies that ensure maximum return on energy invested and setting minimum efficiency requirements were stated as important.

End use – What policies relating to end use are most important to advance in order to minimize the environmental impacts and promote the benefits of biomass for energy? (1-Not an important policy, 5-Very important policy)					
	1 – Not an important policy	**2**	**3**	**4**	**5 – Very important policy**
Standards for minimum combustion efficiency				•••	•••
Policies to promote energy saving and maximize return on energy				••	••••
Certification schemes – such as the Forest Stewardship Council			••	•••	•
Regulatory and financial incentives to support small-scale, high efficiency projects			•	•••	••

Are there any other policies not identified here that are important in your opinion? How do they compare against the policies rated above?

It was mentioned that a review of current policies should take place to ensure optimization and full use of existing policies rather than creating entirely new one. It was suggested that project-level energy analysis to ensure there are net energy gains should also be undertaken.

6. Key Findings, Analysis and Recommendations

This chapter provides a collective summary of key findings with respect to eNGO and conservation groups' perceptions of the main environmental benefits and issues related to biomass use for electricity/heat generation from the literature review, interviews and on-line survey. The chapter concludes with a series of observations that should be considered when developing metrics on the use of biomass for heat and/or electricity production, and recommendations for further work.

6.1 Overall themes – support and benefits for bioenergy

Information and opinions collected indicate that the highest levels of support for the optimal use of biomass for electricity/heat is with small-scale, distributed, high combustion efficiency biomass systems. There is more support for heat-only or CHP systems because of the higher efficiency compared to electricity-only systems. Maximizing the amount of energy obtained from heat-only or CHP systems is one of the key strategies mentioned to mitigate and reduce potential environmental impacts associated with forest-based biomass utilization.

There was also strong support for the use of sawmill waste, pulpmill waste and other non-forestry waste (municipal solid waste and landfill waste) as viable feedstocks for bioenergy production with the main benefit being a potential reduction in GHG emissions from a reduction in fossil fuel use – specifically in the forestry sector (sawmills, pulpmills) that require significant amounts of electricity and other fuels to operate. There is also a benefit in using these sources of waste as there is no incremental impact on the forest – these wastes are available from existing operations outside the forest land-base.

If non-forest-based biomass resources are used for energy, there was modest support for the use of grass and short-rotation woody crops grown on crown lands, private lands or marginal agriculture lands as long as high-standard certification schemes are employed. The benefit of this is perceived to be the use of marginal agriculture lands to grow energy crops would lessen the need for forest-based biomass sources. It is noted that the FSC certification standard is the minimum standard that would be acceptable. There are several concerns with the lack of current certification and regulation on private lands and it was expressed this should be addressed if short-rotation woody crops are sourced from private lands.

Support for stem-only harvesting versus using forest slash as a biomass resource was very mixed. In general, there was more support for harvesting and using the trunks of trees compared to forest residue; however there were some very strong opposing views on this. With the trunk of trees have more energy content than forest slash on a per volume basis, one benefit of harvesting stems only compared to forest residues is that less forest land would be disturbed. A few organizations were of the opinion that the Great Lakes – St. Lawrence forest region could benefit

from improved silviculture practices from stem-only harvesting for biomass because of the volume of low-grade biomass currently available in that region.

Where there is support for stem-only harvesting, the support comes with two main caveats:

- that the AAC is considered truly sustainable from environmental, social and economics perspectives.
- that the additional harvesting of biomass is a redistribution of the AAC and not in addition to the AAC.

There was support for the use of biomass as a local resource for energy generation as opposed to imported fossil fuels, with the benefit being reduced transportation emissions associated with a local resource. This is especially relevant for remote and isolated communities that could benefit from utilizing their local resource. With this, however, came the caveat that it is very challenging and complex to compare the environmental tradeoffs between a local biomass resource and imported fossil fuels without knowing the specific regional circumstances behind each resource.

There was a marked lack of support for the use of forest residue as a biomass resource because of the perceived environment impacts associated with this resource and the opinion that forest residue should not be considered a waste. This is discussed in more detail below.

Table 5 summarizes the main environmental benefits captured with respect to level of support and associated benefits. This summary is a reflection of the authors' synthesis and analysis of the information received.

Table 5. Summary of main support and environmental benefits of biomass

Support	Level of support	Environmental benefit
Small-scale distributed, high combustion efficiency	High	Maximizes energy from biomass (return on energy invested) and minimizes any potential environmental impacts from sourcing biomass
Utilizing a local energy resource	Medium	Reduce transportation emissions associated with external fuel sources
Usage of end-of-life biomass (wood diverted from landfills) and sawmill/pulpmill waste	High	Sources are considered a more valid waste than other biomass sources Reduction of fossil fuel consumption and associated GHG reductions from combusting fossil fuels
Usage of grass and short-rotation woody crops from crown lands, private lands and marginal agriculture lands	Medium	Favourable GHG emission profile for short-rotation woody crops Efficient use of marginal agricultural lands and hence could require less forest-based biomass land
Exploring stem-only harvesting for biomass and improved silviculture	Low, but noteworth	Takes advantage of abundant low-grade biomass available and could support increased silviculture in this

practices in the Great Lakes – St. Lawrence region	y	region

6.2 Overall themes – environmental Issues

Using the information from the literature review, interviews, and through the on-line survey, the following three issues emerged as the most significant environmental concerns:

- Biodiversity, wildlife habitat and endangered species
- Soil fertility and forest productivity
- Carbon accounting frameworks and GHG emissions

Other notable environmental concerns were the sustainability of current forest management practices, impacts on water, and conversion of primary / old growth forests to managed forests. However the emphasis and focus of the feedback received was clearly on the above top three issues with specific detailed feedback in each of the areas captured below.

6.2.1 Biodiversity, wildlife habitat and endangered species

Many organizations expressed concern that existing forest practices do not adequately protect biodiversity, wildlife and endangered species and impacts could be greatly exacerbated if significant amount of forest residues are removed for energy. Research in this area is a relatively new focus in Canada compared to Europe and there is active research, at the University of Toronto for example, that is studying the effects of forest harvesting on biodiversity and forest productivity in the boreal forest[72]. It was mentioned that the issue of slash removal is more of a concern in coniferous-dominated forests (i.e. the boreal) than mixed forests.

Of acute concern is potentially the impact on caribou and that current policies around protecting this threatened species are not adequate, as well as the concern that current forestry practices are not legally following the *Migratory Bird Act*[73] where harvesting activities can result in the inadvertent destruction of the nests and eggs. The Canadian Boreal Forest Agreement[74] was mentioned as one positive step industry and environmental groups have taken to ensure the ecological significance of the Canadian boreal forest, and that threatened and endangered species are adequately protected.

It was repeatedly emphasized that the removal of forest residues and coarse woody debris can have a significant negative effect on biodiversity and wildlife habitat. This leftover material (dead snags, downed trees) provides essential habitat for wildlife in the forest.

6.2.2 Soil fertility and forest productivity

According to many of the organizations, not only is forest residue and coarse woody debris critical for supporting biodiversity and wildlife habitat, it is also critical to maintaining soil

[72] http://www.forestry.toronto.edu/people/malcolm/malcolm.html

[73] http://www.ec.gc.ca/nature/default.asp?lang=En&n=7CEBB77D-1

[74] http://www.canadianborealforestagreement.com/media-kit/Boreal-Agreement-Full.pdf

fertility, supporting the level of dead organic material pools in soils and supporting regrowth of the forest. Forest residues support a wide range of fauna such as organisms and insects that work together to break down material into dead organic matter and return these needed nutrients to the soil. Healthy soils are critical to the important ecological functions forests provide. Maintaining forest residue on-site is also important to prevent soil erosion, especially considering logging roads and the impacts from large-scale harvesting.

A number of organizations expressed concern that there is not sufficient understanding of the impacts of forestry slash removal on different eco-regions and soil types in Canada. This concern is more acute for forest sites or forest management units that are considered low productivity because of poorer soil conditions. Sensitive forest sites are considered more of an issue in northern regions of the boreal forests in Ontario and this is also the focus of the research at the University of Toronto, as mentioned above. The Ministry of Natural Resources is conducting long-term monitoring studies of soil fertility to better understand the impact of biomass removal. Since research is emerging in Canada, these opinions were backed up by citing research from different countries in Europe[75,76,77].

Finally, if a bioenergy sector creates a market for forest residue, there was concern that this additional market incentive and demand for forest residues would further complicate and worsen the issues with soil fertility and forest productivity.

6.2.3 Carbon accounting and GHG emissions

Accurate carbon accounting frameworks and a proper planning horizon are vital to accurately understanding the GHG impacts of using forest-based biomass. There is significant concern among organizations about whether biomass combustion can be considered carbon neutral and offers a GHG benefit compared to fossil fuel alternatives and organizations referred to the Manomet study[78] and a few other publications were cited[79,80]. Organizations expressed the opinion that saying a waste material taken from the forest and combusted can be considered carbon neutral is inaccurate and misleading. To properly account for the GHG impacts of biomass utilization and its role in reducing global GHG emissions, it was the opinion of most organizations that forest carbon as well as full upstream GHG emissions must be included which accounts for all activities related to harvesting, transporting, processing and handling of the biomass, and that this lifecycle analysis must be of an acceptable timescale. This is especially

[75] G. Engell, B. Leijon, "Survival and Growth of Planted Seedlings of Pinus sylvestris and Picea abies After Different Levels of Biomass Removal in Clear-felling", *Scandinavian Journal of Forest Research*, (1999) 14: 303-311

[76] B. Olsson, H. Lundkvist, H. Staff, "Nutrient status in needles of Norway spruce and Scots pine following harvesting of logging residues", *Plant and Soil,* (2000) 223: 161-173

[77] R. Penttila¨, M. Lindgren, O. Miettinen, H. Rita and I. Hanski, "Consequences of forest fragmentation for polyporous fungi at two spatial scales", *OIKOS*, (2006) 114: 225 - 240

[78] Manomet Centre For Conservation Sciences. "*Massachusetts Biomass Sustainability and Carbon Policy Study: Report to the Commonwealth of Massachusetts Department of Energy Resources*." Brunswick, Maine, 2010. Brunswick, Maine.

[79] G. Zanchi, N. Pena, N. Bird, "The upfront carbon debt of bioenergy", *Joanneum Research, 2010*

[80] Bioenergy – a carbon accounting timebomb - http://www.birdlife.org/eu/pdfs/carbon_bomb_21_06_2010.pdf

valid for the boreal forest considering its remoteness and long haul transportation distances and also considering the role it plays in carbon storage and the carbon impact of converting primary forests to managed forests (which is currently planned in certain forest management units in Ontario). Forests that are converted from primary to managed forests, there is an immediate loss of carbon that is referred to as the *carbon falldown effect* and this carbon can take decades to return to the forest.

6.3 Other issues

6.3.1 Type of biomass resource

There are various views amongst organizations on an acceptable type of forest-based biomass. As mentioned above, the use of sawmill or pulpmill waste is considered the best type of biomass resource to utilize as it can truly be considered a waste and is a good strategy to reduce GHG emissions. Of considerable debate was the use of forest residues compared to stems only. As discussed in Section 6.2.1 and Section 6.2.2, forest residues are viewed to be critical for important ecological functions. There is strong opinion that residues are critical for forest functioning, and creating a market for this resource could increase poor forest practices and create further incentives to create this residue or make this residue more readily available. Of utmost importance to most organizations is the minimum amount of forest residue that must be maintained on low productive and nutrient-poor sites and the research required to understand this. Microorganisms, insects and fungi communities rely on this material and very little is understood on the effect removal of forest residue has on these communities in Canada, and references from Europe were provided to support this[81,82].

There was more support for the harvesting of stems only for bioenergy amongst the organization interviewed, and less support from organizations that completed the on-line survey, and the reason for this could not be clarified or elaborated. There was resistance from some organizations on using stems and they stated that only disease-infected or post-fire salvage trees are acceptable resources for bioenergy.

6.3.2 Climate change and the role of the boreal forests

Intertwined in the carbon issue is the role the boreal forest plays in global carbon storage. There is great concern on how the boreal forest will change and adapt with climate change. Protection of current intact forest ecosystems and sustainable forest management will help maintain the capacity of the boreal forest to resist climate change. As highlighted in Section 3.1, the Canadian Boreal Initiatives report "*The Carbon the World Forgot*"[83] captures concerns and issues with the role the boreal forest plays in mitigating and adapting to climate change.

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[81] R. Penttila, J. Siitonen, M. Kuusinen, "Polypore diversity in managed and old-growth boreal Picea abies forests in southern Finland", *Biological Conservation,* (2004) 117: 271 - 283

[82] J. Siitonen, "Forest Management:, coarse woody debris and saproxylic organisms: Fennoscandian boreal forests as an example", *Ecological Bulletins*, 49: 11-41

[83] http://www.borealbirds.org/resources/carbon/report-full.pdf

6.3.3 Private and agricultural lands

Land-use conversion was the top concern cited for using agriculture land for bioenergy production. It was expressed that unless the agriculture land is marginal, it should not be used for anything but food production, as this could create competition for this land and have indirect consequences. There were significant concerns expressed about the potential for high pesticide and herbicide use because of the need to control invasive species.

6.3.4 Air emissions

Other critical air emissions were raised a few times with concerns over local air quality, but were not considered as important as GHG emissions. Some organizations commented that adequate technologies exist to minimize air emissions to comply with regional requirements.

6.3.5 Hydrology and water quality

Concerns of water quality were mentioned, but were not considered as important as other issues. From the literature review, interviews and on-line survey, there were not many references or citations associated with hydrology concerns from utilizing forest-based biomass.

6.4 Research gaps

The most frequently mentioned scientific research gap was the impacts to soil nutrients, fertility and site productivity resulting from biomass removal, specifically forest residues. This includes the impacts to microbial and decomposition communities and how they are affected by forestry residue removal. It was noted that this is not well understood and much more research is needed in Canada.

Impacts on biodiversity and the effects of biomass removal on Canada's species-at-risk were also mentioned as significant scientific research gaps. Although it is widely felt that additional harvest pressures on forests will have consequences on biodiversity and endangered species, more research is critical to better understanding these effects.

Proper and accurate carbon accounting for both forest carbon (the impacts of carbon from forest management, biomass harvesting and natural age class structures of forests) and full upstream carbon emissions were also raised as key research gaps. It was emphasized that assessment of carbon storage in dead organic matter is critical, because of the large proportion of total carbon that is stored below ground in boreal forests.

6.5 Limitations of analysis

The publicly stated opinion and positions of researched organizations were, for the majority, supported by organizations referencing their own publications. In reviewing some of these publications[84], they in turn, reference scientific research from various accredited sources where

[84] It was not possible to complete an exhaustive review of public reports

applicable. For example, the report entitled "*The Carbon the World Forgot*"[85] from the Boreal Songbird Initiative and the Canadian Boreal Initiative includes three pages of citations from published research, other non-profit organizations and various national and international government agencies. For the one-on-one interviews and on-line survey, it was challenging to validate whether opinion of concerns/issues were based on scientific substantiation due to lack of supporting references received. Although evidence of scientific substantiation was requested during the interviews and a follow-up request was sent, only a few responses addressed this component of the work. The opinions expressed during the interviews have been captured and viewed as opinions based on the references received. This lack of direct examples in Canada seems partly due to the ongoing research and limited published research in Canada on the environmental impacts of forest-based biomass. Nonetheless, the breath of information collected, summarized and prioritized within this report is a reasonable representation of the dominant opinions of the major potential benefits, issues and challenges associated with biomass utilization for electricity/heat production.

6.6 Analysis of opinions

The following is a summary of Pembina's analysis of the information collected through this consultation process. Additional references and citations are included here to further validate the findings of this work.

A consistent message from organizations was centered on current forest management practices being unsustainable, in terms of supporting long-term forest productivity and wildlife habitat. Organizations felt that current regulations, management guidelines and harvest rates are not adequate to support a forests' ability to sustain itself and continue to provide ecological goods and services. Several examples of unsustainable practices were given including clearcutting in the boreal, roadside burning and conversion of primary forests to managed forests. A report noted by a few organizations entitled "*Increasing pressures to use forest biomass: A conservation viewpoint*" [86] by CPAWS-Wildlands League discusses the increased pressures to use forest-based biomass as a fuel source with references cited from many published research articles.

Clearcutting in the boreal was raised as a major concern among organizations as being an outdated and unacceptable practice. Another report by CPAWS – Wildlands League entitled "*A Cut Above – A Look at Alternatives to Clearcutting in Canada's Boreal Forests*"[87] looks at the issues associated with this wide-spread management practice that has been adopted in the majority of the boreal forest and the impact clearcutting has on biodiversity and forest productivity. The report explores alternatives to the standard clearcutting practice that can support wildlife habitat conservation goals.

[85] Carlson, M., Wells, J., Roberts, D. 2009. The Carbon the World Forgot: Conserving the Capacity of Canada's Boreal Forest Region to Mitigate and Adapt to Climate Change. Boreal Songbird Initiative and Canadian Boreal Initiative, Seattle, WA, and Ottawa. 33 pp. http://www.borealbirds.org/resources/carbon/report-full.pdf (accessed March 28, 2011)

[86] http://www.wildlandsleague.org/attachments/Forestry.Chronicle.Conservation.Perspective.Biomass.pdf

[87] http://www.wildlandsleague.org/attachments/A%20Cut%20Above.pdf

There were not many references or research examples provided on the other significant management issues such as appropriate scale of harvest and adequate planning horizon. The opinions expressed with respect to these issues were more qualitative.

Although U.S. focused, a study by the West Wisconsin Regional Planning Commission[88] discuss the effects of removing forest residues from forest sites as it relates to soil nutrients, regeneration, wildlife and microorganisms and a report focusing on the bioenergy industry in the U.S.[89] reviews harvesting guidelines and related challenges.

The concerns amongst organizations around carbon accounting, forest ecosystem carbon and overall GHG emissions of bioenergy highlights the ongoing debate and complexity forest-based biomass play in global GHG emission reduction potential. The biomass study released from Manomet Centre for Conservation Sciences[90] was referenced by a number of organizations. This study emphasizes that forest regeneration and growth will not instantaneously recapture all the carbon released as a result of combusting biomass and that the GHG emission impact is very sensitive to the type of biomass resource harvested, the land-base considered and the timeframe and scale of the biomass initiative. Accurately accounting for carbon in forest-based ecosystems is of key interest and is a priority in forest-based carbon account research.[91]

Table 6 summarizes the main environmental issues raised and captured with respect to level of concern, scientific substantiation, awareness and research gaps. This summary is a reflection of the authors' synthesis and analysis of the information received and is based on the scientific references cited.

Table 6. Summary of main environmental issues

Environmental issue	Level of concern	Level of scientific substantiation	Level of issue awareness
Biodiversity, wildlife habitat	Very high	Medium	High
Soil fertility and forest regeneration	High	Medium	High
Carbon emissions, carbon neutrality	High	High	Medium
Hydrology and water issues	Medium	Low	Low

[88] http://smallwoodnews.com/Docs/PDF/Utilization/LoggingResidueReport.pdf

[89] http://www.dovetailinc.org/files/DovetailBioGuides0709.pdf

[90] Manomet Centre For Conservation Sciences. *Massachusetts Biomass Sustainability and Carbon Policy Study: Report to the Commonwealth of Massachusetts Department of Energy Resources*. Brunswick, Maine, 2010. Brunswick, Maine.

[91] http://www.undp.org/climatechange/carbon-finance/Docs/Forest%20Carbon%20Accounting%20-%20Overview%20&%20Principles.pdf

Varying use of biomass resource	Medium	Low	Medium
Role of the boreal forest	High	Medium	High
Private and agriculture land	Medium	Low	Medium

6.7 Observations and conclusions

The following is a summary of conclusions and observations made from the compilation of information and feedback received

- The primary support for the optimal use of biomass was for small-scale, distributed, high combustion efficiency biomass systems used to produce heat or heat and electricity (CHP) only. There was less support for using biomass for electricity generation only. There is need for high-efficiency regulations and efforts to reduce upstream energy usage to maximum return on energy invested from biomass resources. Both high efficiency and return on energy invested were essential to minimize environmental impacts associated with forest-based biomass.

- Sawmill wastes, pulpmill wastes and municipal solid wastes were the top priority wastes to be considered as viable biomass resources with the benefits being reduction in GHG emissions from a reduction of fossil fuel use. There was extreme caution expressed that forest / logging residues should be not considered a *waste* resource to exploit. Forest residues play a vital role in both supporting biodiversity and soil nutrient and fertility.

- Improvements to existing forest management practices are encouraged – specifically alternatives to clearcutting and whole-tree harvesting, regulations around the generation and management of forest slash piles and silviculture techniques.

- The three most significant environmental issues expressed among organizations were biodiversity / wildlife habitat, soil fertility / forest productivity and carbon accounting frameworks for forest-based biomass used for energy generation.

- There is great concern amongst organizations on the assumption of biomass combustion being carbon neutral and reductions in GHG emissions reductions very much depend very much on the carbon account framework used, and the circumstance of biomass resource extraction, processing and utilization.

- There are varying views and differences of opinion on the use of stem-only harvesting for bioenergy. If additional harvesting of stems is to occur, the recommendation was provided that any additional harvesting for biomass is part of the current AAC and does not increase the AAC.

- It is the opinion of many organizations that the use of forest residues is not an acceptable biomass resource. This material is essential for biodiversity, wildlife habitat, soil fertility and forest productivity. There was more support for the use forest residues from the on-line survey, however, justification for this support was not provided. If tradeoffs between

stems and forest residues are to be made, feedback suggests that the trunk of the tree is a preferable feedstock than forest residue; although, as stated above, there was also strong opposition from select organizations stating that the short-term GHG emissions from biomass combustion of stems may not be any better than fossil fuels.

- Much more research, planning and regulations are encouraged for site-specific and stand-level impacts of forest harvesting and residue retention as they related to biodiversity, wildlife habitat and soil fertility. A better understanding of residue removal and identification of nutrient poor sites and stand-level retention targets are also encouraged. It was emphasizes that there is a need for science-led standards, and further research into GHG and non-GHG impacts.

- With regard to forest certification schemes, the FSC National Boreal Standard[92] was commonly stated as the minimum certification scheme necessary to ensure an adequate level of forest sustainability. It was stated that it is the only independent and credible certification scheme in the market.

- There was little information received on the tradeoffs between biomass for energy and other forms of energy – fossil fuels or other renewable energy options. It can be summarized that the general opinion was that biomass for energy has less environmental impacts that coal and potentially less environmental impacts than natural gas; however providing rational and justifications to these opinions was not received. It was expressed that making these comparison is very specific to the region where the fuels are sourced from.

- The environmental concerns related to forest-based biomass in Canada, the knowledge and research being conducted in Canada is new relative to the situation in other jurisdictions – specifically Europe. Many organizations expressing concern appear to be doing so based on a more precautionary approach and stressed the need for further research in Canada.

- Many of the issues raised are not specific to a biomass sector, but are applicable to current forestry practices. For example, if biomass is sourced for energy, the removal of forestry slash could exacerbate the already existing issues of biodiversity and soil fertility. It is the additional pressures on the forests from an emerging biomass sector that were highlighted as concerns.

- There were a few organizations expressing the opinion that Canada is moving ahead with forest-based bioenergy without a full understanding of the impacts of this additional pressure on forests. There was agreement that transitioning away from fossil fuels is of the utmost important, but more research and an organized approach is required to understand the effects of a bioenergy industry in Canada.

[92] http://www.fsccanada.org/docs/boreal%20standard.pdf

6.8 Recommendations

The following recommendations are provided to Environment Canada with respect to biomass use for electricity and heat production:

- Key criteria and indicators associated with biodiversity, wildlife habitat and endangered species as well as soil fertility and forest productivity should be well represented when developing a life cycle value assessment for biomass.
- Support the research at universities and government ministries that is focused on the effects the removal of forestry slash removal has on biodiversity and soil fertility in Canadian forests. This research will help inform the important criteria and metrics required for an accurate lifecycle evaluation.
- Develop and establish a well-rounded carbon accounting framework to be used to accurately capture the carbon implications of sourcing forest-based biomass. The carbon accounting framework should address the concerns associated with proper planning horizons, initial carbon debt from sourcing stems of trees only, loss of carbon from soil disturbances from harvesting operations, and hauling distances.
- Further develop a framework to accurately compare the tradeoffs between sourcing forest-based biomass and other fossil fuels taking into account the specific regional environmental impacts of each energy source.
- If forest residues are to be sourced for biomass, include and model local thresholds of biomass extraction specific to the topology and geography of the region to ensure adequate biomass remains to support soil nutrient and forest productivity.

Appendix A. eNGO and Conservation Groups

Table 7. eNGO and conservation organizations assessed in literature review

ENGO / Conservation organization	Region	Area of expertise
Nature Canada	National	Conservation
CPAWS	National	Conservation
Canopy	National	Conservation
Ivey Foundation	National	Conservation
Forest Ethics	West	Conservation
Environment North	National	Conservation
Canadian Boreal Initiative	National	Conservation
Yukon Conservation Society	North	Conservation
Manitoba Wildlands	National	Conservation
Nature Saskatchewan	Prairie	Conservation
Friends of the Earth Canada	National	Conservation
Nature Conservancy of Canada	National	Conservation
Algonquin Wildlands League	Ontario	Conservation
Wildlife Habitat Canada	National	Conservation
Bird Studies Canada	National	Conservation
Alberta Wilderness Association	West	Conservation
Ecosuperior	Ontario	Conservation
WWF – Canada	National	Climate Change, Conservation
Ontario Sustainable Energy Association	Ontario	Energy
British Columbia Sustainable Energy Association	West	Energy
Equiterre	Quebec	Energy, Climate Change
Sierra Club	National	Energy, Climate Change
David Suzuki Foundation	National	Energy, Climate Change
Association québécoise de lutte contre la pollution atmosphérique	Quebec	Energy, Climate Change
CAN Canada	National	Energy, Climate Change

Greenpeace Canada	National	Energy, Climate Change and Conservation
Ecology Action Centre	East	Energy, Climate Change and Conservation
Ecology North	North	Energy, Climate Change and Conservation
Environmental Defence Canada	Ontario	Energy, Climate Change and Conservation
Conservation Council of New Brunswick	North	Energy, Climate Change and Conservation
International Institute for Sustainable Development	National	Energy, Climate Change and Conservation
Saskatchewan Environmental Society	Prairie	Energy, Climate Change and Conservation
KAIROS - Canadian Ecumenical Justice Initiatives	National	Faith, Climate Change and Conservation
Assembly of First Nations	National	First Nations
Centre for Indigenous Environmental Resources	Prairie	First Nations, Energy, Conservation
Oxfam Canada	National	Human rights

Appendix B. eNGO Interview Responses

B.1. Observations of impacts and benefits of biomass for energy

B.1.1. Established biomass for energy policy

The following question was asked regarding biomass energy policy:

> *Does your organization have a stated position or a policy on the use of forest biomass (and, to a lesser extent, agricultural biomass) for generating energy?*

Interviewee 1 stated that their organization supports small-scale, dispersed harvest of biomass and high efficiency combustion for heat. They support small-scale co-generation only if it meets a standard of at least 60% efficiency. This organization is not in favour of whole-tree harvest for any purpose, or electricity generation from biomass which inherently have low efficiencies. They are generally in support of cultivation of agricultural biomass but only on marginal farmland that would not have to be converted from food production or natural forest.

Interviewee 2 stated that their organization does not have an established position on biomass for energy, though representatives of this organization have made comments in the media that were supportive of heat generation using wood pellets derived from biomass waste products.

Interviewee 3 stated that their organization does not have an established position on bioenergy because there are differing opinions within the organization, but that they have worked on biomass issues in the context of making sure that biomass for energy is developed sustainably, rather than working on issues around whether it should be developed.

Interviewee 4 stated that their group does not have a specific policy but rather a generic goal of sustainability. Their group is comprised of volunteers who meet monthly so they focus on issues where there is expertise among the group. The interviewee did note that they are starting to gather information on bioenergy.

Interviewee 5 stated that their organization has no policy positions but they have program areas to focus their funding on environmental initiatives.

Interviewee 6 stated that their group does not have a formal policy on biomass for energy.

Interviewee 7 stated that their group supports using biomass for generating energy if the biomass used is a waste product, not from a targeted harvest. However, their group is open to a targeted harvest if it can be proved that it has been from fires or insect damage such as spruce bark beetle killed trees. There is confusion around this issue about what it sustainability means. The group is against activities that harm habitat or create more access that exacerbates hunting pressures.

There is not much of a forestry industry in the Yukon so there is not much waste available in the form of sawmill waste. The biomass that may be available comes from transmission lines that are cleared and other rights-of-way. Right now, huge amount of biomass is burned along highways/ transmission line rights-of-way that are cleared and from ongoing maintenance. This material could be diverted to bioenergy.

Interviewee 8 said that their organization supports the development of a globally consistent independent certification system for bioenergy, measured against stakeholder-developed standards. They suggested the Roundtable on Sustainable Biofuels as an example of a system that could be developed for biomass energy.

Interviewee 9 stated that they have a position but that it has not been articulated in a policy document. Their organization supports the use of forest and agricultural biomass for energy with a number of caveats- in particular, using waste streams as a source rather than dedicated harvest or cultivation.

Interviewee 10 stated that the organization does not have a published policy. Currently there is an internal policy that is not complete but has been started and is in the works. The policy highlights that there are some concerns with bioenergy and no clear position has been taken.

B.1.2. Benefits of biomass energy

The following question was asked regarding benefits of biomass energy:

> *If biomass can be sourced in such a way that the environmental impacts are acceptably managed, what are your 'top of mind' and most significant benefits of using biomass for energy compared to using fossil fuels?*

Interviewee 1 stated that there may be GHG emission reduction benefits to using biomass instead of fossil fuels, but this is very dependent on combustion efficiency and harvest methods. The interviewee noted that biomass is only GHG neutral if combustion is adequately efficient and is also dependent on the fuel system that is being replaced. For example, the interviewee suggested that in a low-efficiency coal-burning electrical generating plant, converting to natural gas is a better choice than converting to biomass in terms of GHG emissions, but that high-efficiency combustion of biomass for heat to replace residential fuel oil is a good choice in terms of GHG emissions.

Interviewee 2 stated that the major benefit of biomass is that theoretically, biomass is not adding any more carbon to the atmospheric carbon cycle. They also noted that there may be fewer GHGs associated with transportation of biomass for isolated communities where fossil fuels which must be transported over long distances, as opposed to biomass which can be locally sourced in many areas.

Interviewee 3 stated that use of biomass for energy is likely less carbon intense than fossil fuels, and may have fewer land and water based impacts than extraction of fossil fuels, but that this is contingent on the type of biomass and harvesting and management practices. They stated that biomass could be useful as transition fuel to shift away from fossil fuels.

Interviewee 4 suggested that there are two benefits to using biomass for energy production: using biomass reduces GHGs over using coal; it is a local fuel source that does not have to be imported from outside the region.

Interviewee 5 stated that the principle benefit is the opportunity for GHG emission reductions. If all of the impacts are addressed then a harvest intensity or frequency of every 200 years offers a GHG reduction over the use of burning fossil fuels. By regrowing the trees, carbon emissions are ultimately reduced, but this happens over many years.

Interviewee 6 stated that the main benefit would be reduction in overall pollution – air emissions and GHG emissions, if lifecycle analyses prove that GHGs are actually reduced. Another advantage to using biomass is that it is a local resource that is renewable if it is done right, as opposed to something imported.

Interviewee 7 stated the main benefit their group sees in using bioenergy is the displacement of fossil fuels. Biomass can be considered carbon neutral but fossil fuels are still used in the harvest and transportation of biomass. If biomass is sourced locally, fewer emissions would result than with the transport of diesel fuel from far away supply centres. Other benefits include the ability to cogenerate heat and electricity. This is best done with district systems. Local jobs can be created by developing a biomass industry. Because of fire suppression, a non-diversified fuel mosaic of the forest has resulted. It is important to break up this fuel mosaic. Thus biomass harvest can be used to keep the forest healthy and protect against fire and insects.

Interviewee 8 stated that the benefits of biomass energy are mainly reductions in GHG emissions, along with lower biodiversity impacts from fossil fuel exploration and development.

Interviewee 9 stated that bioenergy is a renewable fuel source with a potential to achieve carbon neutrality. In their province, they felt that there is extra human resource capacity in the forestry sector because the level of harvest has declined in recent years. The stated that there are serious environmental impacts of exploring for and producing coal and other fossil fuels, and that biomass could replace some of these sources of energy.

Interviewee 10 responded that ideally there is a place for forest-derived biomass. This will depend on the results of lifecycle assessments and GHG balance as to whether there is a feedstock and scenario that can be supported from a climate change perspective. They suggested that biomass is an end-use (post-harvest) feedstock since harvesting living forests or plantations will not result in GHG savings. Thus sawmill waste is an appropriate input, rather than starting from raw forest. They were uncertain about the GHG balance but suggested that it might be possible to divert wood (i.e. used lumber) from landfills to burn it instead for energy as opposed to generating landfill gas.

B.1.3. Environmental Impacts of use of biomass for energy

The following question was asked regarding concerns of biomass energy:

> *What are the 'top of mind' and most significant <u>concerns</u> of using biomass for energy compared to using fossil fuels?*

Interviewee 1 stated that the most significant concerns were an increase in harvesting pressures in areas where levels of forestry activity are already high. Biomass harvesting for energy could encourage destructive forestry practices (i.e. high volume intensive harvest with removal of forest slash). They noted that harvest of biomass leads to a short term overall increase in GHG emissions unless it's combusted using high-efficiency technologies and replaces GHG intensive fossil fuels. They noted that the assumptions and modelling of carbon neutrality of biomass is questionable, and suggested that there is evidence of long term declines in soil carbon and changes to forest structure after harvest, which contributes to an overall increase in atmospheric carbon.

Interviewee 2 noted that their top concern was air quality as there have been some concerns in local communities where outdoor wood-fired boilers can create high amounts of particulate matter due to improper combustion of wood. They noted that use of biomass may have implications for forest carbon storage, and they are not confident in the assumption of carbon neutrality.

Interviewee 3 stated that they have a number of concerns related to biodiversity, water and soil, overharvesting, loss of ecosystem services, damage to riparian protection and loss of high conservation value forest. They stated forests that have been converted from their natural state are more susceptible to climate change, and thus we should not be harvesting and converting any natural forest. They stated that it is a misconception that biomass is a renewable energy source because the fuel source could be depleted over time if not sustainably managed.

Interviewee 4 questioned whether biomass use would be sustainable. Related to this, the interviewee questioned what sort of harvesting methods would be used, and suggested that the effects on forests as a result of global warming are unknown. The interviewee referred us to work done by Mike Flannigan on the increase of forest fires and insect outbreaks in the forest in response to climate change[93,94]. The issue of some species migrating northward was also raised. The interviewee also questioned what additional pressure biomass harvesting would put on biomass and if the lumber and pulp and paper industry rebound, along with the additional demand for biomass for energy – is it possible to support all three? With this additional bioenergy pressure, there are implications for endangered species. Locally there would be concerns about the contiguity of the forest and habitat for endangered species such as caribou. A further concern that was offered was whether biomass harvesting would change the composition of the forest. Currently, harvesting is biased toward pine or spruce for paper and lumber. The boreal forest is largely coniferous, so a balance is required in removal of species.

Interviewee 5 divided the impacts into three categories: climate related and accounting of GHG emissions; biodiversity impacts – related to material removal and effects at the species level through structural changes in the forest; and long-term site productivity (this crosses over with removal of material from the forest).

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[93] M.D. Flannigan, Y. Bergeron, O. Engelmark, and B.M. Wotton, Future Wildfire in Circumboreal Forests in Relation to Global Warming, http://www.cfr.washington.edu/classes.esc.401/CircumBorealpres.pdf (accessed March 31, 2011).

[94] Flannigan, M., Girardin, M., Tardif, J., and Y. Bergeron, Climate and fire relationships in the central and eastern Canadian boreal forest, (Sault Ste Marie, ON: Sustainable Forest Management Network, 2003). http://www.sfmnetwork.ca/docs/e/PR_200304flanniganmclim6.pdf (accessed March 31, 2011).

Interviewee 6 identified as a key concern that forestry companies will start to generate waste (tree tops and branches) to be used for bioenergy based on policies that promote the generation of waste from forestry practices.

Interviewee 7 sees two main concerns with use of biomass for energy - habitat destruction and increased activity in forest leading to greater access and overhunting. Other concerns that the interviewee has with using biomass for energy related to the pollutants emitted when biomass is burned. When there is incomplete combustion of wood, black carbon results and is deposited onto snow. The black carbon on top of the snow changed the albedo and absorbs more heat onto landscape than would normally be the case. This results in a positive feedback loop for global warming, since black carbon is a climate forcing agent. Although biomass combustion results in smoke and pollution, it is less offensive than diesel.

Interviewee 8 stated their concern that bioenergy must be developed in a sustainable manner, that must include mitigation efforts to reduce impacts on biodiversity (e.g., avoid siting development in high conservation value areas) and methods to ensure and maximize significant GHG reductions based on a life-cycle analysis.

Interviewee 9 stated that they are concerned about the nutrient loss from the soil from bioenergy harvest due to whole-tree harvest methods used in bioenergy production. They pointed to evidence that after 3 cycles of harvest, nutrient levels are reduced so much that fertilizers are required for further growth.[95] They are also concerned about implications for soil acidity [96]and soil temperature,[97] and loss of biodiversity and replanting of plantation forests.

Interviewee 10 mentioned that there are several large concerns around using biomass for energy. A true lifecycle assessment is required to understand the GHG picture since information around GHG balance is sometimes misleading. It was mentioned it takes more wood to generate the same amount of energy compared to coal. Interview 10 also notes that most evaluations do not take into account the full lifecycle of using wood such as soil disturbance (which releases GHGs). Using biomass for energy may result in a short-term benefit but not a long-term benefit. The long-term impacts of soil disturbance may not outweigh the benefits from substituting fossil fuels with biomass. It is necessary to conduct lifecycle analyses from a temporal perspective. Interviewee 10 also identified a number of biological impacts including the problems associated with removing woody debris and the impact that it has on soil quality and biodiversity.

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[95] Distribution of biomass and nutrients in some New Brunswick forest stands: possible implications of whole-tree harvesting. (La distribution de la biomasse et les substances nutritives dans quelques peuplements forestiers du Nouveau-Brunswick : implications possibles de la récolte intensive). 1990. Maliondo, S.M.; Mahendrappa, M.K.; van Raalte, G.D. Forestry Canada, Maritimes Region, Fredericton, New Brunswick. Information Report M-X-170E/F. 40 p. http://cfs.nrcan.gc.ca/publications/?id=7793;

[96] Potential acidification of sites due to intensive harvesting in New Brunswick. 1987. Mahendrappa, M.K.; Maliondo, S.M.; van Raalte, G.D. Pages 110-114 in C. Granger, editor. Proceedings of the 6th Canadian Bioenergy Research and Development Seminar, February 16-18, 1987, Richmond, British Columbia. Elsevier Applied Science, London, United Kingdom, and B.C. Research Canada, Vancouver, British Columbia. http://cfs.nrcan.gc.ca/publications/?id=8508

[97] Intensive harvesting impacts on soil temperature and solution chemistry in the Maritimes region of Canada. 1994. Mahendrappa, M.K.; Kingston, D.G.O. New Zealand Journal of Forest Science 24: 402-414. http://cfs.nrcan.gc.ca/publications/?id=6112

B.1.4. Impacts and benefits of harvesting only stems for bioenergy

The following question was asked regarding harvesting stems:

> *What do you think are the biggest environmental impacts and benefits of using whole tree forest biomass for energy production (trunk only)? This can include impacts and benefits associated with harvest, transportation, combustion, silviculture, etc.*
>
> *c. Can you rank these impacts and benefits in order of importance?*
>
> *d. Are there local issues, recent studies, or practices that have made any of these issues particularly important in your region?*

Interviewee 1 stated that existing forestry operations and forestry regulations in their region are creating an unsustainable level of harvest, and thus additional harvesting for bioenergy is not acceptable to them. Regardless of the use of the biomass (for energy or other fibre products), they thought that additional harvesting would have increased environmental impacts. They had the opinion that whole-tree harvest should not be practiced at all, especially on poor soils. They noted there is a large body of science to support this position, including recent work by the Manomet Center for Conservation Sciences report from Massachusetts.[98]

Interviewee 2 noted that there is a loss of carbon from the forest with whole-tree harvesting and that a full carbon inventory should be completed before this type of harvesting is allowed. They noted that salvage trees from fire zones or insect-killed trees might be good candidates for this type of harvest.

Interviewee 3 stated that there are numerous concerns, including loss of fish habitat, riparian zones, biodiversity and endangered species habitat. They stated that any harvesting for biomass must become part of the existing annual allowable cut (AAC), rather than creating an additional demand on the forest. They noted that adding this extra demand on the forest while keeping current forest policies would not be sustainable. In addition, they stated that using stems that could otherwise be used in higher value-added production is not an environmentally or economically sustainable use of forest resources.

Interviewee 4 is an advocate of using the trunk for commercial purposes, while he is adamant about leaving the leaves and branches in the forest. The interviewee identified the effects of global warming on the forest as a concern related to whole-tree harvesting, noting that northwestern Ontario has a higher rate of global warming than other parts of Canada. This increased warming experienced by forests in this region is leading to additional pressures on the forest caused by fire and insects. Other concerns identified include the pressure on endangered species resulting from a recent provincial government move to exempt forestry from the Endangered Species Act.

Regarding the use of the bole of the tree for biomass, interviewee 5 responded that assuming the harvest level does not change and is sustainable; there will be neutral impacts on the forest. One risk pointed out is that less common trees that are left behind during typical forestry operations such as tamarack, white cedar, and black ash are normally ignored because there is no market for

[98] Manomet Centre For Conservation Sciences. *Massachusetts Biomass Sustainability and Carbon Policy Study: Report to the Commonwealth of Massachusetts Department of Energy Resources*. Brunswick, Maine, 2010. Brunswick, Maine.

them. However, if these species can be used, there will be a new focus of silviculture, and the composition of the forest could change. In the Great Lakes – St. Lawrence forests, this actually could represent a benefit. Historically, these forests were comprised of hardwoods and mixed conifers. Over time, the balance among these species has shifted due to preferential harvesting. If there is a market for "low quality wood", the forest could benefit through "improvement cuts" and harvesting this low quality wood.

Interviewee 6 is not opposed in principle to biomass production but stated that it comes down to the question of sustainable use of forests. It was suggested that paper is not the only valuable product from forests, and if done sustainably, then why not produce energy from biomass? Using biomass could have lower GHG emissions, but a lifecycle analysis of energy production from whole-tree harvesting versus fossil fuels is extremely important to understand. If a lifecycle analysis can show that GHGs emissions are reduced using biomass, then this could be a valuable benefit, along with the use of a renewable rather than non-renewable resource.

Interviewee 7 sees the impacts of whole tree harvest for bioenergy as being similar to lumber harvest. Compared to using harvesting residue (slash), there is more calorific value in using the bole of the tree so a smaller area would need to be disturbed and there would be fewer transportation issues. Trees that have been killed by spruce beetles make better fuel for combustion since they have a lower moisture content so less drying required. Removing these trees makes sense because energy can be obtained, but if they are left then they just become fuel for forest fires. It is still necessary to leave some trees for enhancement of the forest floor and for regeneration.

Interviewee 8 stated that, unless it can be proven otherwise, it seems that dedicated harvest for bioenergy seems to be the lowest value use of trees from an economic, social and environmental perspective.

Interviewee 9 stated that while this method does not have as many environmental impacts as harvesting with removal of slash, they would still prefer to see selective harvesting methods used that support biodiversity.

Interviewee 10 stated that their organization does not support whole-tree harvesting because it removes biomass which has benefit for the soil and takes away habitat and food for various species. At this time, their organization cannot support using boles of trees for energy production. Interviewee 10 stated that there is a difference between logging for products and for bioenergy in that the "full math" has not been done for bioenergy in relation to GHG impacts. They questioned at what point is it appropriate to take forest materials and use them for bioenergy, and suggested that boles of trees should be used for lumber while the residual materials from mills and end of use materials can be used for bioenergy. Interviewee 10 also expressed concern that Canada is forging ahead on using whole trees for energy without having full information. The interviewee wanted to make it clear that it is equally important to note that eNGOs recognize the importance of getting off fossil fuels and that there is a temporal urgency to this. However, we need to do more research to ensure using biomass for energy has the net results that we want. Interviewee 10 raised concerns over the level of the annual allowable cut (AAC) stating that eNGOs are concerned that the AAC could go up because there demand for biomass for energy will cause greater competition for wood. The AAC must be controlled rather

than allowed to expand to meet this greater demand for biomass. In fact, the AAC is not currently set at a sustainable level. The way that the AAC is set needs to be revisited since the current rule is that revisions to the AAC are not allowed to impact timber harvest by more than 1% in British Columbia. Other values related to the forest must be managed within this constraint. There is a significant concern that new biomass industries, such as cellulosic ethanol and pellet production for export, could impact the ACC.

The mountain pine beetle has had a significant impact on the forest industry and biomass production in BC. The trees that were killed by mountain pine beetle are currently the main source of biomass but there is a concern that the industry wants to take down all the trees in the mountain pine beetle affected areas. In fact, not all trees have been killed and there is some standing green so it would be a mistake to completely remove all biomass from those areas. Unfortunately, the public is receiving mixed messages about the situation. Regeneration is coming along better than predicted and these areas of standing green are critical to the regeneration of the forest within affected stands of trees. A major concern around creating an industry that is dependent on fibre from mountain pine beetle killed trees is that the stockpile of wood will run out in twenty years. As a result, some members of the industry are planting hybrid poplar plantations now in anticipation of replacing harvest of mountain pine beetle killed wood. Examples of these plantations exist on the east side of Vancouver Island.

B.1.5. Impacts and benefits of using slash/harvesting residue biomass

The following question was asked regarding using slash/harvesting residue material from existing forest harvesting operations:

> *What do you think are the biggest environmental impacts and benefits of using tree tops and branches from existing forestry operations (tops and branches used for bioenergy, trunk used for other purposes) for energy production?*
>
> *c. Can you rank these impacts and benefits in order of importance?*
>
> *d. Are there local issues, or recent studies, or practices that have made any of these issues particularly acute in your region?*

Interviewee 1 stated that branches, tops and bark should not be seen as waste, and that they play an incredibly important function in soil productivity, nutrient cycling and wildlife habitat. They perceive no benefits of using forestry slash. Interviewee 1 noted that removal of tree tops and branches has tremendous impacts on a forest ecosystem. Because the bulk of nutrients are in small branches, bark, and foliage, removal of these components has implications for nutrient cycling in the forest ecosystem. In addition, soil loses the ability to hold moisture, becomes dry when exposed to sunlight, and is damaged from rutting (grooves in the soil from machinery) and compaction during harvest. Removal of slash also takes away protection for seedlings and small plants to become re-established and changes the decomposition ability of soil organisms, because of increased soil temperatures.

Interviewee 2 noted that they were not very familiar with the environmental implications of removal of branches and tops. They gave the example of Sweden, which has progressive policies, uses all parts of the tree for biomass. They suggested that this could be used as an

example for other regions, provided that there was evidence that this would not have negative implications for the carbon cycle.

Interviewee 3 stated that because there is little to no forestry activity occurring in their region currently, many of the issues associated with using slash/residue are the same as those for whole-tree harvest (i.e. conversion of natural forest to managed forest). They also stated that burning forest biomass in large centralized thermal plants is not the most sustainable end-use and that regional co-generation would be a better end use.

Interviewee 4 commented on the use of sawmill shavings and byproducts of the milling process as good sources of biomass for energy production (particularly cogeneration) since it is not feasible to haul these byproducts back to the forest. On the other hand, the interviewee reiterated comments made about whole-tree harvesting; stating that anything but the bole of the tree has to be left in the forest. Interviewee 4 responded that the whole tree cannot be harvested for energy production, referring to the fact that the trunk of the tree could be used but the branches and leaves must stay in the forest. It is this rotting residue that is basis of a forest ecosystem. The interviewee referenced Will Karmion, a forestry professor at the Lakehead University.

Interviewee 5 stated that biodiversity is the major impact to removing the whole tree, including the tree tops and branches from the forest. The residues left on site provides habitat for micro-fauna, insects, and small and large animals. It was suggested that there is concern from eNGOs about slash piles. Currently there is little market demand for the slash, but harvesting biomass for energy could create a market. As it is, there is already a tendency to remove the material from the harvest site to roadside. By creating a market incentive, industry will be working harder to take the material off site rather than redistribute it in the forest. Removal of this material also raises issues about biomass impacts at the site level, particularly soil nutrient levels. Twigs and stems have high nutrient levels – when they are removed from nutrient-poor sites, nutrient impoverishment results. This point echos the concern of biodiversity impacts – where soil nutrient levels are affected by intensive forestry, the soil micro-fauna and flora are also affected.

Interviewee 5 also referred to long-term site management conducted by the Ontario Minister of Natural Resources as part of a Class Environmental Assessment for Ontario. The preliminary data from this long term data collection shows some level of impact on nutrient poor sites from material removal. Regarding benefits of using tree tops and branches, it was noted that the benefit framed by the government (use of slash for bioenergy production) is a solution to the slash piles at roadside. However, it was stated that this problem (the creation of slash piles) was created by choosing an inappropriate technology and from the lack of regulatory oversight, emphasizing that there is no ecological benefit of removing this material from the forest. The interviewee provided concluding remarks on this question by stating that impacts will vary among sites due to variation in the forest composition, nutrient status and how wide the harvest and removal of material is across the landscape.

Interviewee 6 responded that the most important challenge is to understand from a biological point of view is the amount of forest material that needs to be left behind in the forest versus what can be taken. It was also pointed out that understanding this appropriate level is an evolving area of research. The concern was also raised about promoting generation of waste (residue/ slash) from forestry practices rather than encouraging companies to redistribute this material in the forest. Regarding local concerns, the interviewee has not seen any local backlash

regarding biomass harvesting for energy. All projects have been well-accepted to date and mainly for economic reasons.

Interviewee 7 cites impacts that have been noted in other regions where there is a viable forestry industry. Where slash/residue material is harvested, foresters have had to go back and fix the soil since the nutrients were removed. Thus soil degradation is a major concern. The benefit to using the harvesting residue is that there is no "waste".

Interviewee 8 stated the material that is viewed as "waste" (slash/residue) is actually coarse woody debris, which provides soil structure and nutrients that are of great ecological significance. They stated that slash/residue must be managed sustainably and referred to FSC standards as the best way to achieve this.

Interviewee 9 said they are concerned about implications of the removal of slash for wildlife habitat and nutrient loss from the soil. They believe that removal of slash at a low level of does not have large impacts, but that in their province many large forestry companies have permits to remove slash at a large scale, and they find this very concerning.

Interviewee 10 stated that their organization is cautious about using residue material since this is what feeds the soil quality which needs this organic matter. Harvesting residue is an important food source and provides habitat for species. Some people assume this is "wood waste" but it is not waste from an ecological perspective. One major problem is that slash piles are left at roadside because it is not economical for them to load up this material and transport it to mills. Because the slash piles do not benefit the forest, it is worth investigating whether there are GHG benefits from using the roadside slash piles for energy production but a full lifecycle analysis is needed.

B.1.6. Considerations for private lands /crown lands

The following question was asked regarding sourcing biomass from private lands:

> *Are any of the concerns or benefits noted above specific to biomass from private lands as compared to crown land?*

Interviewee 1 stated that there is definitely a need for regulation of management of private holdings, but that private landowners should not be expected to manage their land for multiple values, as is expected of Crown land management. They stated that there is definitely a need for management regulations of forest resources on Crown land, but there is also a need to provide education and financial resources to encourage good stewardship of small private woodlots.

Interviewee 2 stated that while there are few private woodlots in their area, and thus small potential for bioenergy harvest, there are some First Nations groups with extensive surface ownership and they would like to see forest management on these lands similar to the provincial/ territorial standards.

Interviewee 3 said that they were concerned that there is no forest management oversight or regulation on private lands in their region. They noted that examples of both exemplary harvesting practices, and poor harvesting practices, can be found on private lands.. They stated

that private woodlot owners should be expected to meet, at minimum, the provincial standards, and it would be better if they were required to meet Forest Stewardship Council standards or an equivalent checklist.

Interviewee 4 identified several issues concerning harvesting biomass from private woodlots. The woodlands handbook applies to Crown land only and there should be strict rules on private lands similar to Crown land. Regulations such as harvesting only in certain seasons to avoid soil rutting should be applied to private lands. Without requirements to replant trees on private land, "weedy species" (willow and alder) will overtake private lands. An example was given of regulations in Scandinavia where there are tight controls on harvesting and planting on private lands. The Scandinavian example also has minimum and maximum harvest regulations. Private woodlot owners are penalized if they are not harvesting a certain portion of their land. They also have to use management practices that guarantee sustainability. In response to the question about crown land, Abitibi-Bowater was mentioned as an example of strict practices. This company has a woodlands handbook that covers various aspects of forest management such as spills, river crossings, replanting, season to harvest, nesting sites, what can be taken to mill, and what has to stay in forest. It was also suggested that this company was a good example because of its ISO 14001 and SFI certification. The interviewee felt that stringent regulations do exist for forestry practices on crown land.

Interviewee 5 mentioned how some municipalities have planning prior to harvest such as in tourist areas, but there is little in the way of sustainable forestry requirements for private land. The creation of significant demand could result in complete denuding of the forest especially in the central areas that are closer to markets. The lack of regulation and policy oversight on private land could result in clear cutting and bulldozing of land. The advantage of harvesting on crown lands is that if there are problems, then new policies can force change, and this is done with broad application. Unfortunately, the addition risk is that if demand is large (and there is the possibility to create huge demand for biomass), this could result in massive allocations that would be difficult to pull back later. Thus an extremely large area would be impacted which could have massive impacts on biodiversity on a regional or even provincial scale.

Interviewee 6 stated that from an environmental perspective it makes no difference whether the land is owned by the crown or owned privately. What is different is the regulatory regime and the compensation involved.

Interviewee 7 stated it is necessary to leave some biomass for habitat. It is a good idea to remove some fire kill on a small scale. In the Yukon, when agricultural leases are granted (these are 10 acres or more in area) part of the requirement is to clear a portion of the land. This is not necessarily done sustainably. Policies should be introduced that promote the practice of leaving material on forest floor which acts as cover for new growth. Management guidelines could be applied to both private and crown lands.

Interviewee 8 stated that they are concerned about the potential for wide-scale biomass harvest on private lands because private woodlots are subject to less sustainable forest management regulations than Crown land.

Interviewee 9 stated that a large proportion of forested land in their province is private and thus the lack of harvesting regulation for private lands can have significant implications for overall sustainability. However laws relating to water and air quality do apply and could be enforced if

more resources were placed in enforcement (of both public and crown land). They noted that private woodlot owners are attempting to produce high-value wood products and non-timber wood products aimed at different markets while using low quality wood for bioenergy.

Interviewee 10 pointed out that in some cases allowing people to have more control over their land (in the case of private lands) encourages better stewardship but this can remove it from some of the protective ecosystem standards as well, which can be a problem. Ultimately, stewardship depends on who owns the land. Some landowners are better stewards than the government but not all of them are. The problem with private lands is that the same rules as for crown land do not always apply. For example, there are concerns around species at risk. Interviewee 10 remarked that the landscape is changing with climate change and wondered what this means for privately controlled land. Landowners will need to be more flexible since they will have less ability to manage and steward the land under climate change scenarios. It was mentioned that stringent ecological standards should apply to both private and crown land. As far as standards for bioenergy, Interviewee 10 suggested that we have yet to see any standards set for bioenergy projects. There are process and content issues that require consultative standards. Regarding forest carbon offsets, these should be vetted by the community through a public, transparent and participative process. So far Interviewee 10 has not seen anything of this sort of process for bioenergy but the industry is proceeding rapidly. Overall, there are concerns from a governance perspective (provincial/ federal) and there is a lack of transparency and participation.

B.1.7. Forest management and conservation

The following question was asked regarding forest management guidelines and conservation initiatives:

> *How do you think forest management guidelines/practices and conservation initiatives affect the impacts noted above? Do protected areas or good management practices contribute to mitigation of the impacts from harvesting?*

Interviewee 1 stated that current management regulations in their province are not adequate to deal with current harvesting levels, and thus definitely not adequate to handle any increase in harvest from biomass harvesting. They stated that good forest management practices and standards, while helpful, are not ‘silver bullets’ and do not replace regulations that can be enforced.

Interviewee 2 stated that the only active forest management that’s really occurring in their region now is fire-fighting. If harvesting biomass is going to take place, then strategies for fire-fighting are going to have to be revisited in the future with a goal of maximizing carbon storage potential. They stated that conservation efforts are beneficial, but the level of harvest occurring right now is so low that there is no conflict between modest use of the forest and conservation.

Interviewee 3 noted that the environmental impacts of the provincial policies (namely the scale of the AAC) supersede any conservation efforts or establishment of good management guidelines. They indicated that the scale of the AAC is really the main driver behind the impacts of forest operations, and thus other efforts are actually futile in preventing impacts. They suggested that if biomass is going to be promoted as a more sustainable fuel source, then forest practices need to meet more sustainable standards, such as those from the FSC.

Interviewee 4 felt that in general strict regulations are good but that monitoring is an issue. The interviewee lamented that the immense piles of chipper debris that result when trees are debarked and chipped at the harvest site are not redistributed across the forest as required by regulation. When chipping is done at the site, there is no debris at the mill but there is an immense amount of chipper debris left in piles in the forest. As companies are often given permission to burn these piles, this is usually the course of action taken. Similarly, trees are delimbed at the landing site. In the past, debris was removed where the tree was cut but due to other impacts on the forest floor the machine used for this was replaced by one with oversized tires that hauls the whole tree to the roadside. Forestry companies should to redistribute the limbs in the forest. Companies will sometimes chip and haul the chips to a cogeneration plant. Without proper monitoring, many companies leave this slash in piles, which stifles growth. In winter, these piles are burned which results in particulate matter and other air emissions. In reference to the regulations, it was reiterated that endangered species must be respected. Other regulations that should be put in place include a requirement for the number of trees per acre retained, tight control of water crossings, and slash/ chipper debris management.

Interviewee 5 pointed out that there will be a rewrite of the Forest Stewardship Council (FSC) Boreal Standard soon. Companies that are certified must adhere to this standard and respond to pressure from all parties to include biomass practices in FSC. Certified companies have to meet these standards, which are higher than the regulatory environment. The Canadian Boreal Forest Agreement was also referred to, which commits signatories to develop guidelines. The interviewee was confident that something will emerge from this that is also higher than the regulatory standard. The objective of these standards is to address concerns around biodiversity. Companies are forced to harvest in a way that retains tops/branches on site, GHG footprint of products is calculated, and nutrient poor sites are avoided.

Interviewee 6 suggested that if we introduce harvest guidelines then biomass production for energy could be done sustainably. Sustainability is an important criterion around how the resource is harvested. Harvesting should be done at a slower pace so that we are not trading one problem for another.

Interviewee 7 stated that habitat issues, ground cover soil, standing trees for birds and fallen trees for habitat should all be covered by guidelines. Hopefully this would reduce the impacts associated with using biomass for energy.
Interviewee 8 stated that FSC standard are currently better than provincial regulations in regards to minimizing the environmental impacts noted above.

Interviewee 9 stated that current regulation is not adequate to mitigate the current impacts of harvest. They cited an example from their province where current habitat zones are being removed to convert low impact forestry to plantation forest. They mentioned FSC standards as an example of good management and Environmental Choice as an energy specific standard, but that large companies often create their own certification system which that undermines other companies that are trying to achieve higher management.

Interviewee 10 commented that there are currently no guidelines in place in BC. It is necessary to develop something stronger than a guideline that is led by science. We need to find the best source of biomass (in terms of the feedstock), considering all the ecological impacts. Such a standard needs to be monitored and enforced. We need renewable resources that are managed sustainably to manage GHGs. We also need regional rules. There is a great deal of variation

among eco-regions therefore there may be regions in which it is more appropriate to harvest biomass for energy, and other areas where it is not appropriate.

B.1.8. Information gaps

The following question was asked regarding information gap of using biomass for electricity/heat production:

> *What research needs or information gaps do you believe need to be addressed to better understand the impacts and benefits of sourcing of forest biomass?*

Interviewee 1 stated that there needs to be a more accurate assessment of the time lag between combustion of biomass and sequestration of carbon. There also needs to be better accounting of the GHG impacts of different efficiencies of combustion as compared to other fossil fuel options. They stated that the knowledge of the effects of biomass for energy on biodiversity is piecemeal, and a comprehensive assessment of impacts on all types of forest and aquatic life is needed.

Interviewee 2 stated that their region needs an overall forest inventory, and needs accurate carbon modelling to determine whether forest carbon stores will grow or decline with climate change, and then determine whether harvesting biomass for energy can occur which either maintains or increases the amount of carbon stored in forests. They also would like to see an assessment of the appropriate scale of harvest that will not cause significant environmental impacts

Interviewee 3 stated that there needs to be a better understanding of how current forestry rights are parceled out, and what the forest is used for. They stated it is important to know if biomass sourcing is going to be redistribution of the existing AAC, or an increase in the AAC. They suggested that an ecosystem-based analysis of high-value conservation areas, endangered species and habitat be conducted before a biomass harvesting takes place to ensure no-harvest areas would be established.

Interviewee 4 identified the GHG emissions from biomass compared to coal as the key question that needs to be researched. The Boston Massachusetts Manomet study was referenced, which concluded that when coal is replaced with biomass, it results in a 3% increase in GHGs resulting from harvesting, dehydrating and burning. In response to the Manomet study, Massachusetts has slowed down its use of biomass for energy. It was noted that electrostatic precipitators can take 98% of the particulate matter out of the process but monitoring GHG emissions is difficult. Another research areas identified was the effects of global warming on the boreal forest. Related to this, it was pointed out the importance of the role the boreal forest plays as a carbon sink – more research on this is beneficial. Further research is also needed to understand the impact of biomass use on endangered species and habitat and whether there are additional pressures.

Interviewee 5 stated that little is understood about microbial/ decomposition communities and how they are affected by material removal from sites. Very little is also known about the role of tree stumps and roots and what happens to microbial communities when these are removed. However, on-site biodiversity and long-term ability to support complex ecosystems is likely compromised. Europe is dealing with degraded systems (ecosystems with lower productivity and biodiversity) and is trying to figure out how to solve this problem whereas in Canada we need to learn how to avoid the problems altogether. Regarding the issue of biomass being an effective

substitute for hydrocarbons, we need accurate and regionally-specific life-cycle analyses. Carbon in forests, under normal circumstances, would return to soil.

Interviewee 6 noted that there is an ongoing debate around how sustainable or "green" biomass is. It was suggested that emulating processes such as the multi-stakeholder working groups that developed the Canadian Boreal Forest Agreement and the FSC certification offer an appropriate model for resolving the debate about sustainable use of biomass.

Interviewee 7 noted several information gaps around use of biomass for energy in the Yukon. Research is needed on how fast the forest in the Yukon can actually regenerate.

Questions that need to be answered include:

- "how much wood does a biomass facility need to operate and how long does it take us to grow it?";
- "how much biomass is available and how much is needed to keep these facilities going indefinitely?";
- "how can sourcing biomass benefit the forest health in term of breaking up the fuel mosaic, or if there's a certain type of forest that's more susceptible to an outbreak, how can we mitigate this?";
- "with growth rates (mean annual increment of growth) in the north, could it make sense to have a tree farm?"

Interviewee 9 stated that determination of carbon neutrality needs to be better defined and that there is a need for a better understanding of energy return on investment for bioenergy. For example, they would like to know what is the distance that biomass can be transported to have a net carbon gain as compared to fossil fuels (including manufacturing and transport). They noted that this distance will be variable depending on the type of biomass and the region, and that there has been no life cycle analysis completed in their region. He noted that Canada ships a large amount of pellets to Europe and that this distance could displace any carbon gains.

Interviewee 10 identified a few key information gaps. The first is a full GHG lifecycle assessment which would include a temporal component. The second gap is the impact of biomass harvesting on soil and biodiversity. The third gap is the lack of knowledge on loss of carbon from soils. This soil loss of carbon is not fully taken into account in terms of total amount and across temporal scales. We need to look at the full growth cycle and carbon removal of the forests.

B.1.9. Benefits and impacts of agricultural bioenergy

The following question was asked regarding benefits and impacts of agricultural bioenergy:

> *What do you think are the biggest environmental impacts and benefits of cultivation of agricultural bioenergy crops for energy production? (Crops include fast growing perennial grasses like switchgrass, and tree species like hybrid poplar or willow.)*
>
> *c. Can you rank these impacts and benefits in order of importance?*
>
> *d. Are there local issues, or recent studies, or practices that have made any of these issues particularly important in your region?*

Interviewee 1stated that the primary impact of cultivation of agricultural crops for energy would be the conversion of land (either natural forest or food-producing areas) to crops. This could be avoided by cultivation only on marginal agricultural land. Intensive agricultural practices could reduce soil carbon, and may lead to increased use of herbicides/pesticide.

Interviewee 2 did not feel they could answer this question.

Interviewee 3 stated that they did not have enough knowledge to answer this question, and only noted that use of waste products is preferable to the use of dedicated land.

Interviewee 4 used the example of biofuels to discuss potential problems that might arise with bioenergy crops. In particular, the interviewee referred to potential problems with invasive species and conversion of arable land from food crops to bioenergy crops. The interviewee discussed local concerns around limited availability of arable land in the northwestern region of Ontario. It was suggested that using these small pockets of arable land for bioenergy crops results in less diversity and less land for food. On the other hand, it was suggested that growing bioenergy crops on marginal land is acceptable, but there should be caution over invasive species. However, the interviewee also recognized the issue of monocultures resulting from bioenergy crops. Converting "marginal land" to bioenergy crops results in reduced biodiversity. Regarding endangered species, growing bioenergy crops is associated with use of pesticides and fertilizers resulting in runoff and leaching of undesirable things into water, affecting the ecosystem.

Interviewee 5 suggested that there may be biodiversity issues associated with bioenergy crops such as the introduction of invasive species and foul field conversion to cropland which has an impact on birds and other wildlife, as they benefited from reversion of cropland to forests and other natural habitats. Additionally, bioenergy crops would need chemical inputs – this begs the question, are they better than burning fossil fuels, or have more fossil fuels been used in their production? The interviewee pointed out that issues with intensive cropping depend on how cropping is done.

Interviewee 6 responded that there are issues around using agricultural land to produce anything other than food. The interviewee identified the issue of using agricultural land to grow resources for electricity resulting in competition for access to agricultural land, stating that this does not mean that we cannot look at the options but that we must pay attention to this issue. The interviewee would also like to see lifecycle analyses to compare bioenergy crops to the status quo. The interviewee was skeptical that bioenergy crops would have a favourable GHG and energy balance. The interviewee noted that if bioenergy crops have a smaller carbon footprint than fossil fuels, then they have benefits over fossil fuels: they are a renewable resource and they would have a smaller transportation footprint since they would be a local resource.

Interviewee 7 noted that conversion from natural habitat to cultivated land results in habitat disturbance. Impacts would also result from the introduction of species for bioenergy crops. It was suggested that there are great native species such as willow and poplar that grow quickly thus requiring maintenance along rights-of-way. If the biomass that is removed from these rights-of-way was used for energy production, there would not be any increase in access to wildlands (reducing access for hunters) and there would be a reduced need for trees from natural forest areas, also resulting in less disturbance, less transportation and a lower risk of forest fires.

Another impact that would result from the use of bioenergy crops is reduced diversity as bioenergy crops are typically monocultures. The degree to which a monoculture impacts the landscape depends on how large an area is required for growing biomass and how many farms are needed. The transportation impacts will depend on how far the bioenergy crops are from the biomass facilities.

Interviewee 8 noted that there is a difference in the amounts of water consumed between traditional crops as compared to bioenergy crops. They also questioned whether there could be a net GHG reduction on a life-cycle basis. They are also concerned about land conversion of natural areas to cultivation with wide scale use of agricultural bioenergy crops.

Interviewee 9 stated concerns about bioenergy crops replacing food crops, and the application of large amounts of fertilizers and pesticides. They also stated that concerns about use of herbicide on crops such as fast-growing poplars. Because these crops return as sprouts from the base of the tree after harvest, and because there is more BTUs of heat in the trunk as compared to the sprouts, operators often spray large amounts of herbicide to kill all new growth. They also commented that in reality there is little difference between management of plantation forest and management of agriculture bioenergy crops, and thus issues related to silviculture and agriculture should both be addressed.

Interviewee 10 commented that we need to look at energy intensity. It may be possible to have a small portion of the landbase that could produce a large amount of energy, for example if a small intensive area is used for switch grass. Bioenergy crops take away from the land that is allocated to natural forest or to agriculture thus they impact natural habitat or risk food security. Considerations around bioenergy crops include the challenges that climate change will bring such as floods and droughts which will result in shifts in the landscape. It is important that agriculture crops do not require a lot of energy input, land area and water since we must avoid depleting other resources and creating other environmental problems in the process. It was mentioned that agriculture crops could create further issues related to genetically modified seeds. There is a race to grow and harvest biomass at a rapid rate and this presents the risk of bringing in other problems so we must think this all through before embracing the industry. There is a sense of urgency in BC to develop the bioenergy industry and an underlying pressure driving it forward without precautions in place. It is important for us to find alternatives to fossil fuels but it is important to ensure that obtaining biomass does not harm other values.

B.2. Overall sustainability

B.2.1. Scale of harvest

The following question was asked regarding the scale of harvest:

> *How does scale of harvest/cultivation of biomass influence your opinion of the severity of the impacts and benefits noted above? What scale is appropriate in your region?*

Interviewee 1stated that they are in favour of small-scale harvest that is distributed across the landscape.

Interviewee 2 stated that harvest should only occur only at a level that will not significantly change ecosystem functioning. They stated that there is not enough evidence to determine what

that level is, and thus we should operate on precautionary principle for now and harvest only at a scale that we know will not create significant impacts.

Interviewee 3 stated that the current level of forestry activities is not sustainable from an ecosystem perspective. They suggested that if harvesting for biomass energy is going to take place, it must be derived from a portion of the existing AAC, rather than an additional demand. They suggested that in order to meet FSC standards the total AAC must be decreased.

Interviewee 4 expressed that reduction of forest habitat is a key issue. It was also pointed to tourism as an economic driver for the region in lieu of forestry industry. This has created an incentive locally to maintain a pristine environment. If a greater scale is used for biomass production, then more biodiversity will be compromised as more monocultures are used. In the case of bioenergy crops, there are limited pockets of arable land so there is a limit to the scale on which this can be adopted.

Interviewee 5 noted that the larger the scale, the more landscape level biomass removal results. Any activities that happen on the stand level are multiplied by the overall scale of the harvest. At a critical threshold, full tree harvest could reduce the forest's ability to provide seed stock and fungal communities would be affected on a regional scale, also affecting regeneration. With clearcutting, a great deal of source material is removed, inhibiting forest regeneration. Harvest practices must be addressed at the stand level. If the harvest event addresses biodiversity, then it is less likely to have effects at landscape level. At a jurisdictional level, it might be necessary to severely limit the extent of intensive harvest, for example to 5% of the overall forest. As harvest intensity increases, a smaller area of the forest should be included in the harvest.

Interviewee 6 suggested that the overall volume of harvest is not necessarily the right criteria, saying that if harvesting is done right on a small scale then this transfers to a large scale. We must be aware of cumulative impacts but the key thing is to do it right at the local level, therefore the scale of harvest is not how the interviewee would look at the question of impacts.

Interviewee 7 stated that the scale of harvest does influence the degree to which the environment is impacted; the bigger the scale, the bigger the impacts. This point was punctuated by asking, "how deep into the wild lands do we have to go to haul out logs so we can watch tv?" We need to change our attitude about energy production and we must size operations not to how much energy we can get out of the resource but how much the forest can support sustainably. The question seems to be the other way: "how much energy can we squeeze out" instead of what it should be, which is "how much can the land support without affecting ecological services?"

Interviewee 8 stated that the scale of harvest is very important in assessing sustainability. They stated that all development must be assessed at multiple scales (i.e. how each project fits into overall landscape planning). In terms of sustainability, there is a large difference between combustion of biomass at a level can be met by our current production as compared to They gave the example of bioenergy needs being met entirely from crop substitution as compared to combustion of biomass that would require conversion of natural areas. They stated that if land is converted, then it must be integrated into other land-use demands, and considered as part of proper landscape planning with networks of protected areas.

Interviewee 9 noted that transporting biomass over long distances would negate any GHG reductions, and thus a decentralized approach to biomass production is necessary.

Interviewee 10 pointed out that we must be mindful of altering the annual allowable cut for whatever purpose to accommodate additional harvesting pressures. It was suggested that there needs to be an ecosystem based management (EBM) model approach that takes into account the productivity and functioning of ecosystems. An example of an area that has used the EBM is the Great Bear Rainforest.

B.2.2. Planning horizon

The following question was asked regarding planning horizon:

> *How does the planning horizon (timeline) of harvest/cultivation biomass influence your opinion of the severity of the impacts and benefits noted above? What is an appropriate planning horizon in your region if carbon neutrality is to be assumed?*

Interviewee 1 stated that this is highly dependent on harvesting practices. The best-case estimate for regrowth and carbon neutrality would be 80 years, and the worst case estimate would be never achieving regrowth or GHG neutrality. They stated that this is extremely important in the context of the timeframe associated with climate change. There is ample evidence that we need to sharply reduce greenhouse gases in the next 10 years, and if conversion of biomass energy will not help us achieve these reductions, then we should be concentrating on other options.

Interviewee 2 stated that they were not familiar enough with this to be able to answer specifically, and could only answer generally that the timeframe for regrowth in their region will be longer than other, warmer regions, and this needs to be integrated in any forest management plan.

Interviewee 3 stated that they were not familiar with this topic and were not able to answer.

Interviewee 4 responded that removing biomass from the forest today reduces resiliency of the forest to global warming in the future. Predictions of transition from boreal forest to grassland over the next 100 years have been made for the local region if global warming continues at the same rate. More research and climate modeling on a local scale is needed.

Interviewee 5 noted that many forests are harvested in a shorter rotation than when they would die naturally. The extreme example is British Columbia rainforests which can live to 1500 years but are harvested on an 80 year rotation. Thus the forest never returns to the carbon sequestration levels that it would have achieved. As a result, carbon stored on site is permanently reduced. The baseline is lowered even more by removing residue. It was stated that if we replace fossil fuel with biomass, we are probably putting out more GHG's per heat unit which will require more biomass to get the same amount of energy as fossil fuels. It will take over 100- 200 years for the carbon to return to the site (if the site has not been degraded).

Interviewee 6 stated that if we have adopted the right criterion for evaluating impacts (biodiversity, soil, etc.), then the timeline is not important as long as those other things are considered.

Interviewee 7 responded that the planning horizon is important. It's also important to harvest at the appropriate time of the year (usually late in winter), based on a number of factors to reduce impacts. The interviewee was not sure whether feedstock that needs to be constantly regenerated and harvested in a more intensive manner but affects a smaller area is better than spreading out

to a larger land area but with less intense management. However, it was stated that in all possible circumstances, it is important to mimic natural forest succession systems.

Interviewee 8 stated that, similar to the spatial scale of harvest, an appropriate planning horizon must be part of an assessment of cumulative impacts and appropriate land-use planning.

Interviewee 9 felt that they were not able to answer this question specifically, but did mention that the energy regulator in their province was planning on a 10-year time frame and that they felt this was not adequately long.

Interviewee 10 commented that their organization is aware of the urgency to reduce fossil fuels as soon as possible and find alternative sources of energy. However, there could be a temporal impact associated with using biomass for energy. We need to look at the full lifecycle emissions generated by using biomass for energy and the sequestration of carbon. Tree planting and regeneration of forests takes multiple decades to get the same sequestration back again. In the short term we lose storage and add emissions to the atmosphere.

B.2.3. Mitigation of impacts

The following question was asked regarding mitigation of impacts:

> *Are you aware of any innovations/technologies measures that can help reduce the environmental impacts of using biomass for energy production (i.e. harvesting / silviculture techniques, biochar, pyrolysis, carbon capture and storage)?*

Interviewee 1 stated that minimum efficiency standards for combustion would be essential in mitigating GHG impacts.

Interviewee 2 stated that they were not familiar with this area and were not able to answer.

Interviewee 3 stated that they were not familiar with this area and were not able to answer.

Interviewee 4 identified several mitigation measures. Finding ways to leave biomass in the forest is necessary for soil renutrification. Regarding combustion, electrostatic precipitators, scrubbers and cogeneration will mitigate the impacts of combustion. As far as forestry management practices, application of the ISO 14001 standard lessens the impacts of harvesting. The interviewee suggested that too much is unknown about different strategies around managing and minimizing GHGs.

Interviewee 5 responded that it is necessary to set harvest guidelines on how much material can be removed from the forest. This needs to be done based on research and an understanding of what is a critical threshold on a particular site type for removal of slash.

Interviewee 6 stated that because biomass is a heat-based generating mechanism, efficient cogeneration is a must.

Interviewee 7 cited gasification, pyrolysis, cogeneration, converting biomass to biochar and carbon capture and storage (CCS). It was pointed out that most GHGs are from heating and transportation, and to a lesser extent from electricity, but some communities are exclusively on diesel. Using biomass for energy would displace GHGs from individual home heating or replace diesel on the grid. There was interest in biochar as a natural CCS technique and soil amendment

material for soil development. Currently there are farms testing out biochar soil development. Cogeneration is an effective method for displacement of fossil fuels for space heating and electricity generation. There are also technologies that can be deployed during the harvest of biomass to lessen impacts around cutting, stripping and hauling wood out of forests. Management techniques should also be employed such as reducing forestry roads, ensuring habitat is not destroyed and leaving ground cover.

Interviewee 8 stated that this is not an area of expertise for their organization and so they are not able to respond.

Interviewee 9 stated that there are a number of technologies to maximize the useful energy in the biomass, such as gasification, co-generation, high efficiency stoves, small scale pellet stoves heat maximizers (which recover heat loss,) or Finnish mass ovens (large stone ovens). With regards to harvesting, they suggested that smaller harvesters could be used, which would increase the proportion of selective harvest in their region.

Interviewee 10 identified harvest methods as important in mitigating impacts and suggested that biomass for energy should be harvested only from plantations and not from natural forests. Transportation of biomass needs to be considered in the overall lifecycle analysis, particularly for export of biomass since the GHG balance may not be positive.

Interviewee 10 suggested using genomics (which is not genetic modification, but based on natural selection) to determine what kind of seeds have shown to be less water intensive or more insect resistant without genetically modifying. We can reduce our impact on other resources by just being smarter with seed selection.

B.2.4. Optimal use of biomass

The following question was asked regarding the optimal use of biomass:

> *In your opinion, if we are going to harvest biomass, what is the most optimal use of biomass? What makes this choice optimal? I.e. electricity, heat, fuels, pulp and paper, high value forest products.*

Interviewee 1 stated that the optimal use of biomass is to 'leave it in the forest'. They stated that if biomass must be harvested, than the optimal use would be the option that maximizes the economic value of each tree harvested, which also coincides with the highest levels of employment.

Interviewee 2 also stated that the best use is the option which produces maximum benefits per unit of wood harvested, and that this option may vary regionally.

Interviewee 3 stated that bioenergy should only be sourced from residual waste products from mills, that harvesting should meet FSC standards at minimum, and that combustion should lead to high-value energy such as combined heat and power.

Interviewee 4 identified burning waste at a mill site as an appropriate solution to getting rid of the mill waste and suggested that the source of biomass for energy should be restricted to using sawmill waste. As far as the optimal use of biomass, the interviewee responded that value-added

uses of forest are the most optimal, giving the example of a paint stick factory which uses fibre from the trunk of tree. The interviewee pointed out that any use of biomass must be within the forest management plan and must use sustainable methods. Value-added products are best because more economic development is created for the money invested resulting in diversification of the work force and greater resilience of the community.

Interviewee 5 responded that in regard to using biomass for energy, due to the higher energy conversion efficiency into heat, biomass that is used for energy should be used for heat rather than for electricity. It was noted that using tops and twigs for pulp and paper results in a higher economic multiplier and for solid wood, value-added products are the optimal use of biomass due to their even higher economic multiplier.

Interviewee 6 stated that in some cases electricity generation would be the most appropriate, whereas in other cases wood pellets for heating (residential/ institutional/ industrial) would be the best use. However, the interviewee provided the caveat that it is rarely a good idea to start with a new resource to produce energy. It is always better from environmental perspective to make energy from something that has already been used for something else. The interviewee also identified other non-consumptive uses of the forests, stating that forests are not just resources for trees to be cut down but can provide habitat for mushrooms that can be harvested, among other non-traditional uses of forests. Biomass could also provide non-traditional products such as fibre for clothing.

Interviewee 7 stated that the optimal use of biomass is in a small scale lumber industry to service local needs rather than importing lumber from British Columbia. Locally-made value-added products would be the best use of biomass. Other high value uses would be cogeneration (producing electricity and heat) but the value of this would depend on what the electricity is used for. An important question here is whether biomass is used to generate electricity for mining. Space heating would also be valued, especially the use of cordwood for wood stoves.

Interviewee 8 stated that the most optimal use is that which has the potential for the greatest GHG reduction.

Interviewee 9 stated that ecosystem goods and services are essential function of forests and thus the best ‘use’ is to leave biomass in the forest. If it must be harvested, they suggest use of biomass for co-generation or heat (but never electricity alone as this is not an efficient use).

B.2.5. Environmental criteria for sustainability

The following question was asked regarding environmental criteria for biomass sustainability:

> *What criteria should be used to evaluate the environmental sustainability of use of biomass for heat/electricity production?*
>
> *e. Could you suggest the 3 most important criteria in your opinion?*
>
> *f. Below these questions you will find a table of criteria developed from a literature review of various certification schemes and guidelines from other organizations. Could you choose the top 5, and the second top 5 criteria in terms of importance, and provide comments about the criteria or additional criteria that you find are lacking?*

Interviewee 1 stated that the protection of biodiversity, maintenance of healthy water systems and maintenance of healthy soil and carbon storage were crucial.

Interviewee 2 stated that financial return per unit of wood, carbon neutrality and maintenance of air quality were all very important.

Interviewee 3 stated that bioenergy should only be formed from residual or waste products from mills, that there should be no additional cutting, and that combustion should lead to high-value energy.

Interviewee 4 responded that renutrification of the forest is critical. The interviewee also identified reduction in GHG emissions as an important factor. Other criteria identified by the interviewee include biodiversity – which will decline if cultivation is used, and sustaining forest habitat. Good forest practices that guarantee sustainability will allow the industry to operate without compromising the other uses of the forest. In the end, the interviewee stated that we cannot rule out the forest economy.

Interviewee 5 preferred to answer this question when returning the table of criteria.

Interviewee 6 responded that local community involvement is an important aspect for achieving sustainability noting that various actors would need to be involved and that sustainability is more likely to be achieved with local involvement. The interviewee also pointed to the importance of using the best available tools such as lifecycle analysis to evaluate options.

Interviewee 7 stated that the most important criterion is the minimization of habitat destruction. This concept can be supported by two management areas: 1) ensure that forestry and land-use planning has been done for the harvest area; 2) eliminated negative environmental consequences to habitat and soil and prevent creating access for hunters. Following this, is the necessity for employing resources that will result in the biggest reduction in GHG emissions.

Interviewee 8 stated that criteria should include sustainable harvest at the site level, sustainable land use at the landscape level (including assessment of cumulative natural area conversion and whether there is any compromise of options for protected areas establishment), and demonstrable and significant reductions in GHG's.

Interviewee 9 stated that criteria should include net energy gain, reduced carbon footprint as compared to conventional fuel sources, and a biodiversity index to ensure that there is no loss of biodiversity due to bioenergy harvest.

Interviewee 10 questioned at what point in a tree's lifecycle does bioenergy fit in? For example sawmill residue or lumber that has been used for housing being diverted to landfill could be used for bioenergy rather than freshly harvested trees.

B.2.6. Ranking of environmental criteria

Each interviewee was asked to rank a list of environmental criteria. This list was developed by the Pembina Institute in a project that researched the necessary environmental aspects and criteria associated with biomass for energy. Groups were asked to choose the 10 most important criteria from a list developed from a literature review by Pembina of forest certification schemes. The following summarizes these rankings.

Interviewee 1 *(awaiting response)*

Interviewee 2 named protection of rare, threatened or endangered ecosystems or species, the maintenance of ecological functions and integrity of the forest, carbon neutrality over the life cycle of the project, air emissions contained at a lower level than baseline power production, and sustainable forest management plans as the top 5 most important criteria. The next 5 most important criteria were protection of representative samples of existing features within the landscape, protection of riparian buffer zone and wetlands, maximized use of the resource, maintenance of soil fertility and sustainable operations of forestry activities.

Interviewee 3 I find it very difficult to 'choose' criteria from the FSC. A lot of work and time went into establishing FSC criteria and standards, and if biomass is to be sustainable it must be conducted according to FSC standards – all of them – not a ranked selection of some of these. So my "A"s would be the following 5: Meet all FSC criteria; achieve the highest end use (co-generation district energy; harvest) only residual forest biomass residues; achieve minimum carbon neutrality; air emissions not higher that current.

Interviewee 4 *(awaiting response)*

Interviewee 5 *(awaiting response)*

Interviewee 6 *(awaiting response)*

Interviewee 7 *(awaiting response)*

Interviewee 8

Interviewee 9 identified as the top 5 most important criteria: maintenance of the ecological functions and integrity of the forest, protection of riparian buffer zone and wetlands, life cycle net GHG emissions from fossil fuels, are minimized, and maintenance of soil fertility, Electricity is generated in a manner that ensures the rate of harvest does not exceed levels that can be sustained. They named the next 5 most important criteria as: the development and implementation of a long-term forestry management plan that encompassed sustainable practices, and that the results of monitoring are incorporated into this management plan, minimizing soil erosion, protection of soil health and productivity, emission of air contaminants is lower as compared to conventional power production and that representative samples of existing features (e.g. old growth forest) within the landscape are protected in their natural state.

Interviewee 10 identified three criteria that biomass projects should be evaluated against: GHG impacts; biodiversity; and soil.

B.2.7. Biomass for energy as compared to other types of energy

The following question was asked regarding ranking biomass for energy compared to other forms of energy:

> *How would you rank biomass for energy in terms of overall environmental impacts compared to other forms of energy (e.g., coal, natural gas, oil, nuclear, geothermal, solar, wind, tidal, wave)? It would be helpful if you could give some explanation of the rationale for your ranking.*

Interviewee 1 stated that this comparative ranking is very dependent on the efficiency of combustion and application (electricity/heat). They stated that the biomass combustion for electricity generation at a low efficiency is worse than natural gas in terms of GHGs, but efficient biomass combustion for heat is equal or better than natural gas. Harvest of biomass can have either lesser or greater effects than the production of coal or oil, depending on harvest methods used. They stated that wind, tidal and solar power are all preferable to biomass.

Interviewee 2 stated that biomass for energy would rank lower fossil fuels in terms of environmental impact because it can be sourced locally and is renewable, but that it has higher environmental impacts than geothermal, solar or wind.

Interviewee 3 said that they think biomass has fewer impacts than coal and nuclear, but more impacts than wind and solar. They believe that it is on par with natural gas in terms of overall impacts.

Interviewee 4 pointed to Jacobsen's study from Stanford University which presents a review of solutions to global warming, air pollution and energy security[99]. This is the best comparative review among sources of electricity generation that the interviewee has seen and would generally follow the recommendations of the study, but not unqualified. The study reports that in sum, use of wind, concentrated solar power, geothermal, tidal, photovoltaic, wave, and hydro to provide electricity for battery-electric vehicles and hydrogen fuel cell vehicles and, by extension, electricity for the residential, industrial, and commercial sectors, will result in the most benefit among the options considered. [100] For example, there is controversy around the impacts of wind regarding birds and bats studies. Overall, the interviewee felt that more research on the efficacy and impacts of each fuel source versus the others is required.

Interviewee 5 ranked biomass somewhere around nuclear or oil given the suite of options and the order presented (coal, natural gas, oil, nuclear, geothermal, solar, wind, tidal) and pointed out that there are significant waste and risk issues around use of nuclear and oil. The interviewee noted that once the infrastructure is in place, the remaining options (geothermal, solar, wind, tidal) have fewer ecological impacts.

Interviewee 6 responded that it is important to use lifecycle analysis to rank options based on GHG emissions. Overall, the interviewee felt that biomass is definitely better than fossil fuels. In comparison to hydroelectricity, hydroelectricity probably emits less GHGs than biomass but without seeing a lifecycle analysis, it is not possible to say with certainty, but it would be interesting to compare. Bioenergy has more impacts than wind, solar, and geothermal energy sources. Nuclear is in a category of its own.

Interviewee 7 stated that bioenergy should be ranked alongside other forms of energy production on a lifecycle basis. Every form of energy has impacts but biomass is better than coal, natural gas, oil and nuclear energy. Nuclear energy has lifecycle impacts in the uranium extraction and waste generation/ storage phases. Geothermal is better than biomass because it does not require forest extraction and can produce more electricity – though this too is not without its impacts.

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[99]Mark Z. Jacobson, Review of solutions to global warming, air pollution, and energy security, Energy & Environmental Science, 2009, 2, 148–173. http://www.stanford.edu/group/efmh/jacobson/Articles/I/ReviewSolGW09.pdf (accessed March 31, 2011).

[100]Ibid.

Solar and wind energy are preferred to bioenergy, but these are intermittent sources whereas biomass can be continuous. Thus bioenergy is a good complement to wind and solar energy. Tidal and wave energy are not applicable in the populated areas of the Yukon. Hydrokinetic, that is, in-river-turbines are a good choice but these are small in output so we are talking about a different scale of generation than what can be produced with bioenergy.

Interviewee 8 stated that because their main concern is reducing GHG emissions, bioenergy ranks broadly equivalent to other renewable sources, such as wind, solar, hydro, geothermal, tidal and wave as an alternative to fossil fuels. As with other sources of renewable energy, bioenergy must be developed sustainably according to credible and defensible criteria. The impacts and benefits depend on the methods of growth and harvest, and the scale at which it is undertaken.

Interviewee 9 stated that they feel biomass is comparable to geothermal, solar or wind, when harvested sustainably and that was definitely better than nuclear, coal, oil or natural gas.

B.3. Policy development

B.3.1. Suggestions for policy development

Groups were asked how they suggest these environmental impacts and benefits be considered in the development of policies regarding biomass for energy production.

Interviewee 1 stated that their top priority for a biomass policy is a moratorium on whole-tree harvest because removal of tops and branches is a major nutrient and carbon loss for the ecosystem. They stated that regulation around how clear-cutting can be practiced needs to be defined (i.e. define a clearcut and define what types of forest are acceptable for clearcut and what are not). They stated that minimum efficiency standards for combustion should be established, and that regulatory and financial incentives should be created to support small- scale, and high efficiency projects.

Interviewee 2 stated that their primary interest in the policy is to minimize environmental impact of harvest and combustion and to ensure carbon neutrality. For large scale projects, wise use (a use that maximizes value or community benefits) of the resource should be a requirement.

Interviewee 3 stated that no new forests should be cut for biomass: that allowable cut must be derived from existing cuts, or else use of slash/harvesting residue. They stated that high value combustion should be enforced and that FSC as a minimum standard.

Interviewee 4 discussed the need for endangered species to be addressed by policy. The impacts of global warming need to be considered by policy and impacts need to be minimized. It was also pointed out that diversification of the economy should be addressed by policy. Interviewee 4 noted that forest practices do have an impact and that protection of waterways is an important element that should also be covered by policy.

Interviewee 5 suggested that a harvest guide was necessary, noting that resource bureaucracies could change harvest practices or they could rely on market based mechanisms such as FSC certification. The interviewee speculated that certification schemes will continue to be ahead of government noting that more is accomplished privately through environmental groups working

with these organizations than with the government. Interviewee 5 expressed concerns about the government encouraging increased use of forest resources for bioenergy. Currently the government of Ontario is signing contracts with new biomass users for the purposes of bioenergy production (in addition to existing contract with forestry companies)raising the questions "How big is it going to get? What is the scale of demand they are inviting? Will they put policy in place to ensure nutrient poor sites are not targeted?" The interviewee cautioned that right now there is nothing in place to ensure that these contracts are not applied in a way that is harmful to the forest.

Interviewee 6 stated that we cannot only look at these things from an economic point of view. We have seen how wrong this approach has been for the forestry sector. The forest cannot regenerate itself just because we say it will; we need an integrated approach, one that includes economics, environmental and social elements and incorporates local communities.

Interviewee 7 pointed out that forest management plans and land use planning are important. So far land use planning in the Yukon has only really been done in remote areas where planning is less contentious. There are no land use plans for areas where development pressure is present, whether from agriculture, forestry, mining or residences. It is important for the impacts/ benefits of biomass to be considered in any land use planning. It is especially important if a bioenergy strategy comes about in the Yukon. Use of biomass must be done sustainably based on what the natural system can support and not only look at it from an economic standpoint.

Interviewee 8 stated that explicit sustainability criteria should be developed to guide policy, incentives and regulation.

Interviewee 9 stated that any biomass policy should include energy savings (i.e. less energy input as compared to baseline fuel sources). They stated that a policy should include prescriptive regulations on harvesting and guidelines for calculating carbon footprint. They also mentioned that a policy that defines maximum acceptable impacts on ecosystems (but doesn't ban harvesting) is a beneficial model and should be extended. With regards to combustion, they mentioned that minimum efficiency standards are relatively easy to achieve, especially in provincially owned buildings or buildings that receive and provincial funding must meet standards.

Interviewee 10 had several suggestions for policy development. Projects should not be proceeding without having done foundational research. Multi-stakeholder input is needed for policy development. Bioenergy policy needs to be informed by research looking at best source of biomass. Biomass could be an appropriate alternative to fossil fuels. It is necessary to include environmental impacts in any bioenergy policy. Bioenergy policy must be assessed within the context of the overall energy policy which answers, how much energy do we need and where are we getting it from? Within British Columbia, biomass policy needs to consider spatial variation and consider where biomass for energy harvesting should occur and the intensity level used. This relates to the question of the best feedstock sources (which could be small scale plantations) and assessed within overall land use planning. In addition to policy development, there is a need for more monitoring and enforcement. Also, policy makers need to use an adaptive management approach. This may require the use of pilot projects and GHG research for each feedstock to evaluate the benefits of each in light of climate change.

B.3.2. Examples of good policies

Groups were asked to provide examples of biomass policies in Canada or internationally that are good policies, or that address your specific concerns of yours.

Interviewee 1noted that southern Ontario has good practices around forest harvest, and requirements for clearcut, partial cutting and tree marking, and Maine has strong restrictions on clearcutting. They named Quebec as having good policies for herbicide use on crown land. For combustion, they named the feed-in-tariff for heat in the UK as an option that would provide a higher value for biomass energy, and that Vermont and Massachusetts have established minimum standards for efficiency for electricity.

Interviewee 2 mentioned Scandinavian countries (Sweden in particular) as having admirable policies, especially because these policies do not allow burning of slash or sawdust unless energy generated is being used (as opposed to roadside burning of slash).

Interviewee 3 noted that Silva Forest Foundation has developed strong criteria for harvest, along with the Forest Stewardship Council.

Interviewee 4 did not provide any examples.

Interviewee 5 suggested that any policy about bioenergy should cover GHG emissions and the timing of those emissions. The interviewee referred the Manomet study from Massachusetts, saying that a state policy was written based on the results of the study but lamented that not much has been done in Canada.

Interviewee 6 referred us to Francois Tanguay of the Wood Coalition, which promotes the sustainable use of wood for construction in the institutional/industrial markets as an alternative to concrete. Wood is preferential from a GHG, economic, and environmental (renewable resource) point of view. Francois has provided information indicating that policy in Austria promotes sustainable use of biomass.

Interviewee 8 referred to the Roundtable on Sustainable Biofuels as an example of high level standards and independent assessment to guide better practice for bioenergy.

Interviewee 9 pointed to the recent Massachusetts situation as an example of a progressive policy. After the Manomet study concluded that forest bioenergy is not carbon neutral, the state legislature was forced to modify their renewable standard and now requires all new biomass to demonstrate carbon neutrality before they can receive any state funding. They noted that carbon neutrality is hard to guarantee, and that this new policy may make smaller projects economically prohibitive. They also mentioned the ban on herbicides in Quebec as a model that could be replicated in other jurisdictions.

Interviewee 10 was not aware of any good policies to provide as examples but offered that the fact that we don't know of any is frightening. Interviewee 10 suggested that we need communication, due diligence and public input to inform policy development. Examples of international policies could also be used to inform the highest standards possible for bioenergy policy.