Strategies for Strengthening the Bioenergy Sector in Canada

Final Report of the

Canadian Bioenergy Challenge Dialogue

This Challenge Dialogue was coordinated through a partnership between

BIOCAP Canada Foundation and EnergyINet

July 17, 2006

BIOCAP CANADA

EnergyINet
Unlocking Tomorrow's Energy

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Acknowledgments

The organizing team and Lead Champions would like to acknowledge the Participants and Sector Champions of the Bioenergy Challenge Dialogue for their continued effort, contributions and support during the six month journey we took together.

Executive Summary

Over the last six months, approximately 230 participants drawn from across the country and representing the sectors of agriculture, forestry, oil and gas, petrochemicals, waste management, academia, government and NGOs addressed the question of bioenergy in Canada. The purpose of their efforts was to establish a comprehensive, cross-sectoral strategy to advance the proposition that the nascent bioenergy sector can become a significant contributor to Canada's energy mix while providing sustainable environmental, societal and economic benefits to the citizens of Canada.

How We Worked Together

The participants used the Challenge Dialogue™ process to tackle this complex problem. The Challenge Dialogue process is an iterative, deliberately collaborative, bottom-up process designed to bring together diverse participants with potentially divergent points of view. The Challenge Dialogue process is a variation of a Delphi process but with much more opportunity to input suggestions and information as it is not pre-scripted. The goal of the process is to achieve alignment of purpose rather than agreement on all the specifics. Alignment allows the evolution of dialogue leading reasonably quickly to common understanding and significant progress for the group. A key reason for using the Challenge Dialogue process is that it is strictly egalitarian and neutral and thus the outcome represents the combined will of the diverse group of stakeholders involved in the process. Consequently, the Challenge Dialogue provided a forum for the participants outside of the usual strictures and procedures that could limit the mechanisms for exploring the broad reaching and potentially sensitive or conflicting issues surrounding bioenergy.

What we Achieved

While it cannot be said that a comprehensive, unified, national bioenergy strategy was developed during the Challenge Dialogue, there was alignment that the following 5 core themes should be pursued to illuminate and address the key issues and challenges to developing a robust and viable bioenergy sub-sector in Canada. In aggregate these themes can be developed to become the basis of a national strategy:

1. ***Size of the Prize: The potential is world-class***

   Canada has the potential to provide at least 20% of its energy needs from bioenergy by 2020. This statement must be qualified in that it can only be achieved providing that the necessary policies and practices are put in place to achieve this result. Attainment of the significant potential of bioenergy to contribute to the energy supply of Canada will require significant, sustained support from all stakeholders.

2. *Logic Model: How it all fits together*

A logic model is a thorough analysis of the drivers, resources, inputs and activities that would be required to achieve the desired outputs, outcomes and impacts assembled to show the inter-relationships among them thus providing the underpinning to any strategy. The participants reached the consensus that the bioenergy sector is a cluster of related sub-sectors, the drivers and activities thereof being quite different. Consequently, the strategy for bioenergy is best handled as a cluster or portfolio of related but different sub-sector strategies with some elements that are common to all the sectors. The General Logic Model is included in this report because it aids the reader in understanding this cluster related sub-sectors that is the bioenergy sector.

3. *Bioenergy Sector Development: How to work together effectively*

While the diversity of the sector precludes a tight organizational structure, a coalition (or some other appropriate organization) with membership drawn from the private sector, NGOs, universities, and government should be formed to work on those issues that are common across the sub-sectors such as policy and communications, and possibly as a coordinating mechanism for R&D and the Flagship Projects. Both BIOCAP and EnergyINet are willing to contribute further effort to cause this to happen.

Participants in the Challenge Dialogue process were aligned around the importance of developing a “brand” for bioenergy in Canada that is suitable for all sectors. In this way, the contribution and importance of bioenergy to the general economy can be made visible, and this visibility will accelerate acceptance thus enabling societal and regulatory changes to occur more quickly.

4. *Research and Development: How to move development more quickly*

The participants concluded that all policies and practices adopted for bioenergy need to be based on good, independent science focused on the sustainability of bioenergy and bioenergy systems, and that sustainability encompasses biological, environmental, social and economic perspectives, all of which must be considered. Very importantly, the sharing of information must be accelerated and facilitated. Consequently, it is recommended that:

- Enhanced communication and partnerships among researchers and labs, industry and policy-makers must be established to more effectively address both immediate and longer-term issues.
- Stronger communication is essential among research funders regarding the various activities in the country to reduce overlap and spur collaboration.
- “Break-through” research needs to be emphasized, and this could be accomplished by establishing a Working Group on Transformative Change to a bio-economy with a focus on identifying breakthroughs that could bear fruit within ten years.

5. ***Flagship Demonstration Projects: How we can test our ideas most effectively***

Participants adopted the concept of Flagship Demonstration Projects as a means to rapidly and substantially raise awareness of the importance of Canada's bioenergy sector in providing environmentally sustainable, reliable, competitively-priced energy. Participants in the final workshop enthusiastically developed the concept of a suite of linked, focused, highly visible, integrated, large-scale Flagship Projects. These Projects were viewed as important to:

- engage multiple stakeholders in an issue of common interest thereby increasing support and reducing risk,
- accelerate learning and sharing of experience and learning,
- communicate and raise the profile of bioenergy,
- focus research and policy efforts to validate or qualify various bioenergy options,
- demonstrate actual implementations of bioenergy technologies in the "real-world",
- serve as high-profile potential success stories, and
- spur near-term action.

It was recognized that several projects currently underway in various regions of Canada could qualify as Flagship Demonstration Projects providing they offer the requisite multi-stakeholder value or could be configured appropriately to do so. In addition to these existing projects, the Participants proposed 9 new Flagship demonstration projects. Participants were in alignment around the need to develop several, if not all, of these types of projects to provide significant opportunities to accelerate development of bioenergy in Canada and also help to attract research and development funding to the sector.

Next Steps

The key recommended steps are:

1. **Develop sector-specific Logic Models, including a comparison of impacts of various bioenergy options.**
2. **Convene a meeting to create the national coalition of bioenergy with the initial task of branding bioenergy.**
3. **Host a national industry and research conference.**
4. **Host a meeting of research funding organizations to identify specific opportunities for collaboration and target areas.**
5. **Establish a national network of Flagship Demonstration Projects and the supporting infrastructure to evaluate and communicate the results.**

A. Introduction

What was the Canadian Bioenergy Challenge Dialogue?

The Canadian Bioenergy Challenge Dialogue was an iterative, deliberately collaborative, bottom-up process designed to bring together the diverse participants of the bioenergy sector. Our work together was to engage in an extended discussion about the potential for bioenergy in Canada, and to come to grips with the complexities and the challenges that currently hinder rapid, rational, sustainable development of Canada's biomass resources for bioenergy. The Challenge Dialogue process was specifically intended as a neutral place where participants could meet and freely have meaningful discourse. Consequently, the Challenge Dialogue provided a forum for the participants outside of the usual strictures and procedures that could limit the mechanisms for exploring the broad reaching and potentially sensitive or conflicting issues surrounding bioenergy.

Purpose of the Dialogue

Energy, and from where we source it, is a fundamental issue to our economic, social and environmental well-being. With rapidly increasing energy prices, particularly in transportation, and a realization of the significance of our energy choices on our quality of life, alternative energy sources have come to the forefront as an integral part of our existing and future economy. Of all renewable energy sources, biomass is the most flexible; it can be converted into heat, power, transportation fuels, industrial and specialty chemicals, and a variety of biomaterials and bioproducts. Effectively managed, bioenergy is climate-friendly, can help reduce air pollution and can effectively extract value from and dispose of municipal and industrial wastes. Bioenergy can also be integrated into our existing infrastructure for distribution and use. It is for these reasons that the BIOCAP Canada Foundation and EnergyINet sought to find ways to increase bioenergy production and utilization in Canada, using the Challenge Dialogue process as a tool.

With 10% of the world's forests and over 60 million hectares of agricultural land, Canada is the envy of the world in terms of biomass resources. Despite this, bioenergy still accounts for only ~5% of Canada's energy production. Canada is also home to some of the world's best researchers and innovators in biomass management and conversion, creating a perfect situation for rapid sector growth.

Even with all its promise, Canada's bioenergy sector is highly fragmented and lacks the exposure and recognition granted to other renewable energies such as wind and solar. For bioenergy to make the substantial contribution to Canada's energy mix that is potentially possible requires greater acceptance by the public, support from government and uptake from existing industry.

Thus, the Challenge Dialogue was intended as a mechanism for identifying the hurdles facing bioenergy development in Canada, proposing a strategy for overcoming those hurdles and building the community of practice that could deliver on the key opportunities highlighted by participants from across the country.

Key Bioenergy Drivers Leading to the Dialogue

Several drivers provide the justification for encouraging bioenergy sector development in Canada, namely:

1. Providing an ever increasing supply of clean energy while simultaneously mitigating the drivers to climate change are perhaps the two greatest challenges that the world will face in the 21st century. These challenges are especially critical for Canada, a nation that will be impacted by climate change more than most others, yet has among the world's highest per-capita greenhouse gas (GHG[1]) emissions and energy consumption and is a significant energy exporter.
2. Canada's vast forest and agricultural resources provide this nation with a competitive advantage in the fight against climate change and the ability to produce a renewable supply of energy, chemicals and materials. Rising energy costs—and the promise of even higher costs in the future—have combined with technology improvements to make biomass a credible and economically competitive alternative to fossil fuels.
3. There is an ever-increasing amount of urban, agricultural and forestry waste (slash) being produced that needs to be managed in an environmentally responsible and cost effective way.
4. Beyond climate change, providing clean energy is essential to ensure the long term health of Canada's society and ecosystems in terms of clean air, clean water, and clean soil.
5. To ensure economic success in an ever increasingly competitive world, Canadian industry needs to move beyond resource extraction and harness the research, development, design, and demonstration capacity of the nation to derive high value from our vast biomass resources. Policy can be informed by this national capacity of innovation to help encourage the competitiveness of Canadian companies.

[1] Includes CO_2, CH_4 and N_2O gases that absorb infra-red radiation and have been implicated in forcing climate change

Expected Outcomes of the Dialogue

As a key component of an efficient and meaningful Dialogue, it was important to reach alignment among participants on the expected outcomes and the anticipated results of the process. They include:

1. To complete an efficient, effective Dialogue that has engaged a broad range of participants from industry, government, academic and NGO sectors and has built a baseline of shared understanding regarding what is required to accelerate the development of a vibrant and sustainable bioenergy industry in Canada.
2. Participants are clear on the extent to which bioenergy has the potential to be a major player in the production of energy and will have developed a collective vision for and adopted for a Bioenergy Strategy that is both aggressive and realistic, and that has attracted interest and enthusiastic support from a wide range of industry, government, academic and NGO partners.
3. An Action Plan is developed for initiating a broad collaborative program to capitalize on the biomass energy potential of Canada. The Action Plan builds on the work of existing national, provincial, regional and sectoral initiatives, to optimize synergies and minimize duplication. It recognizes the regional differences of Canada's biomass resources and integrates these differences into the plan. It catalyzes the involvement of the private sector and provincial governments in this field, and guides the industrial development of this important opportunity in Canada. It includes:
    - enhanced mechanisms for stimulating innovation;
    - encouraging information sharing among active stakeholders and the greater community and public;
    - increasing collaboration among industry and government sectors and with the research community and NGOs;
    - creating alignment among other bioenergy initiatives at the federal, provincial, regional and sectoral levels;
    - incorporate the learnings from other nations, as adapted to Canada;
    - clarifying the role of bioenergy as a specific product suite within an emerging bioeconomy; and
    - developing mechanisms for encouraging sector development requirements such as education and training, policy and regulation; and
    - developing models for integrating bioenergy within the broader scope of existing energy systems.

4. Catalyze the formation of consortia or other partnering mechanisms to develop business cases and public support for flagship bioenergy projects that will demonstrate that these projects can be commercial, while at the same time being environmentally beneficial (or at least benign) and technically feasible. The development of these cases and the projects they support will help to build bioenergy expertise, attract development capital, deploy existing technologies and identify gaps and priorities for natural science research and for technology and policy development.

Owners of Dialogue and the Strategies Developed Therein

A portfolio of strategies was developed by the approximately 230 participants of Canadian Bioenergy Challenge Dialogue, who are knowledgeable Canadians from industry, government, academia, and NGOs. Initially the Dialogue organizers sought to create a single, unified national strategy but this proved to be impractical. However, we found that it was possible to reach alignment on several specific themes that are important components of a comprehensive strategy.

An initial group of about 140 participants was invited into the Dialogue by BIOCAP and EnergyINet, drawing from their existing contact networks. This group grew as word of the dialogue spread and new participants engaged in the process. Participants came from across Canada and represented both regional and national interests in industry, government, academia, and NGOs in about equal proportion. Many sectors were included, specifically agriculture, forestry, oil and gas, petrochemicals, waste management, academia, government and NGOs. A Champion for each sector was recruited to ensure all view points were adequately addressed at a fundamental level (see Appendix I for the list of Champions).

Significant Conclusions from the Dialogue Workshop
Ottawa, April 12-13, 2006

- General agreement that Canada's bioenergy potential is nationally significant.
- Acknowledgement that even among supportive stakeholders there are great gaps in specific knowledge of what is meant by the "bioenergy sector"
- A great need for brief, informative stories that document how specific areas of the sector could be dramatically strengthened.
- An understanding of the innovation supply chains and the implications for building the bioenergy sub-sectors.
- Need for a general logic model that can be adjusted to suit the different bioenergy sub-sectors in Canada.
- The case for strengthening and growing this collection of sub-sectors that we call Canada's bioenergy industry sector may have many different foci, such as:
  - ensuring an adequate energy supply
  - providing cheaper energy
  - environmental improvements
  - rural development
  - a bioenergy sector "opens the door" for the development of a Canadian bio-economy and "sets the floor" for bio-commodity prices
  - The need for a serious effort at building the bioenergy brand.

Our Journey through the Dialogue

The Dialogue began in November 2005 with the release of the Challenge Paper. This document was a compilation of assumptions and implementation drivers for bioenergy provided by the organizing team. They were broad in scope and were utilized to elicit feedback from participants on the fundamentals of bioenergy in Canada.

Response to the Challenge Paper was strong and was used by the organizing team to prepare the first Progress Report, released in January 2006. In addition to refining the principles and assumptions, the first Progress Report outlined several important things that could be done to advance the development of the bioenergy sector. Feedback on the first Progress Report was solicited from the growing list of participants.

The second Progress Report was sent to participants in March 2006 and was intended to narrow the focus to specific sector opportunities and needs from the large range of ideas and opinions provided by participants.

These documents were used as a basis of discussion for a national Dialogue workshop, held April 12 – 13 in Ottawa, Ontario. Approximately 70 participants were able to attend the workshop which included significant discussion on the proposed strategies (see Appendix 2 for a description and highlights from the workshop). This final report is a summary of the outcomes of that workshop and the Dialogue as a whole.

Sponsorship of the Dialogue

The Canadian Bioenergy Challenge Dialogue was jointly sponsored by the BIOCAP Canada Foundation and EnergyINet. The two organizations joined forces with the intention of enabling and accelerating the development of a vibrant and sustainable bioenergy industry in Canada and in the process providing a number of environmental, social and economic benefits for Canadians. Both organizations have a mandate to ensure the optimal integration of biomass into the broader energy mix in Canada. The Dialogue process was viewed as a vehicle to better understand the needs of research, innovation and policy formulation, insights that can be used to influence the organizations' own investments of time, energy and resources. It is important to note that the outcomes of the Dialogue were not determined by BIOCAP and

About The Sponsors

BIOCAP Canada Foundation

BIOCAP is a national research foundation that is building knowledge partnerships to harness Canada's research capacity in support of sustainable biosphere solutions to the challenges of climate change and clean energy.

David Layzell, CEO and Research Director for BIOCAP, was one of the Lead Champions of the Bioenergy Dialogue.

EnergyINet

EnergyINet is an incorporated national not-for-profit private-public company that brings together industry, researchers and governments to collaborate in developing and implementing innovations that will ensure an abundant supply of environmentally responsible energy – creating economic prosperity and social well-being for Canadians.

Doug James, the Director of EnergyINet's Alternate and Renewable Energy Innovation Program, was one of the Lead Champions of the Bioenergy Dialogue.

EnergyINet – these organizations were just two of many participants who provided direction to the Dialogue and shaped the final outcomes.

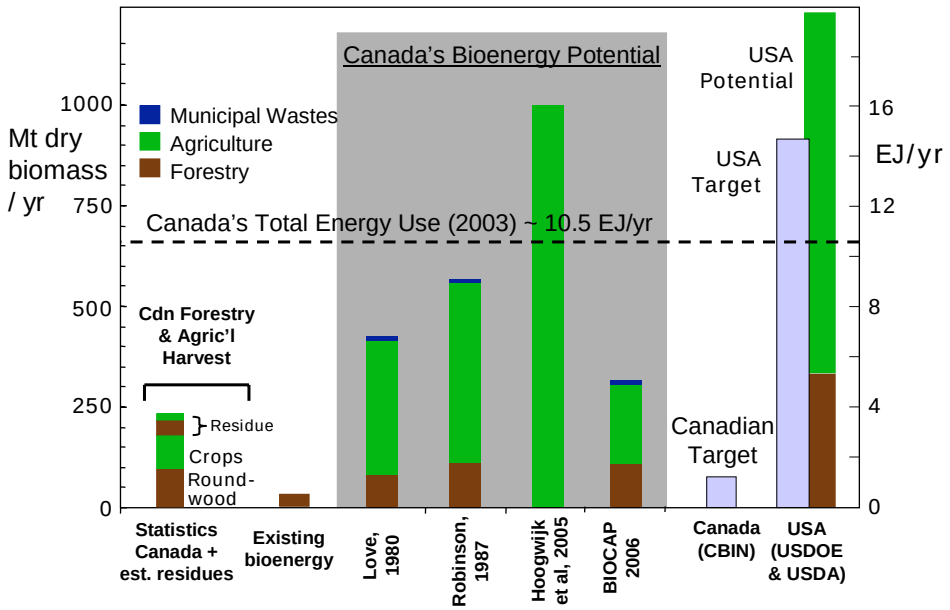
The Challenge Statement

Included in every document, from the Challenge Paper forward, was a Challenge Statement, intended to provide an evolving vision for the bioenergy sector in Canada. It was vigorously debated and revised at every stage of the process based upon feedback from participants.

At the final workshop, participants were concerned about imposing arbitrary targets that may create a "framework for failure" while at the same time recognized the need to measure the progress of the bioenergy sector, or more relevantly, the individual bioenergy sub-sectors such as fuels and power.

Participants requested conclusive information on biomass potential to determine a credible target. Supporting documentation was provided, after which participants were willing to accept a specific target (Figure 1)*. This target was given with caveats to its achievability such as supportive policy, favourable public perception, and adequate investment.

Figure 1. Relative Potential of Bioenergy in Canada*



* Presented by David Layzell, CEO and Research Director of BIOCAP at the Dialogue Workshop

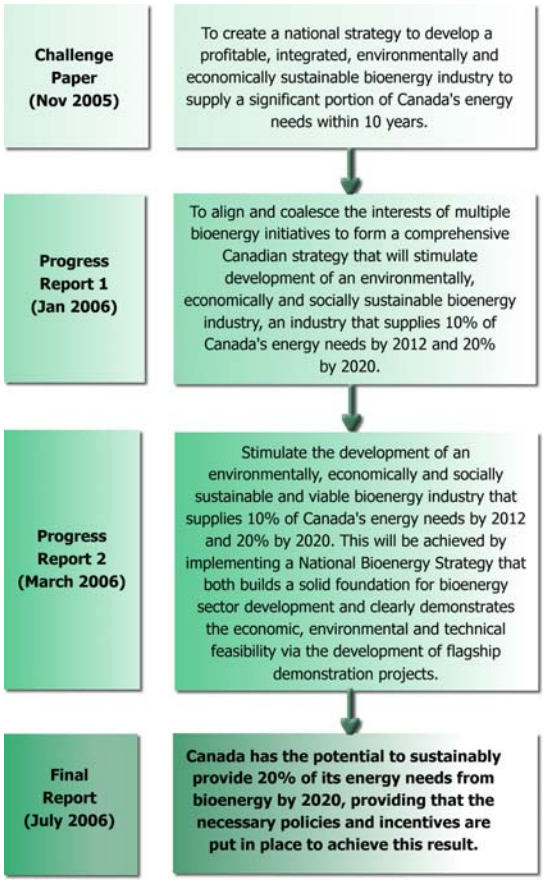
Final Version of the Challenge Statement from the Workshop:

Canada has the potential to sustainably provide 20% of its energy needs from bioenergy by 2020, providing that the necessary policies and incentives are put in place to achieve this result.

As a reference, 20% of 2003 energy consumption is approximately 2.1 EJ and equivalent to the entire energy consumption of British Columbia, Manitoba, and the Maritime Provinces combined.

Please note that the final version of the Challenge is worded more as a goal than as a specific strategy and this is in keeping with the shift of the Dialogue from a single strategy for bioenergy to a portfolio of strategies that will help grow the bioenergy sector. In essence, the final Challenge Statement is a Vision for Bioenergy in Canada, of which there are obviously many subcomponents. These are detailed in section 'C' of this report.

Evolution of the Challenge Statement or Vision During the Challenge Dialogue



Fundamental Principles for Bioenergy that Guided the Dialogue and Set the Stage for Future Activity

In order to ensure all participants were 'on the same page', a set of assumptions was developed using feedback and information provided by participants themselves (for a complete list of final assumptions, please see Appendix 3). These assumptions were amalgamated to create a set of Principles for conducting the Dialogue and subsequent activities for developing bioenergy in Canada:

1. Canada has a significant, perhaps immense, biomass resource potential distributed across several physiographic regions. The size, distribution, sustainability, and competing uses for biomass resources will determine the type, nature and potential viability of any bioenergy opportunity.

2. Bioenergy will likely be an early mover of an emerging bio-economy. Consequently, the development of bioenergy may accelerate the development of components of the Canadian bio-economy. Integration of bioenergy with value-added products can enhance the economic viability of an entire operation.

3. Full-cycle sustainability (biological, environmental, social) of the biomass resource is the fundamental underpinning of any bioenergy development.

4. The long-term rising cost of fossil fuel energy sources will likely provide much of the economic incentive necessary to grow the bioenergy industry. However, broad implementation of bio-energy projects will not be viable unless the economic, social and environmental drivers are adequate, sustainable and recognized.

5. The reduction of air contaminants and greenhouse gases are important but currently are not enough to attract private sector bioenergy investment on their own. Incentives for reducing any contaminant or greenhouse gases may be an early economic bonus that should not be solely relied upon for the long-term viability of bioenergy projects.

6. The world economy for conventional biomass products (e.g., pulp and paper and some types of food commodities) is shifting south, stressing existing biomass-based industries and the related regional economies in Canada, thus providing an incentive to realign the use of existing biomass resources.

7. There are currently many potentially economically viable opportunities to demonstrate promising bioenergy technologies – the low hanging fruit – for which negative value feedstock (such as municipal solid waste and sewage from intensive livestock operations and municipal sewage systems) can be employed.

8. Canada has significant world-class expertise for processing biomass to energy and other bio-products, but we can and must learn from experiences around the world. Some promising technologies and approaches from other countries need to be adapted to Canadian circumstances.

9. Research will be necessary to optimize the sustainable utilization and management of Canadian biomass resources, determine economic potential and impacts, efficiently integrate with existing energy infrastructure, and to develop new/improved conversion technologies. Canada has excellent R&D&D capacity in universities, government, research institutions and industry.

10. A major inhibitor to the development of bioenergy is the fragmentation and lack of sector integration and this has led to minimal recognition of bioenergy as a viable sector or sub-sector of the economy. The fragmentation is largely the result of disparity of the sector – with multiple feedstocks utilizing a broad variety of business models in scattered locations. The differences in these key components make it difficult to transfer knowledge and experience between the operations and activities occurring across the country.

11. Governments can lead and assist in implementing and developing the bioenergy industry by providing multi-jurisdictional enabling policy and harmonization of regulation.

12. Bioenergy must develop within and be integrated into a broader energy strategy for Canada.

13. While most projects will be region-specific, Canada has an extensive transportation infrastructure that will be critical to the development of the bioenergy sector as a whole, since transportation of feedstock is a key determining factor of bioenergy success.

14. The success of the individual projects as sound business ventures will accelerate the acceptance and the deployment of bioenergy across Canada. That success will be dependent upon the ability to attract investment capital and qualified personnel to produce a quality product demanded by customers at a price that provides a fair return on the capital employed by the bioenergy producer and every party along the value-chain.

15. Policy influence on the demand for bioenergy products could be in the form of either mandates or incentives for the consumption of the good.

16. The development of a Canadian bio-products-bioenergy industrial sector that improves the economic viability of agriculture and forest commodities would have an important beneficial impact on the livelihood and stability of Canada's rural communities.

Coming Together

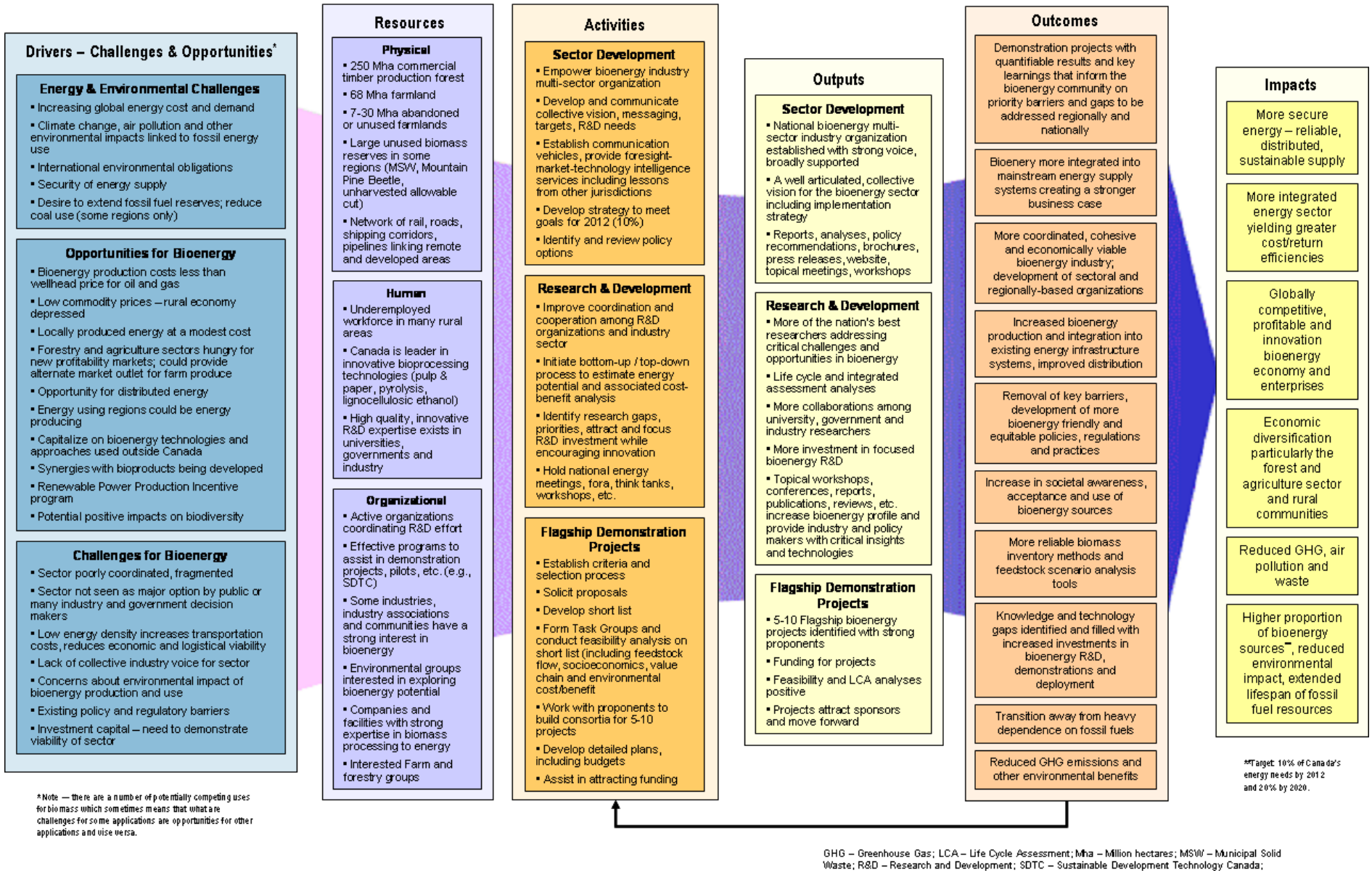
The action phases of Dialogue concluded with a Workshop in Ottawa on April 12 and 13, 2006. The results of the Workshop are presented in Appendix II.

B. Targeting Outcomes and Impacts

In order to determine what activities would be included in a portfolio of strategies for bioenergy sector growth, it was necessary to identify the key drivers for bioenergy in Canada (the challenges and opportunities present) and what resources are available nationwide and around the world that can be transferred to Canada. The desired outcomes and impacts of bioenergy in Canada were then used to determine the activities with the strategy. In other words “What has to be done to accomplish X?”

Below is a logic model that outlines the flow of thought from drivers and resources, to activities and outputs of those activities based upon the drivers and utilizing the resources, to finally the outcomes and impacts of bioenergy as a whole. Participants were very supportive of the reasoning behind the logic model which serves to outline bioenergy as a whole. However, the bioenergy ‘sector’ includes such a broad variety of feedstocks, conversion processes and products with varying drivers and impacts that, while the general logic model generically represents the overall bioenergy sector, it cannot include enough of the important details, drivers and outcomes particular to each sub-sector to be broadly useful. Consequently, the participants concluded that the best approach to the bioenergy sector is to consider it as a cluster or portfolio of related sub-sector strategies, and hence activities, with some elements common to all sub-sectors but with each having their own logic model. Examples of sub-sectors identified were lignocellulosic biomass heat and power, first generation biofuels (ethanol and biodiesel), second generation biofuels (bioethanol and biosyndiesel), energy from waste (municipal solid waste focused), and commodity chemicals. All are produced and utilized within feedstock-to-product threads; threads vary greatly in terms of feedstock, conversion technology, and final product.

Overview Logic Model for Bioenergy in Canada



GHG – Greenhouse Gas; LCA – Life Cycle Assessment; Mha – Million hectares; MSW – Municipal Solid Waste; R&D – Research and Development; SDTC – Sustainable Development Technology Canada;

Sub-sector Impacts

In keeping with the sub-sector theme and recognizing that the attributes of different feedstock and products lead to varying impacts, participants proposed a simple explanation of the various bioenergy options. Some feedstock-to-product threads (options) are highly beneficial for the rural economy, while others significantly reduce net GHG emissions when compared to fossil fuel options. Sometimes different options have polar opposite impacts – for example, biofuels tend to lower air pollution while inefficient, uncontained biomass combustion can lead to high levels of particulate matter. Consequently, bioenergy implementation activities and policy need to specifically target the outcomes, and hence impacts, they intend to achieve. Although there are general themes and trends throughout the bioenergy sector, specific choices made regarding implementation may have a wide variety of impacts.

The flexibility of biomass in terms of feedstock, products, and impacts makes policy management significantly more difficult than single product-focused renewable energies such as wind and solar power. In addition, biomass is a renewable energy that can be quickly depleted (unlike wind or sunlight) if managed incorrectly, so this needs to be reflected in any sustainable business practices and policy. In order to make informed policy decisions on which bioenergy options to encourage, an accurate comparison of the impacts of choices regarding feedstocks and conversions needs to be available. These impacts could include greenhouse gas reduction, air quality improvement, rural development, energy security, job creation, energy cost reduction, and waste disposal.

C. Components of an Effective Strategy

Strategic Activity #1: Sector Development by Coalition Building

The bioenergy sector is highly fragmented and organizations use a variety of messages to convey the benefits of bioenergy. This creates challenges in developing policy, increasing public acceptance, understanding, exposure, and overall sector development. The fact that ~5 % of Canada's energy is currently sourced from biomass is often overlooked and more exposure is given to other alternative energy options such as wind. There already exists a host of industry organizations representing different areas of the bioenergy sector such as biofuels, bioproducts, forestry, and agriculture producers. In addition, bioenergy is a portion of the mandate for groups addressing alternative energy, climate change, air quality, adaptation, rural revitalization, and biodiversity.

Participants of the dialogue were in general agreement that an umbrella organization to unite these groups in sector development is not a viable option and would not be supported by the existing industry. However, they were receptive to the idea of a coalition of organizations. In order for a coalition to function, there must be a purpose for coming together greater than 'increased communication'. Rather, there needs to be a specific

project or action that the coalition intends to undertake and for which such a coalition is needed to increase the chance of project success.

General Principles of a Biomass Coalition

A Coalition can be an effective instrument to accomplish specific tasks to obtain a collectively desired result. Participants were in favour of a task-specific group rather than a continuously-operating industry-supported organization for all of bioenergy. The following are suggestions of general principles for the formation and functioning of a coalition, based upon recommendations by participants of what was needed and what an organized group of stakeholders should be able to accomplish.

1. The Coalition will come together on a specific issue, with the mutual identification among the parties of a challenge or project that needs addressing

2. For each issue, the Coalition will have a finite timeline, with the intention of disbanding once the issue has been addressed to the parties' expectations

3. As the Coalition will be convened on an issue specific basis, only those parties who have a strong vested interest in the topic in question will be involved

4. Either a member of the Coalition or a third party such as BIOCAP or EnergyINet may function as the secretariat and organizing team for activities of the Coalition

5. The Coalition may be used as a lobbying body, approaching government with a single voice and agenda on a specific issue

6. Any financial requirements of the Coalition will be determined on an ad hoc basis

Development of the 'Bioenergy' Brand

Participants of the dialogue identified a clear need to increase the exposure of bioenergy, and biomass use in general. A simple, strong message or branding of bioenergy that is supported by the industry would lead to greater understanding and acceptance by the public and policy makers. While it is recognized the various forms of bioenergy have specific and specialized benefits and constraints, a common general message could substantially help sector development. Thus, as a first specific project for a Canadian Biomass Coalition, a group of organizations can work to develop and promote a simple biomass brand and message.

Consumer recognition and acceptance of bioenergy is paramount to sector growth. Not only do consumers provide the market, they can have a dramatic influence on government policy. To develop this recognition and acceptance, bioenergy needs to be portrayed with a consistent list of characteristics and benefits. While there may be caveats to every benefit, a simple message will be an effective message. This will enable step-by-step progress of the industry as consumers' knowledge and acceptance

increases. Some potential key bioenergy messages based on assumptions that were refined throughout the dialogue are:

1. Bioenergy is a renewable energy

2. Bioenergy is produced from biological materials (biomass) such as crops, wood, and municipal wastes

3. Bioenergy creates jobs in rural regions

4. Bioenergy can complement and improve the performance and environmental impacts of fossil fuels

5. Bioenergy use helps reduce greenhouse gases that lead to climate change

6. Bioenergy use can improve air quality and reduce smog creation

7. Bioenergy can be used to create energy while disposing of waste

8. Biomass can be used in most of the applications where fossil fuels are used today

Alignment on the final key messages will need to be created among members of the coalition.

Consumers will be able to make informed purchasing decisions once they are well informed of the benefits of bioenergy. For bioenergy, this means identifying bioenergy and products sourced from biomass. A labeling system or method of identifying that biomass was utilized to create a product is necessary. However, because biomass is often combined with fossil fuel resources in a complementary fashion, the percentage of biomass content should be included. This is already a common practice for biofuels – for example, 85% ethanol in a gasoline-ethanol mix is called ‘E85’, while fuels for diesel engines with 20% biodiesel are specified ‘B20’. With this successful branding as an example to follow, it is proposed that products and energies that contain or are sourced from biomass, irrelevant of type, be branded ‘Bio%’. For example, a power producer that generates 10% of electricity from biomass could identify this as Bio10.

An effective communications campaign is essential to grow the recognition of, and hopefully consumer preference for, bioenergy. The details of a communications campaign could be determined by the Biomass Coalition, but components could include a dedicated website, advertising on mainstream media, and targeted engagement of politicians and senior policy advisors.

Future Coalition Activities

The coalition would be issue-centric, only coming together to address a specific issue or activity. Those involved would be the ones from the sector with the most interest in the particular issue – for example, those involved in the forestry sector would likely choose

not to participate in a coalition project on municipal waste policy issues. Probable near-term issues for the coalition would be a common message on government incentives for bioenergy sector growth and a classification system to denote the biomass content. The Flagship Projects Program (see below) would be an excellent source of information on key bioenergy issues that might require coalition alignment and united action to get them addressed. The experience of project leaders will be invaluable in identifying real world challenges and potential solutions, policy or otherwise. Examples of issues that may require assessment as identified in the Dialogue are biomass classifications, waste definition and policy handling, and environmental standards. While the formation of the coalition could be undertaken by anyone, BIOCAP and EnergyINet commit to initiate the creation of the first coalition on bioenergy branding.

Other Sector Development Recommendations

Decision Support Tools – Biomass is extremely flexible in applications and can be used for power, heat, fuels, chemicals, materials, fibres, etc. For a community or group rich in biomass resources and looking to capitalize on their resource, a way to make an informed decision on how best to proceed would be invaluable. RETScreen, provided free of charge by Natural Resources Canada is an excellent resource for making decision on biomass heat and power projects. However, it could be strengthened to include other biomass conversion options.

As discussed below, the Flagship Projects Program will also be an invaluable source of information for making decisions on biomass projects. This information will be based upon real world experiences, both positive and challenging.

Strategic Alliances – The importance of strategic alliances to growing the bioenergy sector in Canada was recognized in the Dialogue. Relationships between large and small companies and among academia/NGOs, government, and companies can help to speed progress. Knowledge and technology transfer between organizations is invaluable for learning from past experiences and capitalizing on the expertise of others. A facilitator of partnerships and alliances is very useful in identifying areas of convergence where partnerships can be quite lucrative for both parties. Technology transfer between research and innovations at universities and government labs, and startup or established companies, should be encouraged and looked at in further detail to maximize progress.

There is a real need for ongoing support from all participants along the entire bioenergy innovation chain, from basic research through pilot projects to full-scale implementation. Linking the stages of the innovation chain is equally important and support organizations need to work together to ensure opportunities do not fall through the cracks. Effective and regular communication between funding and support organizations with their upstream counterparts will increase the likelihood of rapid progress from discovery to reality.

Strategic Activity #2: Enhanced R&D Communication

As with sector development, research and development benefits from effective communication and strategic partnerships. It is important for development of bioenergy that the research work is valid, appropriate, linked to other related work and relevant. Research investment must be strategic and the projects must have value beyond the projects themselves including uptake by industry and/or government. Hence, a key priority for R&D in Canada is communication among groups and individuals not only of research results, but of the work they are already conducting or planning. **Partnership building among researchers and industry** will drive innovation and growth of the bioenergy sector. Industry needs to be more involved and supportive in funding, ensuring coordination and helping to focus bioenergy research in Canada. In addition, industry and government input into funding decisions can help ensure that there is an end-user for the results.

While a coalition of industry and industry-supporting organizations is recommended for sector development, **strong communicative relationships among research funding organizations** are recommended for R&D. Effective communication among organizations is essential in ensuring replication of research does not occur. This is not Canada-limited either – research organizations and individuals must be constantly assessing what has already occurred around the world in order to effectively build on that work and then apply it to the Canadian context. While this is more easily accomplished for research involving technology, there are significant lessons to be learned in biosphere management and bioenergy social science aspects from around the world.

In regards to research content and direction, **sustainability of bioenergy and bioenergy systems** must take high priority. World-class research is essential to determine the extent to which bioenergy can contribute to Canada (and the world's) energy needs. While technology development and innovation for efficiently converting biomass into products is a very important aspect of bioenergy development, perhaps the greatest need for research is in feedstock management and adaptation. Our biological systems are incredibly complex and if Canada is to derive a significant proportion of its energy needs from biomass, effective management – including biological, environmental and social perspectives – of these biological systems is essential to ensure sustainability.

To facilitate the sustainability of large-scale bioenergy developments, participants in the Dialogue recommend forming a **Working Group on Transformative Change to a Bioeconomy**. This working group would assess feedstock management, technologies, and social issues of extensive bioenergy implementation. This group would be looking at the long-term (i.e., more than ten years).

Dialogue participants also recommended that a yearly **Canadian Bioenergy Congress** be held. Reporting research results should be one of the aims of the Congress, but communicating business learnings and government policy and programs should also be one of the aims. There could be special sessions detailing the progress and experience of **Flagship Projects** (see below). Although the congress would be largely Canadian

based, international speakers discussing R&D and bioenergy implementation would play a key role in ensuring Canadian research adapts for application here, rather than replicating the work of others. The Congress could be held annually at various cities across the country, leading to a wider variety of participation.

Strategic Activity #3: The Flagship Projects Program

Overall, of the various bioenergy strategy components, participants seemed to be the most excited about the Flagship Projects Program portion of the Dialogue. The intention of this program would be to highlight both actual successful existing and new bioenergy projects. Most importantly, these projects will demonstrate very tangibly and objectively that bioenergy can work in various locales and conditions. The sustainability of projects - financially, environmentally and socially - will be communicated to stakeholders to demonstrate that such projects can be successful and viable.

Through the Flagships Program, the experience and lessons learned by companies and project leaders will be shared among projects including not only the successes but failures and challenges as well. How those challenges were overcome or how they continue to inhibit growth and development will be key issues for communication. Challenges and roadblocks are best demonstrated through evaluating real projects and experiences rather than theoretical challenges. With effective demonstration of issues, Canadian policy makers at all levels of government will be provided with valuable information they can use to identify and implement a comprehensive portfolio of changes to regulations, incentives, and requirements that best enables bioenergy to serve the needs of Canadians.

The Dialogue participants who were able to attend the workshop in Ottawa put forth some excellent ideas for new Flagship Projects (see Appendix IV). However, it was also noted by participants that there are already many activities and projects underway in Canada which could serve as Flagship Projects. Identifying and highlighting these existing successes was something that participants felt should be done right away, since they can add to the profile of the sector and can provide experiential learning beneficial to new projects. Examples of existing projects that could be considered for Flagship Projects status are included in Appendix IV. As the program grows, the number of Flagship Projects is also expected to grow as others are inspired to initiate innovative and situation-appropriate activities.

To highlight the Flagship Projects, we propose a complete communications package including a dedicated website on projects, including project summaries, multimedia content, contact information, lessons learned and growth inhibitors (feedstock, policy, community acceptance, etc.). This information will be gleaned from interviews and consultation with project developers. Using this approach, we will be able to identify the ingredients for project success. Included on the website will be a forum for communication with, and among, project developers. Select Flagship Project Summaries will also be selectively included in ongoing communications by BIOCAP and EnergyINet.

A yearly report outlining the continuing progress of projects will provide a comprehensive overview of the industry as a whole and serve as an effective communications tool to highlight real world impacts. Communicating specific results and data will be an important component of making this a more meaningful resource so as to highlight reasons for success or failure. At the national conference (as proposed under 'Research and Development') a special section will be devoted to Flagship Projects and actual bioenergy implementation across Canada.

The Flagship Program ties in to the Sector Development Coalition Plan. By identifying systematic challenges and problems encountered by Flagship Projects and proponents, a Coalition can come together to address the Challenges and work with the necessary bodies, including government, to overcome them. Flagship Project Leaders and supportive individuals and organizations could collectively work toward a solution.

By providing exposure to the Projects, not only will the projects be provided with excellent visibility but bioenergy as a whole will be given enhanced recognition. These tactics will help to engage those who are currently knowledgeable about the opportunities for bioenergy in Canada.

As a starting point, Appendix IV includes descriptions of several existing projects that could be potential flagship projects as well as concepts for new flagships as provided by participants.

Flagship Projects that could demonstrate, coordinate and integrate bioenergy activities in Canada

Existing: Operating/Planned

1. Charlottetown District Energy System
2. Grande Prairie EcoPower Centre
3. Biomass Fired Electrical Generation in Kirkland Lake
4. De-ink Sludge in Cap-de-la-Madeleine
5. Turning Manure into Power Near Vegreville
6. Ouje-Bougoumou District Heating
7. Utilization of Pulp Mill Waste in Port Alice
8. CPIG Power at Cudworth
9. Sawmill Cogeneration at Middle Musquodoboit
10. Paper Mill Waste Harnessed at Kapuskasing,
11. Eliminating Beehive Burners around High Prairie
12. Wood Waste Gasified in La Ronge
13. Kettleby's Biomass Heated Greenhouse

New/Proposed

1. Mountain Pine Beetle Consortium
2. Integrated Cattle Biomass
3. Prairie Biofuel (Syngas) Centre
4. Wetlands Biomass
5. Combined Heat and Power and Agri-fuel Bioheat
6. Northern Ontario Green Auto/Green Community
7. Combined Heat and Power Initiative for District Heating Involving and Industrial Cluster (Sault St. Marie, Ontario)
8. Biogas for Extraction of Oil Sands
9. Pyrolysis Biorefinery

D. Conclusions

Summary

The three strategic activities of coalition building, enhanced R&D communication and the flagship projects program are intended to promote growth of the bioenergy sector in Canada while at the same time identifying and exploring future opportunities and issues. The three strategic activities recommended are the initial key elements in a portfolio of activities that can become a comprehensive bioenergy strategy for Canada. However, participants were in alignment that although these three strategic activities would be very beneficial to the bioenergy sector, they did not encompass an entire national bioenergy strategy in of themselves.

The primary intended outcome of each strategic activity is:

- **#1: Coalition Building**—To create alignment with and to provide a unified voice on specific bioenergy issues
- **#2: R&D Communications**—To increase the value of R&D investments by reducing project replication and enhancing uptake of existing knowledge
- **#3: Flagship Projects Program**—Provide success stories to increase acceptance and uptake of bioenergy by the public, investors and politicians, while at the same time enabling cross-project learning for rapid sector growth

Just as these three strategic activities are linked, any new strategies incorporated into the portfolio need to be integrated with those already in existence. Although the broad variety of existing strategies, incentives, and programs for bioenergy were highlighted as being a hindrance to growth by participants, they also recognized the significant differences in challenges and opportunities faced by the different bioenergy options. Hence, a portfolio approach is necessary for effective communication and linkage among the organizers and participants of the various sub-sectors.

How did we do?

The measure of success of the Dialogue can be assessed by re-examining the four expected outcomes.

1. The Dialogue created a common baseline of understanding among a diverse range of stakeholders on what is required to grow a sustainable bioenergy industry in Canada.
2. General alignment was reached among the participants of the Challenge Statement on the extent to which bioenergy could play a significant role in Canada’s energy mix.
3. As outlined in this report, a portfolio consisting of three primary strategic activities was developed during the dialogue. Each of these strategic activities still requires a detailed action plan for implementation. BIOCAP and EnergyINet commit to initiating the process, but ultimate success will require strong support from the community

including industry, government, academic, and NGO buy-in to the action plans. Knowledge transfer and enhanced communication will be important components of R&D success, while multi-sector coalition building will help bioenergy groups effectively address specific issues.

4. Preliminary business cases for flagship projects were proposed by project leads at the workshop and there will be further developed as the flagship program takes shape. Enabling effective communication among these projects and highlighting success stories will be essential in providing program value.

Given the anticipated outcomes, the Challenge Dialogue can be considered a success, even though a shift was required from developing a single strategy for the entire bioenergy sector to the development of a portfolio of complementary strategic activities for each sub-sector within the bioenergy sector.

Next Steps

Although this report represents the conclusion of the Canadian Bioenergy Challenge Dialogue, the process of creating and implementing the portfolio of strategies based upon outcomes of the Dialogue is still to be done. We feel that it is important in the short-term to commit to several concrete, realistic actions. We recommend:

- ***Develop sub-sector-specific Logic Models***—as clarified by the Dialogue process, bioenergy is best explained as a collection of sub-sectors. These sub-sectors can vary greatly in implementation drivers and resources while causing significantly different impacts. Logic models for each sub-sector will help determine which sub-sector-specific projects and actions will lead to the desired outcomes and impacts. By comparing the impacts of various bioenergy options, decisions can be made by government and industry on which avenues to pursue to deliver desired impacts.
- ***Convene a meeting to create the national coalition of bioenergy with the initial task of branding bioenergy***—Participants identified the lack of a cohesive bioenergy brand is a significant impediment to public and political acceptance. The formation of the biomass coalition to determine a plan of action for branding will be the first instance of the coalition in action and will help shape future activities. Industry groups and leading companies across the bioenergy sector will need to be involved in the branding effort, which could include certification on sustainability to receive the bioenergy brand.
- ***Host a national bioenergy industry and research conference***—BIOCAP held its first national conference in February 2005. With almost 400 in attendance and over 120 posters, the conference was deemed a great success. To build upon this well-received event, BIOCAP commits to holding a second national conference for research and industry in Ottawa, October 30 – November 1, 2006. Side-events will allow those attending to address specific issues such as bioenergy branding.

- ***Host a meeting of research funding organizations to identify specific opportunities for collaboration and target areas***—There are many regional and national research funding organizations in Canada that are involved in bioenergy. A meeting among these organizations and agencies will create a forum where participants can determine strategies for reducing replication and strategically investing bioenergy research funds. This meeting could be held in conjunction with the national conference.
- ***Establish a national network of Flagship Demonstration Projects and the supporting infrastructure to evaluate and communicate the results***—The efforts to build the Flagship Program will begin with identifying existing projects (beyond those in Appendix 4). A website will be created that will include information on projects, including source of funding, technical characteristics (including feedstock and technology), and any other useful information for new developers. The learnings from these projects will serve as a useful tool to those committing to launching new projects.

Appendix I: Dialogue Champions and Organizing Team

Lead Champions & Sponsors

Doug James
Program Director, Alternative and Renewable Energy, EnergyINet

David Layzell
CEO and Research Director, BIOCAP Canada Foundation

Sector Champions

Rod Bryden
President and CEO, Plasco Energy Group

Ian de la Roche
President and CEO, Forintek Canada Corp.

Tim Haig
President and CEO, BIOX Corp.

Wayne Hillier
Director, Health, Safety and Environment, Husky Oil

Janusz Kozinski
Associate Vice-Principal, Research, McGill University

John Oliver
President, MapleLeaf BioConcepts

Marlo Raynolds
Executive Director, Pembina Institute

Organizing Team

R. Keith Jones
Executive Director, Product Development, Innovation Expedition

Janice Mady
Operations Director, BIOCAP Canada Foundation

Bob Mitchell
President, Inspired Value Inc

Don Simpson
Chairman, Innovation Expedition

Jamie Stephen
Research and Communications Coordinator, BIOCAP Canada Foundation

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Appendix II: Final Workshop Summary and Outcomes

The Dialogue workshop was held in Ottawa on April 12 and 13, 2006. This workshop facilitated a representative group of stakeholders to engage in a lively interactive session aimed at achieving the following expectations:

1. Participants are clear on the extent to which bioenergy has the potential to be a significant contributor to the production of energy in Canada.

2. Participants will have developed and adopted a Bioenergy Strategy that is aggressive yet realistic, and will place Canada at the forefront of bioenergy development in the world.

3. Participants will have developed a draft Action Plan for initiating a broad collaborative program to realize the Bioenergy Strategy that will attract interest and enthusiastic support from a wide range of industry, government, academic and NGO partners.

4. As a stretch goal, the participants will develop and undertake actual Flagship bioenergy Projects that will be lead by Project Champions who emerge from the workshop (who may be individuals, companies, consortia or other partnering mechanisms).

5. As a stretch goal, the participants will form an organizing group to lead the creation of a new “Bioenergy Sector Coordinating Organization” to bring together the government, academic, NGO and business groups to actively further the development of bioenergy sector in Canada.

A workbook was developed as a guide for the sessions and was distributed at the beginning of the workshop. (It can be viewed on the EnergyINet website in ‘publications’ and on the project website http://cdbioenergy.redengine.ca/home/default.aspx). A detailed book of reference materials was also prepared by BIOCAP for the workshop.

The Dialogue Champions (Doug James of EnergyINet and David Layzell of BIOCAP) set some context by reminding participants of the beliefs that have been driving their involvement.

> *"We believe a coordinated effort to develop a national strategy on bioenergy is essential to the economic and environmental prosperity of Canada and to ensure Canada is a world leader in bioenergy. We believe that stakeholders from industry, finance, government, academia, and non-governmental organizations must all actively participate in determining the best practices and options to achieve substantial and rapid progress in the field. We strongly believe that this process will assist in the profitability and success of bioenergy enterprise in Canada, while helping the country meet its climate change and environmental demands."*

The essence of their challenge to the participants is captured in the following excerpt from their welcoming comments:

> "*As Lead Champions, we wish to issue to the participants the challenge to develop an effective and workable "Made-in-Canada" strategy for realizing the potential for bioenergy, for developing Canada's potential to be a global bioenergy powerhouse and to clearly demonstrate that Canada has both the skill and the will to make a difference*."

Significant Conclusions from the Workshop

- General agreement that Canada's bioenergy potential is nationally significant.
- Acknowledgement that even among supportive stakeholders there are great gaps in specific knowledge of what is meant by the "bioenergy sector"
- A great need for brief, informative stories that document how specific areas of the sector could be dramatically strengthened.
- An understanding of the innovation supply chains and the implications for building the bioenergy sub-sectors.
- Need for a general logic model that can be adjusted to suit the different bioenergy sub-sectors in Canada.
- The case for strengthening and growing this collection of sub-sectors that we call Canada's bioenergy industry sector may have many different foci, such as:
  - ensuring an adequate energy supply
  - providing cheaper energy
  - environmental improvements
  - rural development
  - a bioenergy sector "opens the door" for the development of a Canadian bio-economy and "sets the floor" for bio-commodity prices
  - The need for a serious effort at building the bioenergy brand.

Appendix III: Assumptions Guiding the Dialogue

a) Process Assumptions

The Challenge Dialogue will:

1. Focus on developing an actionable Bioenergy Strategy, advancing a common vision and direction among participants. While the Dialogue is a starting point, further activities supporting collaboration, innovation and tangible progress in the bioenergy sector in Canada are expected to develop over time.
2. Provide a forum for key decision makers to develop a broadly based collaborative strategy for a national Bioenergy Program and to exchange ideas and drivers for the strategy. While government representatives are involved in creation of the strategy as participants, the strategy outcome is not policy and the challenge dialogue should not be interpreted as a government program. The views expressed by participants and reported by the Challenge Dialogue team are not necessarily those of the federal, provincial, or municipal governments of Canada or any other participant.
3. Assume that any broadly-based strategy for the Biomass Energy sector emerging from the Dialogue will be committed to implementing a mission-oriented program. This program will begin with a high-level strategy and near term action plan, and grow into a detailed operational strategy that embraces all elements of the innovation supply chain, including Research, Development, Design and Demonstration; the development of supportive policy options and funding initiatives; and the required commercialization efforts to eventually Deploy the products in the marketplace (R+D+D+D).
4. Multidisciplinary, multi-sectoral networks can be highly effective mechanisms for engaging a broad group of individuals/organizations in collaborative efforts to support innovative interventions. Given the variety and number of initiatives in the bioenergy area across Canada, this Challenge Dialogue process will explore options for integration and improving communications between parties.

b) Assumptions related to the Strategy Development Process

5. The strategy will set targets for significant results within the next 15 years and will also deal with an extended timeframe that takes into account the life-cycle of biomass feedstock.
6. Most estimates of the potential role of bioenergy in the energy sector consistently underestimate its potential. Bioenergy has the potential to provide up to 25% or more of Canada's energy supply, which is significantly more than the current 6% or 0.6 EJ (exajoule). One tonne of biomass that sells for $30 to $100 has the same energy content (17 GJ) as 3 barrels of oil ($C210) or a volume of natural gas that sells for over $C180. In today's prices. A case can be made that the

price separation could help to pay for the additional cost of transport and processing biomass. Research is required to verify this assumption, particularly on a region-by-region basis, and this should be part of the Action Plan.

7. The Bioenergy Strategy resulting from this Dialogue needs to be appropriate for Canada's situation. It may however draw from US, European and other OECD country strategies. It will also have regional expressions. For example, the bioenergy opportunities in Canada's southern-most regions are predominantly agricultural and municipal and therefore the related elements in the Canadian strategy may draw upon related ideas in the US strategy. The opportunities in the northern boreal areas of Canada on the other hand are predominantly forest-related and therefore could draw upon similar elements
8. The barriers associated with some uses of bioenergy (e.g. heat and power generation) are often less associated with technological limitations than with the need for efficient integration across sectors as well as enabling policies and management strategies that recognize the multiple social, environmental and economic values associated with bioenergy and a bioeconomy
9. Research is critical to develop optimal technologies and strategies for biomass production today and into the future, to understand the full environmental costs and benefits of biomass production and use as an energy resource, and to develop more efficient and effective strategies for processing transporting and converting biomass into value-added energy, chemicals and materials.
10. Partnerships are essential to bioenergy success – companies and groups that have not previously worked together, such as forestry companies and power producers/fuel producers need to collaborate. One has the feedstock; the other has the plants and conversion technologies. Transportation, education and capacity building are also critical factors.
11. Sustainability must be a core principle of any bioenergy strategy and its implementation. Sustainability limits the rate of consumption of the resource due to the finite size and rate of regeneration of biomass and ecological needs. There is only so much biomass created and it is in turn determined by growth rates and limited by maintenance of things like soil quality and competition for other uses of land resources. The potential biophysical resource is nevertheless very large. The strategy should reflect a full understanding of the biophysical life cycles and options for their sustainable development).
12. While acknowledging that fossil fuels will continue to play a central role in Canada's energy supply for years to come, development and commercialization of Canada's alternate energy sources is nonetheless also seen as a significant priority. Biomass is seen as the most flexible renewable alternate energy source. It can be converted directly to heat and power or processed into liquid and gaseous biofuels (including hydrogen), chemicals and other bioproducts.

13. Biomass energy has been the predominant source of energy for human society for tens of thousands of years and continues to be in many parts of the world. However, a credible and viable biomass energy industry in the 21st century must be substantially different from the bioenergy of the past. It must be developed in a sustainable, efficient manner, preserving or accumulating carbon stocks and maintaining or enhancing biodiversity and ecosystem health rather than depleting these ecological values. Also, the conversion technologies must be more efficient and have far fewer emissions of pollutants than traditional technologies. Finally, the 21st century bioenergy industry should recognize and enhance social and ethical values for Canadians.

14. While many bioproducts can be produced from biomass, only those produced in large quantities with minimal net (GHG) emissions will result in nationally significant GHG reductions. Bioenergy therefore offers significant potential for GHG reductions

15. An integrated bioeconomy requires that research, development and commercialization efforts are focused on the harvesting and processing of biomass as well as on the efficient and sustainable production of biomass through enhanced management strategies and new technologies. These sustainability issues are all part of the global challenge to think globally while acting locally (and then transferring and applying the technology and expertise internationally).

16. On a per capita basis, Canada has some of the largest forest and agricultural land resources in the world. Despite this advantage, Canada has not yet set bioenergy targets that are in line with many of its trading partners. If we projected Canada's bioenergy potential from forestry and agricultural resources using methods similar to those used by the US and UK — scaled to account for differences in land availability and productivity in Canada — our biomass production could increase to 2.4 EJ or more, and meet about one quarter of the nation's current energy requirements.

c) Assumptions Regarding Different Aspects of Integration

17. ***Market Integration****:* Forest and agricultural operations generally produce commodities that are sold into markets that have up and down price cycles. The development of a bioenergy sector could provide alternative outlets for these commodities during the downturns in price. Integration also offers the opportunity for the forest, agriculture and municipal sectors to reduce their waste disposal costs and perhaps even turn the waste 'resource' into sources of revenue. Regulation will likely be necessary to ensure the ongoing environmental and social sustainability of these activities.

18. ***Integration into Broader Energy Industry***: The Bioenergy Strategy needs to fall within the context of, and be integrated with a broader energy strategy.

Energy produced from biomass is assumed to be incremental to that produced from other sources of fossil and renewable (primarily hydro and wind) resources. It is assumed by the Champions that all sources of energy will be necessary to supply the increasing demands of our society. Consequently, the implementation of a Bioenergy Strategy is not necessarily intended to compete with or displace other sources of energy. Rather it will augment the overall supply. Further it is assumed that, bioenergy sector(s) will develop more readily if they can capitalize on existing energy processing, generation, and transmission and distribution systems.

19. ***Technology and Value Chain Integration:*** Technology in the more traditional energy sectors seem to be developing in the direction of using new cleaner and more efficient technologies (e.g., oxyfuel firing, coal and bitumen gasification). This selectively separates components which can be used for higher value uses than energy and converts the remaining feedstock into as much energy as possible at a point in the value chain and in situations where it can realize these values. Opportunities exist to co-fuel these new plants with bio-feedstock and leapfrog to the next generation of commodity use and application of energy technologies. Integration of bioenergy into the overall energy system is required because of convergence in technologies (co-firing in coal gasification facilities for example), distribution of products (e.g., electricity, natural gas substitutes or liquid fuels) and regulations. A strategy that is not integrated into the existing distribution system will be less effective. In sum, the Strategy must recognize and build upon all of these aspects of integration.

d) Drivers for Bioenergy Development in Canada

20. The primary drivers of bioenergy development in Canada stem from the need for the agriculture, forestry and municipal sectors to keep their costs down when faced with: escalating energy costs; need to improve their management of waste; and, address climate change and sustainability objectives. The quest for economic development and diversification, particularly in remote areas, and the orderly development of reliable energy resources also support bioenergy development.

21. The order of priority for the development of the bioenergy resources will depend on the relative state of the business environment (policy, resource availability, economics, and technology availability). For example, it is conceivable that future climate change and environmental sustainability policies could become principle economic factors. Resulting market opportunities therefore that make nationally significant reductions in greenhouse gas emissions would likely be developed first (probably large stationary heat and power plants that utilize large quantities of biomass — >10,000 tonnes/yr). However, if the pursuit of local economic and employment opportunities become the principle driver for development of the

sector, then smaller distributed liquid fuel, biomethane and/or liquid fuel plants may be developed sooner than the big stationary plants.

22. Bioenergy provides more jobs per GJ than any other energy source – most of them located in rural areas where employment prospects are often limited and seasonal.
23. There is an opportunity for bioenergy production to make a major contribution to the environmentally responsible and cost-effective management of agricultural, municipal and forestry waste.
24. The development of the bioproducts sector may ultimately drive the bioenergy sector via value-added high-value products that use a relatively small proportion of the feedstock.
25. Bioenergy can be used within our existing energy infrastructure – for example, co-firing in existing thermal plants, blending ethanol with gasoline or biodiesel with diesel, biobased commodity chemicals, upgraded biogas with natural gas – all of which demonstrate the huge advantage of bioenergy over other alternative energies such as hydrogen that need new or altered infrastructure. However, as with any industry, a large increase in operations will require substantial changes particularly to address the challenges of transporting the feedstock.
26. Bioenergy plants are potentially well-suited to distributed power applications, that is, small to medium sized facilities serving regional markets or infrastructure which makes them beneficial for rural economic development
27. Canada can both use and export bioenergy. Bioenergy can displace, complement or otherwise free up other energy sources, including fossil fuels, from domestic consumption leading to a redistribution and rationalization of energy sources and uses. Policy can greatly encourage biomass production and use. This is evident in Germany (biodiesel), Brazil (ethanol) and in Scandinavian countries (lignocellulose). Bioenergy also contributes to energy security.
28. Bioenergy could be a prosperous business sector that grows on its own merits within 10 years. Successful bioenergy activities already exist (e.g. power generation in forestry). However, it takes time to develop viable businesses and during that time. Policy and financial support from government will be necessary to establish the sector.
29. Fossil fuel prices will fluctuate over time but continue a rising trend. This is because fossil fuels are a finite resource, irrespective of whether peak levels of oil and natural gas production will be reached in the near term, increasing scarcity will put upward pressure on the price trend. In addition, the world's energy demands will continue to increase as nations develop and the global population grows.

e) Conditions of Success

30. A successful bioenergy sector requires an enabling policy environment that could include:

    - Guaranteeing market share for biofuels or a level playing field for production of electricity (for example, as compared to nuclear power generation in Ontario),
    - Recognizing the rural economy benefits associated with using domestic biomass instead of imported coal or oil, or
    - Incenting and/or requiring the reduction of CO_2 emissions.

31. Harmonizing and/or ensuring complementary federal, provincial and local government policies. (The bioenergy sector operates within the policy framework of multiple governments: federal, provincial and local. The development of a viable bioenergy industry requires the active support by all of these governments).

32. A successful bioenergy operation requires:

    - reliability in feedstock, quantity, quality (i.e., heterogeneity, condition and purity) and cost. These are all related in a market that can substitute use of the product or feedstock type from the same land. This implies a long term vision with associated policies is required
    - to make projects viable, the financing of facilities is directly related to the nature of supporting policy including attitudes towards subsidies, if appropriate. However, to succeed in the long run, a bioenergy operation must be economic relative to the other competing energy options available in the marketplace.
    - the size of the plant is determined by the availability of cost effective feedstock at one end of the spectrum and capital cost per unit of power generated at the other end. This notionally implies both upper and lower constraints to economically viable plant sizes. The size of the plant must be matched to the resource availability (cost, reliability, productivity rates, etc). In other words, in principle, the size of sustainable economic resource determines the size of the plant that in turn determines the type of applications.

Appendix IV: Flagship Projects

Existing Flagship Projects

1. The Charlottetown District Energy System

Prince Edward Island has been one of the most active Canadian provinces in bioenergy and district energy. Three small district heating plants were constructed in Charlottetown in the 1981–85 period under the auspices of the PEI Energy Corporation, a provincial crown corporation.

The first plant burned municipal solid waste to provide steam heat to the Queen Elizabeth Hospital.

The second plant burned woodchips to provide energy – both steam and hot-water heat – to nearby provincial government buildings and later to other larger private buildings in the downtown area.

The third system was based at the University of Prince Edward Island. Both woodchip-fired systems were expanded in the early 1990s to heat more non-government buildings

Description

In 1995, Trigen Energy Canada Inc. purchased all three systems and established Trigen-PEI. The new company set about constructing one large, district energy system. It connected the three separate systems together and consolidated heat generation at the Energy from Waste Plant on the Charlottetown waterfront.

As well, the company installed a new heat-recovery boiler for the garbage combustion system and added a high-efficiency biomass plant to burn sawmill waste. State-of-the-art emissions controls were also installed at that time. A 1.2-MW Ewing Power Systems' backpressure turbine generates electricity to operate the plant; any surplus is exported to the grid. The expanded district energy system became fully operational in 1998.

This new district energy plant still provides steam to the nearby hospital. It also delivers hot water to a 15-km hot-water heat distribution system that runs throughout the core area of the city. The plant serves over 60 customers and heats 84 buildings, including all the provincial buildings, the university, the technical college, two shopping malls and many other apartment and commercial buildings in the centre of Charlottetown.

The Charlottetown District Energy System also provides energy for cooling to two major customers. Steam that provides district energy to the Queen Elizabeth Hospital is used to air-condition the hospital through the use of steam absorption chillers. The University of Prince Edward Island, meanwhile, employs hot water from the district energy system for cooling by means of hot-water absorption chillers.

Financial resources / Economic Benefits

The customers of the Charlottetown District Energy System do not pay to be hooked up to the system. The utility bears the costs. Trigen-PEI contractual agreements have two tariffs – a Demand Charge for the cost of the district energy system and hookup, which is tied to the Consumer Price Index, and an Energy Charge, which relates to the quantity of energy used. The Energy Charge tracks the price of oil. Most customers find that their energy costs are about 10 percent less than the cost of heating oil. (Natural gas is not available on Prince Edward Island.) Customers are also insulated from dramatic, short-term swings in the price of oil.

Other economic benefits of the Charlottetown District Energy System include the following:

- Less capital tied up in individual building heating systems and heating-oil inventories;
- Elimination of heating system maintenance and replacement costs for customers;
- Greater local self-sufficiency. The Charlottetown District Energy System burns some 66 000 tonnes of Price Edward Island waste materials to displace 17 million litres of imported light heating oil;
- Increased local employment from constructing and maintaining the district energy system. The provincial government estimates that for every dollar spent on biomass fuel, 70 cents stays in the local economy; and
- Increased profitability of the company that supplies the sawmill waste. (A former liability is now an asset.)

Results

Environmental Benefits

Like other biomass-fired district energy systems, the one at Charlottetown offers many environmental benefits, including the following:

- Reduced CO2, SOx and NOx emissions;
- Reduced spillage and leakage of heating oils from individual building systems;
- Improved environmental air quality.

  For example, with only two stacks at the Trigen-PEI plant, there are fewer point sources for pollution than there were with individual building heating plants. The Trigen stacks are equipped with the latest pollution control equipment, including air scrubbers and multi-cyclones and filters for removing particulates

- Reduction of municipal waste landfill and related environmental impacts. Burning municipal waste reduces the landfill area required by roughly 90 percent;
- Elimination of landfill of sawmill waste and potential soil and water contamination; and
- A significant contribution to Canada's commitment to reduce GHGs.

Biomass Fuel Supply

The Charlottetown District Energy System is fuelled by a combination of municipal solid waste (45 percent) and sawmill residue (45 percent), with only 10 percent generated by oil. Each year, the plant burns up to 33 000 tonnes of municipal waste that is collected from Charlottetown and its surrounding communities. Oil-fired boilers at the district energy plant and at the University of Prince Edward Island and the Prince Edward Home provide energy backup and peaking capacity during the coldest weather.

The system burns an equal quantity of sawmill residue that is supplied by Georgetown Timber, a large stud-wood mill on the east end of Prince Edward Island. The residue is delivered to the plant in large 45-foot, self-unloading (walking floor) vans. Before the new Trigen plant was constructed in 1997, most of the sawdust, bark and shavings were dumped in a huge pile behind the mill, which posed serious environmental concerns.

The Trigen biomass plant is now burning hog fuel, a combination of mainly bark and sawdust. (The mill bags the shavings and sells them for bedding.) Included in the fuel mix is old sawmill waste from previous years. The sawmill hopes to clear up this residue in two years.

The combined municipal waste and sawmill residue displace roughly 17 million litres of heating oil per year.

Customer Satisfaction

The customers of the Charlottetown District Energy System are generally supportive of the utility. One of the first private sector customers was the Charlottetown Hotel, which was connected to the pilot district heating system in 1987. Manager Gary Craswell said, "The District Energy System works great for us. We have had few technical problems." The hotel has even considered removing its old oil boilers and re-using the space in the basement. "The cost of removing them is the only reason that they are still there," he said.

Another customer is the Charlottetown Area Development Corporation (CADC), which owns two large downtown properties that were connected to the district energy system in 1999.

First, the Harbourside Project consists of a large block of office and apartment buildings. The manager of properties for the corporation, Wade Arsenault, is positive about the benefits of district energy systems. "I think that it is a wonderful system," he said. "The CADC needed to replace six separate boilers and carry out other upgrades to the heating system. Trigen-PEI came in and installed their heat transfer station and did the other system upgrades at no cost to us.

That saved us roughly $350,000 in capital expenses, and our heating costs are now about the same or have perhaps gone down slightly compared with the cost of heating oil. So we are very pleased with district heating."

The second CADC facility connected to the district energy system is Founders' Hall. This former Canadian National Railway Company workshop in Charlottetown is being transformed into a museum and exhibition centre. "That also turned out well for us," said Mr. Arsenault. In this case, the corporation subsidized the hookup to the district energy system because the building was too far off the line to be economical for Trigen-PEI. "With district heating, we save on furnace maintenance costs," he said. "But the main plus is that we did not have to construct a boiler room, so we have an extra 100 square feet of building space that we can rent out."

Other Islanders have commented on the compact nature of the building heat transfer stations. Pat MacInnis, a teacher at Charlottetown Rural High School, said, "The efficiency of the heat transfer station is tremendous. All you have is a little box, and it heats the entire school."

Potential District Energy Market in Canada

It is well known that Canadians are among the highest per capita energy users in the world. While we have some regional variations, we depend heavily on fossil fuels to meet our heating and electricity needs. Canada is also a heavily forested nation, accounting for 10 percent of the world's forest. According to 1996 figures, the economies of about 340 Canadian communities depend directly on forestry. In addition, over 200 Aboriginal communities are located in the boreal and sub-boreal forests, surrounded by significant forest resources.

In communities where timber and pulpwood are processed, numerous opportunities exist for using the waste industrial heat in district energy systems to heat large buildings and even residential homes that are reasonably close to the source of heat. Revelstoke and Masset, British Columbia, are two communities studying this option.

While the wood processing industries use much of the waste wood that they generate, surplus volumes of wood waste are in or near many communities across the country. Charlottetown, Prince Edward Island; Oujé-Bougoumou, Quebec; and Grassy Narrows, Ontario, have been able to use surplus wood waste from nearby sawmills to generate heat for district energy systems. These three communities are models for Canada.

For the many remote Aboriginal communities across the country, bioenergy-fired mini-district heating systems present opportunities to sustainably manage their forests. Other important socio-economic benefits include creating long-term jobs in the communities and reducing their dependence on expensive, imported oil.

Today about 60 district energy systems operate in Canada. Three of the systems are fired mainly with biomass, principally wood waste and municipal solid waste. Most of the other district energy systems are fired with natural gas or oil. Some involve cogeneration of both electricity and district energy.

Write up courtesy International Energy Agency – IEA BioEnergy, Task29: IEA Bioenergy Network on Socio-economics, http://www.aboutbioenergy.info/Charlottetown.html

2. Grande Prairie EcoPower Centre

The $56 million Grande Prairie EcoPower® Centre was fully commissioned in the fall of 2004 by Canadian Hydro Developers. The plant uses wood waste to generate both 25 megawatts of electricity as well as steam for use in the Canfor sawmills in Grande Prairie and Hines Creek. The electricity generated – about enough to supply 21,000 homes -- is being supplied to the Alberta electrical grid. Through a price-competitive bidding process that included conventional electricity suppliers, Canadian Hydro won a 20 year direct supply contract with the Alberta Government for 60% of the green power that the Centre produces or about 110,000 megawatts per year.

The EcoPower® Centre will cut particulate emissions from the mills by 80 per cent. It will also eliminate the purchase and combustion of over 300,000 Gigajoules of natural gas and reduce direct greenhouse gas emissions by more than 17,000 tonnes per year.

Grande Prairie Mayor Wayne Ailing said: “This project is an excellent example of how solutions can be created that provide a sustainable, competitive advantage...” John Keating, the President of Canadian Hydro Developers, said, “the Centre is a showcase of what can be done across Canada. Biomass is a significant untapped Canadian resource for the renewable energy industry. Everywhere there’s a sawmill in Canada, this can be done. Generation of electricity and steam from biomass is a fantastic way to help create economical communities and competitive businesses.”

Write up derived from a September 30, 2003 Media Release from Canadian Hydro Developers, which can be found at http://www.cityofgp.com/spotlights/can_hydro.htm

3. Biomass Fired Electrical Generation in Kirkland Lake

Northland Power commissioned a combined cycle power co-generation power plant that runs on a combination of natural gas and biomass in Kirkland Lake, Ontario in 1991. Total power capacity is 102 MW and the majority of power comes from 3 gas turbines while 17 MW comes from a wood waste-fired steam plant. KMW designed a unique system comprised of three shop-assembled biomass combustion system, each coupled with shop assembled packaged steam boilers. This innovative design proved to be very successful and is believed to be the first of its kind in North America. After more than ten years of continuous service this bioenergy plant still shows an impressive availability at 96%. The total biomass consumption is 720 tons per day at rated output.

The facility was commissioned in 1991 by Northland Power Inc. (‘‘Northland’’) and Northland remains the facility operator. Electricity produced by the facility is sold to OEFC pursuant to a 40-year contract executed in 1989. If after 20 years, sufficient gas contracts have not been arranged, OEFC has the right to limit the contract to 20 years. Kirkland has entered into agreements for the supply of wood waste natural gas and gas transportation services for various terms.

Write up derived from a combination of an October 2003 speech by Eric Rosen, President of KMW Systems of London, Ontario given in Toronto titled *Moving Towards a Sustainable Business* and http://www.algonquinpower.com/business/facility/cogeneration_kirkland.asp

4. De-ink Sludge in Cap-de-la-Madeleine

Cascades Inc. in Cap-de-la-Madeleine, Quebec, decided to install a process for recycling waste paper into pulp to be used for paper mills. The by-product from this process is material in the form of sludge, which is unsuitable for other purposes thus requiring disposal. Since the sludge has a high degree of organic matter the most economic option for disposal was to combust it to make steam. In 1992 a specially designed combustion system was installed that uses the sludge as the primary fuel source and that combustion system is connected to an existing steam boiler for heat recovery. The recovered heat is used within the plant. The sludge is pre-dried to a moisture content of 45% using heat from flue gases. The heat recovery is rated at 70 Million Btu/hr and on average the plant is consuming 170 tons of biomass per day. At low sludge production the fuel is supplemented with sawdust.

Write up derived from an October 2003 speech by Eric Rosen, President of KMW Systems of London, Ontario given in Toronto titled *Moving Towards a Sustainable Business.*

5. Turning Manure into Power Near Vegreville

A pilot plant near Vegreville in central Alberta processes solid cattle feedlot manure to produce electricity and other value-added products. The Integrated Manure Electricity System (IMUS) processes manure from Highland Feeders' 36,000-head feedlot. The initial phase will only utilize manure from about 7500 cattle and will generate about 1MW of power but plans are to scale the project up to produce about 3 MWs, which is about enough power for a town of about 5,000 people. The value-added by-products that are also produced are environmentally friendly fertilizer and irrigation-quality water.

The manure is gathered from the feedlot and fed into two large concrete tanks with heavy rubberized roofs that serve as the anaerobic digesters. In about 14 days, manure has worked its way through the system and has yielded methane and carbon monoxide, which are fed into a 1500 hp reciprocal engine that generates electricity and heat. Once the gases have been removed, the digested slurry is fed into a solid-liquid separator. The dry solids produce a nutrient-rich fertilizer. Nutrients are also separated from the liquids, leaving irrigation-quality water that is reused on the site.

The concept was to solve or reduce a number of the environmental challenges associated with handling large volumes of feedlot manure and at the same time generate revenues that cover the capital costs and also provide a revenue stream for the operation. The range of benefits provided by this project include:

- Reduced manure handling costs
- Eliminated risk of manure contaminating water resources
- Odor reduction

- Recycling of waste water
- Value-added revenue from the sale of energy and bio-based fertilizer.

According to Barry Sowerby, who writes Mission Green for GM Canada, “The manure from six cows can be converted into enough gas to generate the typical electricity needs of one Alberta household for a year.” It would therefore seem that this and other competing technologies have a lot of potential applications in Canada.

Information for this write-up obtained from *Meristem Land & Science On the Land*, September 23, 2004. http://www/meristem.com/topstories/ts04_29.html and also from *Mission Green: and environmental journey across Canada*, Friday October 1, 2006. http://www.gmcanada.com/inm/gmcanada/english/about/MissionGreen

6. Oujé-Bougoumou District Heating

Oujé-Bougoumou is a Cree Nation community of 650 people, located in the James Bay area of Quebec, 960 km north of Montréal. Land claims settlements with Quebec in 1989 and the Government of Canada in 1992 enabled the community to relocate and construct a permanent new village. High and fluctuating oil prices during that period caused the community to seek alternative sources of energy to heat their homes and public buildings. There were concerns that high energy costs would impede the community’s economic development.

After considering various options, the community leaders turned to an abundant local energy resource – sawmill waste (sawdust) from the nearby Barrette-Chapais sawmill, which was having trouble disposing of its large volume of mill waste. They elected to construct a central, wood-fired heating plant and district energy system to heat the entire community. Natural Resources Canada’s CANMET Energy Technology Centre funded a feasibility study and the system design.

Construction of the district-heating infrastructure began in 1991. The heating plant was completed in 1992. It consisted of a one-megawatt (MW) biomass boiler and a 1-MW oil boiler. With the continued growth of the community in the 1990s, a second 1.7-MW biomass boiler was added in 1998. The two-biomass boilers and the wood fuel reserve are located in the main boiler plant. Two oil boilers, with a combined capacity of 2.5 MW, are housed in a separate building. The peak winter heating load in 2000 was 2.4 MW.

That year, 140 housing units and 20 public buildings were connected to the district heating system. The length of the district heating piping totaled 12 kilometres. The core piping is comprised of insulated, thin-wall, steel piping. High-temperature plastic pipe is used to connect the smaller buildings. The maximum operating temperature of the plastic piping is 90°C. The supply water temperature is maintained at about 85°C, with return temperatures in the 45°–50°C range. The summer water-supply temperature is 65°–70°C, which is all that is needed for domestic hot water.

Each building is equipped with two separate heat exchangers, one for heating the building and a smaller one for domestic hot water. They also have a heat meter to measure the energy

consumption for each building; but to date, the billing has been based on a flat rate for everyone. The intention is to move to a billing system that is based on the energy use for each home.

Economic Benefits

The economic benefits achieved by the Oujé-Bougoumou District Heating System are obvious and dramatic. In the winter of 2000–2001, heating oil prices rose as high as 54 cents per litre before settling back down to 44 cents. For example, at 44 cents per litre, heat from oil costs the community $96 per megawatt-hour. In comparison, heat from biomass costs them $11 per megawatt-hour, including fuel, amortization, maintenance and all incidental costs.

“We have worked really hard to try to optimize the use of the biomass system,” said Duncan Varey, technical advisor for the district heating system. “If we have to go on oil in January, it can cost us an extra $2,000 per day, so it is worthwhile to do regular maintenance and be ready to respond if a problem arises.”

Oujé-Bougoumou residents pay a fixed percentage of their income into a housing fund to cover the construction, operation, maintenance and heating of their homes. The low-cost energy provided by the Oujé-Bougoumou District Heating System combined with energy-efficient building designs have resulted in a surplus in the housing fund, which is used to build additional houses. The savings generated by the district heating system are also making the community more independent.

Environmental Benefits

The Oujé-Bougoumou District Heating System offers many environmental benefits to the community, including the following:

- Reduced CO2, sulphur oxide and nitrogen oxide emissions from oil furnaces
- Reduced emissions from individual wood stoves
- A reduction in fires from both wood stove chimneys and electric heaters
- Resolving a wood-waste disposal problem at the Barrette-Chapais sawmill

Biomass Fuel Supply

During the 1999–2000 heating season, the Oujé-Bougoumou biomass plant burned 3025 tonnes of sawdust. The community hauls the sawdust in their dump truck, which has raised sides to increase its carrying capacity. They pay a $6-per-tonne loading charge for the fuel. In winter, they need two loads per day to supply the heating plant. For the 1999–2000 heating season, approximately 90 percent of the total energy supplied to the district heating system was derived from biomass, with only 10 percent coming from oil.

Write up courtesy of Natural Resources Canada’s web page titled Renewable Energy in Action: http://www.canren.gc.ca/renew_ene/index.asp?CaID=47&PgID=975

7. Utilization of Pulp Mill Waste in Port Alice

Western Pulp located in Port Alice on Vancouver Island has been burning wood waste since the mill started in 1917. The mill produces 500 MT/D of a wide range of viscous sulphite pulp grades. New air emission regulation forced the mill to review their options to improve the operation of their bark-fired boiler. Most of the logs for the mill is sea floated from the mainland and this makes the bark extremely wet and does not burn well. At this time a project was under way to install a new wastewater treatment plant that will produce primary and secondary sludge. Since the property did not allow for land filling of the sludge, disposal became a concern. KMW's solution was to design a combustion system in 1994 that would use the sludge as biomass fuel. The mill also generates other biomass waste from their operation such as knots, wood fines and carbons from the flyash collector. The combustion design allowed for consumption of all the various forms of biomass waste, thus solving a multitude of the disposal problems for the mill.

To eliminate the wet bark problem for the existing power boiler, the heat produced by the combustion was ducted in to a dryer to pre-dry and condition the bark before transport to the boiler. The result of this was not only less boiler emissions due to improved fuel for the combustion but also improved steam generation reducing the need for fossil fuels. The total consumption of the mixed biomass is 220 tons per day.

Write up derived from an October 2003 speech by Eric Rosen, President of KMW Systems of London, Ontario given in Toronto titled *Moving Towards a Sustainable Business.*

8. CPIG Power at Cudworth

The CPIG project is a full-scale commercial demonstration project that processes liquid hog manure into renewable energy, fertilizer and greenhouse gas credits. The large-scale facility uses bacteria to digest liquid pig manure anaerobically to make biogas. The biogas is then used by SaskPower to run two micro turbines that generate electricity and heat. The hog barn provides the raw material – hog manure – and in exchange gets heat for the manure digester and the barns as well as other benefits such as the compost-style fertilizer that is a byproduct of the digestion of the manure.

Construction started on the project in mid 2003 and the first phase was completed in early 2004 and began delivering power into the Saskatchewan power grid before midyear. That first phase produces 120 kilowatts or about enough power to meet the needs of 30-40 homes.

Using the biogas created from manure to produce power holds economic and environmental potential within our province's growing hog industry, and we are excited about the learning opportunities that this demonstration facility will provide for all our partners." said Frank Quennell, Minister responsible for SaskPower at the opening ceremonies of the facility.

Information from http://clear-green.com/may1403.html and from *C3 Views*, the Climate Change Central newsletter, Issue 8, September 2003, p. 4.

9. Sawmill Cogeneration at Middle Musquodoboit

Taylor Lumber Co. Ltd. Is located in Middle Musquodoboit, Nova Scotia. The mill produces 10 million board feet per year of kiln dried and heat-treated lumber. During the early 1990's the mill decided on an expansion including kiln drying of the lumber. The heat source for the kiln was reviewed. One option was to size a biomass fired boiler to meet the heat demand from the kiln. However, this option would not consume all their biomass and therefore would not completely solve the disposal issue.

A more attractive option was to take advantages of all the available biomass and size the bioenergy system for not only the heat demand from the kiln but also for electrical power generation. In 1993, KMW installed a Wood Fired Power Plant which produces 20,000 lb/hr (600 Boiler HP) of saturated steam @ 235 psig. The steam plant supplies steam for the kiln and any surplus steam is directed to a steam turbine for electrical generation.

1000 kW to 1150 kW of electric power is produced of which the mill uses approximately 50% and the surplus of electric power is sold to a local Utility Company. Approx. between 21,000 - 25,000 tons of wood waste is consumed annually.

Write up from an October 2003 speech by Eric Rosen, President of KMW Systems of London, Ontario given in Toronto titled *Moving Towards a Sustainable Business.*

10. Paper Mill Waste Harnessed at Kapuskasing

Spruce Falls Inc., a Tembec Company, is located in Kapuskasing, Ontario. This paper mill had concerns about their disposal of sludge from de-ink process as well as sludge from their waste water treatment plant. One option that was considered was to burn the sludge since it contains a high percentage of organic matter. However, the existing older bark-fired power boilers were not designed to handle the significant moisture present in the sludge. Besides the sludge issue, the mill had concerns about their current steam capacity for mill expansions.

A new boiler was designed for the plant based on 3 combustion chambers with boilers mounted directly above the combustion chambers. The biomass firing the new boiler system is approximately 27% sludge with the balance consisting of bark and mill residue.

This biomass energy system was installed in 1997 and has a steam capacity of 3x 80,000 lbs/hr. At design capacity, the plant consumes approximately 1,000 tons of sludge, bark and mill residue per day.

Write up from an October 2003 speech by Eric Rosen, President of KMW Systems of London, Ontario given in Toronto titled *Moving Towards a Sustainable Business.*

11. Eliminating Beehive Burners around High Prairie

Buchanan Lumber is a forestry based company located in High Prairie, Alberta. The mill employs 200 to 300 people seasonally and produces over 75 million board feet of product per year. This mill is located in the near vicinity of the town and there were concerns about the pollution from the incineration of the wood waste from the mill operation. The mill was using natural gas as a heat source for their dry kilns. A bioenergy system was designed to consume all the biomass residue thus eliminating the need for a beehive burner. The generated heat is be used for the lumber dry kilns.

The installation of a 1200 Boiler HP Bioenergy system was completed in 2001. Substantial savings in operating costs has since been enjoyed, as the existing natural gas heating system for the kilns is no longer required.

The system consumes approx. 180 tons of wood residues per day, generated from the saw milling and planer mill operations.

Write up from an October 2003 speech by Eric Rosen, President of KMW Systems of London, Ontario given in Toronto titled *Moving Towards a Sustainable Business.*

12. Wood Waste Gasified in LaRonge

In a sawmill in LaRonge, Saskatchewan, heat and pressure are applied to wood residue to create syngas – a concoction of methane, hydrogen and carbon monoxide. The syngas is combusted to both generate electricity for sale to the provincial grid and to provide heat to the gasification process.

A co-owner of the mill, Brian Zelensky, said “For years, the forest industry has been searching for innovative ways to utilize wood residue that is currently being stockpiled or incinerated . . . Power and heat generation from wood residue suits the environmental, economic and energy needs of a viable forest products manufacturing industry . . . .”

13. Kettleby’s Biomass Heated Greenhouse

In the past a greenhouse operation was usually seasonal thus requiring little or no heating. Today’s greenhouse operations are very sophisticated and run throughout the year. Naturally they have a large heat demand especially during the cold season.

Foothill Greenhouses located in Kettleby, Ontario, is a 10 acre operation producing approximately 5 Million cucumbers annually. Originally, the heating system was steam based but a gradual switch to hot water system nearly completed. The concerns for higher energy costs, surpassing labour costs that previously was the largest expenditure, lead to the decision to install a new

biomass fired hot water boiler system. The system was started up in June 2001 and is sized for 20 million Btu/hour (or 600 Boiler HP).

The biomass fired energy system produces approximately 70% of the total energy required for their operation and consumes 40 tons per day of wood waste that is acquired from two local sources. The displacement of 2 million cubic meters of natural gas annually yields significant cost savings.

Write up from an October 2003 speech by Eric Rosen, President of KMW Systems of London, Ontario given in Toronto titled *Moving Towards a Sustainable Business.*

New Flagship Projects

1. Mountain Pine Beetle Consortium

Presented by Henry Benskin, Acting Deputy Chief Forester, Province of British Columbia

We've heard references to the Mountain Pine Beetle problem several times during the proceedings so far. It is arguably one of the biggest and most pressing problems in Canada at present. We have a burning platform now in BC – and who knows where it will spread to next.

There is great potential for the Mountain Pine Beetle challenge to be used as a launching board for our bioenergy strategy and for several very interesting reasons. It will afford bioenergy initiatives a great deal of potential visibility and opportunity.

The scope of the problem is 420 million m^3 of pine killed in the province—by 2013 it is predicted to rise to 1 billion m^3.

Developing this opportunity will demonstrate a wide range of technologies but we will have to be sure that when we examine the various technologies the potential for breadth doesn't paralyze us into doing nothing.

Of the several options for dealing with MPB affected feedstock, two are:

1. A fairly well defined project is a 300 megawatt power plant. A feasibility analysis has already been written and published on the BIOCAP website. A fine team of researchers have been involved in this.

As for the site of the plant—meeting a mosaic of challenges will determine the best site (i.e., existing forest industry uses, other resource uses, transportation considerations, etc.). The challenge will be to find a way through this mosaic.

The security of supply is important—the BC Minister of Forests is working on defining 50 million cubic metres of supply over the next few years.

2. Another project is increased pellet production for export—not only overseas but perhaps useful in exploring synergies with Alberta — particularly exploring opportunities to offset the use of natural gas.

In BC and elsewhere, governments are looking at options for new green energy sources. In BC, BC Hydro is launching a green power initiative; the BC Ministry of Forests and Ministry of Energy, Mines and Petroleum Resources are also keenly interested. There is also increasing interest from communities, First Nations and others.

We think these projects are feasible and will create awareness of bioenergy opportunities — the future will lie in the market.

2. Integrated Cattle Biogas

This project already exists and biogas from cattle projects are standing on their feet right now—such as the Integrated Manure Utilization System in Vegreville and Clear Green in Saskatchewan. We're making biogas already all over the world and we should be shining a spotlight on this.

What these groups do need, however, is pre-competitive cooperation or networking in some areas of technological development and that network will afford our industry to expand into the larger scale biogas markets.

Without taking away from any of the other projects that are new and exciting but have large dots on them, we have to shine the spotlight on biogas as an industry and as a network within the sub-industry but also link back to the broader bioenegy industry that creates a lot of links between the various value chains involved.

Don Simpson, Facilitator: We kept hearing yesterday that there are some good projects out there. This group is saying that it wants to draw these investors' attention to some good things that are going on. But you could use some help and again, the help is around. Networking on technology and selling the story – letting people know what's going on.

3. Prairie Biofuel (Syngas) Centre

In anticipation that we would be working in the prairies, we picked the area of straw production. We are looking at gasification to make syngas. We plan to use this syngas to link into the Ipsco Inc.[2] plant in Regina.

We want a technology here that is robust and reliable. We want to open the opportunity of introducing another feedstock.

We have chosen a two year project life. It will cost roughly 25 million to build the plant and 2 million per year for operating it. We anticipate paying $40 per ton for straw feedstock. On a daily basis, we determined 100 tons of syngas would be produced. For a company like Ipsco, that is a mini-mill that makes steel, we think they would be interested in using syngas as opposed to their current use of hydrogen and natural gas. This would be worth $20,000 per day.

We anticipate that, when we reduce the $20,000 per day by our feedstock cost and the amortized capital costs and the operating costs, we will realize about $8,000 per day or about 67 percent return on investment.

One issue we have to deal with is the production of ash. In an iron mill they use lime for fluxing. Maybe there would be a way we could link in that need with the use of the ash.

The technical risk that we want to address in this demonstration is — can we actually run the gas fires 365 days a year, 24/7? We understand that that has been the most challenging part of any gasification project using biomass. Can you get that kind of reliability, dependability, in day-to-day operations?

With Ipsco being the interested party here, we would locate the plant right next to them. There is a limited risk with feedstock in terms of availability, would be only if there was a bad year [for straw production]. We anticipate that Ipsco would be the investor. The longer-term target market for this kind of un-clean, dirty syngas is going to be mini-mills in North America. But, we also see a potential to start spinning this out into other kinds of projects that would start using syngas to make other products as well.

The broad impact is that we think we can make steel cheaper, we can us this waste straw, provide a benefit to farmers, provide local employment and the production and use of a “green”

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[2] The company known today as "IPSCO Inc.," one of the world's leading producers of steel plate and pipe, began its corporate life in Regina, Saskatchewan on July 13, 1956 as "Prairie Pipe Manufacturing Company Ltd. The Company is recognized for its leadership position in both the steel and energy tubulars industry and looks forward to continuing its Canadian success on a larger North American stage. Through its unique perspective on Canadian and US public policy issues, it has made major contributions to environmental and trade issues in the two countries and continues to take an active role in public and community affairs.

gas. If we are successful, then this will lead to a technical breakthrough of being able to operate this kind of facility 24/7, 365 days a year.

4. Wetlands Biomass

Presenter: Hank Venema, International Institute for Sustainable Development

Our project builds on the idea that was expressed here earlier with the Mountain Pine Beetle example—the idea that bioenergy can solve complex environmental problems.

What we are proposing is that wetlands biomass utilization introduces bioenergy as a kind of style of ecological engineering that transforms a procession from an obscure branch of thermal chemical engineering to fundamental ecological systems engineering and design.

A specific example of that is the Netley Marsh at the mouth of the Red River on the southern shores of Lake Winnipeg. Lake Winnipeg, Canada's sixth great lake, suffers tremendous eutrophication problems from the nitrogen phosphorus loads delivered by the Red River. There is a highly degraded, once highly productive, coastal wetlands there that is in terrible shape. A rehabilitation plan done by the province of Manitoba 25 years ago showed that you could revitalize this very important ecosystem. However the cost benefit analysis of that revitalization was terrible.

We looked at this problem and by inserting a bioenergy component into that marshland revitalization scheme we were able to transform that cost benefit analysis from about .3 to 2.5.

What we've done (and this could be about a 20-50 megawatt scale bioenergy system that was using wetlands biomass feedstock harvested annually) is reduce nitrogen and phosphorus loads to Lake Winnipeg and produce this annual feedstock harvest.

We've demonstrated how very complex non-point-source environmental problems can be addressed, making a profit, while serving water quality objectives, biodiversity objectives and habitat objectives. This is a very important placing of the potential for this bioenergy sector and there are some very key innovations that come out of this such as ecological design and ecosystem design principles and how to solve these complex ecosystem problem with bioenergy as a key component.

We have fortunately great engagement from the academic sector to pursue this at an experimental scale. But, what we need are resources to move from that academic research scale to the pilot scale. We need a facilitative regulatory environment, particularly through the

Department of Fisheries, that would allow us to pursue this even a pilot scale; to start to transform perceptions of what elegant ecological engineering looks like with bioenergy.

5. Combined Heat and Power & Agri-Fuel Bioheat

Presenter: Roger Samson, REAP Canada

Our presentation is designed to solicit your enthusiasm for excellence in energy. We have merged two groups: the *Combined Heat and Power Small Scale* and the *Agri-fuel Bioheat* projects as we feel the two projects are highly compatible.

Agri-Fuel

Many owners of commercial operations such as greenhouses are looking at incorporating small scale heat and power to provide their own energy and to sell surplus energy to the grid.

Our concept is that farmers in Canada can become major energy producers.

Most people, business and indeed major cities in Canada are located in agricultural zones. The cost of getting biomass from farms to these markets seems to be advantageous. Just to note, in eastern Canada there is a severe limitation in using forest products for bioenergy due to lack of supply.

What we know from existing biomass uses is that heating is the primary market for biomass that is economically viable and we are trying to bring more commercial opportunity to that market. Commercial heating applications for industries such as greenhouses are ideally suited towards using agricultural fibres for fuel. They are located in rural areas and the farm sector is familiar with handling identified biomass, for example livestock feed.

One of the major issues is the diminishing supply of quality biomass for biomass combustion. We need to work on enhancing the feedstock supplies and the quality of that biomass. And perhaps we should consider introducing quality standards for biofuels.

From an economic standpoint, we are seeing emerging industries. In southern Ontario one farmer is already selling 1,500 tonnes a month of agricultural fibres (crop milling residues) for about $115-120 per tonne or about $7 per gigajoule. This compares with the natural gas futures market at approximately $12 per gigajoule or heating oil at $16 per gigajoule.

In a Quebec conference last year it was realized that there is a 25-50% savings to be had by using these bioheat products to replace fossil fuels. Probably the most economically viable displacement of fossil fuels that can occur is using bioheat to replace high grade fossil fuels such

as natural gas, propane or even electricity—some greenhouses in Quebec are being heated with electricity.

We realize there will be some training requirements—engineers need to be trained in using small scale heat and power.

Our project is to transform agriculture from being just a food producer to being an energy and food producer. We can use 7 million tonnes of crop milling residue currently available in Canada to produce densified biofuels for heat related energy applications and we could potentially produce 6 million tonnes of densified grasses. We could eventually take 10 million ha of Canadian farmland and transform it into grasses to provide a major fuel solution.

This would be a 90 million tonne mitigation solution compared to natural gas, heating oil and other fossil fuels for heat related energy applications. This would also contribute to having carbon storage in the landscape and the roots of these grasses.

This is a tremendous new opportunity for agriculture in appropriate regions in the country.

6. Northern Ontario Green Auto/Green Community

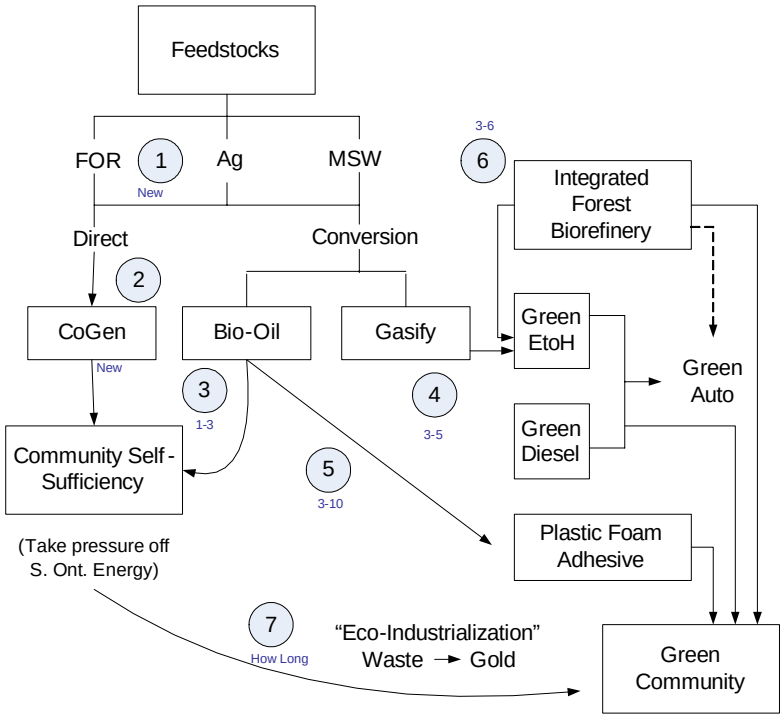
Presenters: Dave Deyoe and Chuck Christensen

We are proposing seven individual projects in the context of our vision.

We anticipate starting in the forest with slash but could also use agricultural biomass or municipal solid waste. We will then convert this biomass using conversion technology to a bio-crude; then take the bio-crude and produce various types of plastics, bio-lubricants and ethanol.

We can handle the bio-crude directly and go into co-generation thereby providing communities with self-sufficiency for energy, taking the pressure off southern Ontario with their huge energy demands.

We can convert the feedstock into a bio-liquid or we can gasify it – the bio-liquid can go into co-generation and also provide community self-sufficiency for energy—there already is a turbine especially designed to use bio-oil so it's here and now and not off in the future.



The gasification project, which is also existing in northern Ontario, is designed to produce green ethanol but it can also produce green diesel – this project would feed directly into the Green Auto initiative by providing green ethanol or green diesel initially and other options later.

Project 5 is a partnership between forest industry and a bio-liquid company to produce phenol replacements for bio composites – the technology is available right here, right now.

7. Combined Heat and Power Initiative for District Heating Involving an Industrial Cluster (Sault Ste. Marie, Ontario)

Presenter: Errol Caldwell, Science Enterprise Algoma

This combined heat and power initiative is for district heating for an industrial cluster and community — Sault Ste. Marie, in northern Ontario. We are talking here about a green power consortium with an objective to provide a hedge against increased and significant heating costs in Ontario for industry and the community.

Sault St. Marie already has an industry cluster already:

- Algoma Steel is the largest power consumer in the community. It is not only a power consumer but also a tremendous potential generator of heat that could be used as a heat source to for other applications

- St. Mary's Paper is a producer of super calendar, very high quality, niche-market paper products. They have heat and power requirements and generate some of that heat internally through their hog fuel usage.

- Flakeboard Company Limited is a producer of Medium Density Fibre (MDF) and related melamine products. The company has heat and power requirements.

- BOREALIS is a major $54 million tourism complex recently announced for Sault Ste. Marie. It is to be constructed on 14 acres. They intend on bringing 200,000 tourists into the Sault Ste. Marie community each year with a boreal forest theme. It will have a 35 thousand square foot geodesic dome with interior and exterior demonstrations of boreal forest themes. They will have a significant requirement for heat. This facility will be a great way to demonstrate this green energy project.

- Municipal water treatment in the west end of the town is also close to this industrial cluster.

- Algoma Steel and CNA, a German company, have entered into an agreement to produce components for wind turbines. West of Sault Ste. Marie there is a significant wind energy installation being built funded through Brookfield Power.

Along with this industrial cluster there are other opportunities for growing this green energy opportunity, as long as the prospective parties know they have a good affordable supply of green energy in that cluster. In terms of affordable biomass which is obviously essential, I think we are looking at a mix of biomass here. We have got some access to forest biomass, whether it is Crown of privately based, we have a growing opportunity to look at agricultural biomass through the production of wheat, reed canary grass and other energy agricultural crops. Municipal waste is another source of biomass. The thing to keep in mind with Sault Ste. Marie is the logical bonus we have here. We are on the Great Lakes transportation corridor and therefore have access to very cheap water transportation. There is a tremendous opportunity to pick biomass up from around the Great Lakes and transport it to this kind of industrial cluster facility.

The Sault College is heavily involved with Brookfield Power in establishing a wind energy technology program. They are also very interested in getting involved in training in the bioenergy area.

To summarize — what we are looking at here is technology integration and a business model that needs to be developed for green district heat and power.

A bit further down the road (3-6 years) is a project for integrated bio-refineries. It involves integrating bio-bas or gasification systems into existing pulp and paper mills to diversify their product stream from just paper to ethanol and other products.

In conclusion we will be looking at the different types of initiatives we can undertake in terms of analyzing what the waste streams are, what can be done with those waste streams, how they can be entered into the community fabric and what are the types of people who are interesting in coming to play in this game. Eventually what we will have is an eco-industrial model of what we can do right now and what we can do in the longer term to establish a Green Community.

Chuck Christensen is with a company setting up a plant to convert biomass to ethanol. The company is presently seeking investors.

What is interesting about this model is that there is an opportunity for companies to work individually—to do a business plan, sell equipment, and get returns for their investors. There is also an opportunity for competition and competition. Additionally there is an opportunity for collaboration.

My company anticipates that we will be using some of the technologies presented here. Initially we'll be using existing technologies, but as other technologies get developed and refined and more economically viable we will start integrating them. The best solutions for biomass, although we may not know what they are today, will shake out through this process.

There are existing opportunities under each one of these seven projects to make money and when you make money that's what puts things in motion. We anticipate that the first ethanol plant will cost approximately $300 million so it's a big chunk of change. However, private investors are very interested in investing as the return is very attractive – approximately 100%.

There are also opportunities for everyone from farmers to investment bankers to invest in this opportunity. We anticipate a 30-month schedule to build the first plant and get the plant up and running, with the first return on investment with three years.

8. Biogas for Extraction of Oil Sands

Presenters: Steve Moran, Alberta Research Council and John Fisher, Dupont

The Fort McMurray Oil Sands project is the largest investment in energy production in Canada. Unfortunately the way this process works is that it uses a great deal of natural gas. We are not sure how much and that is one of the things we need to find out. But it is a large amount—to the point where it was once suggested that the Mackenzie pipeline would carry enough to support Fort McMurray, but it wouldn't go past there.

This puts pressure on the petrochemical industry elsewhere in the Province. It also ties the price of bitumen derived crude going forward to the price of natural gas—so as the price of natural gas goes up over the next 20-30 years, bitumen prices will also go up.

So what is the opportunity? In Alberta, energy operations across the province produce a great deal of waste forest material. It has been suggested by an unofficial and un-attributed source that it is in about the same order of magnitude as the annual allowable cut for the province. There is a

good deal of clearing for mines, for roads, for pads and for pipelines, which is producing a continuous stream of biomass. This biomass, we believe, lends itself to gasification to replace the natural gas that is being used to power the steam assisted gravity (SAG) drainage operations and for upgrading to produce hydrogen. And, we think there is a great opportunity here for a bioenergy product with the major driver from the oil sands.

So, as you can see this is a project that has a huge business pull associated with it. This is not a technology push – investors need to get on board quickly here while the opportunity exists. What we are looking at is a technology demonstration of the gasification at a local mine site to generate the steam and replace the natural gas. This involves a prototype right at the mine site. It will be in the order of somewhere under $10 million to put the prototype in place. Once that prototype has been established and proven and the economic uncertainty associated with scale-up established for using syngas to replace natural gas (and you know how much you can back off on natural gas without any major modifications to the steam generation), then you can make a decision whether you would look at a distributed network of these units or a single large facility. The single large facility would incorporate a collection of biomass at a central facility and then feed the syngas into the natural gas pipeline.

Operating costs on an annual basis for this demonstration are probably in the order of less than a million dollars so it's a relatively small investment there.

In terms of risk, we are probably looking at more of an economic risk in understanding the scale-up and the limitation of the technology (i.e., how much gas can you displace without doing modifications to your steam systems). Technology risk is probably one of the other extensions in long term operability of gasification. This risk is something that will be addressed by this prototype as well.

In terms of leverage points, this is really a multi-generational project. The first generation is what we call "low-hanging fruit" – natural gas displacement by biogas. But, then we can look at separating a hydrogen slip-stream from that biogas to produce an upgrading of the bitumen at the site, as well as tying into biomass feedstock to generate pyrolysis liquids which could be used then to displace petroleum distillates, which are used for viscosity reduction at the bitumen stream to the upgrader.

So you can see now, we can start to get the largest financial driver in Canada pulling the bioenergy sector, the bioproducts sector, along with it. We see it as a really great opportunity.

9. Pyrolysis Biorefinery

Presenter: Ed Hogan

Canada is a world leader in this area – basically we have an industry in this area that no other country has so we are the world leaders.

Going into Renfrew in the next weeks, months whatever and xxx a pyrolysis plant. And what we're going to do here is take some of the residues from the area's power lines into bio-oil. What will make the project work right now are the multi-products such as food flavourings, brown heat and everything else.

It is a big breakthrough that we have all the natural resins. Basically what we've been able to do is pull out the xxx that will replace the formaldehyde...

So these guys now will be extracting all these products and what's left over will be go into bio-fuel that will be used for heat and power in the area.

What's nice about this too is that with BIOCAP and others we are now buying into next generation technology, for example we have UBC now taking these things and looking at xxx . As some of these technologies come around and get developed commercially we'll be able to feed them into this biorefinery.