



Towards a Biobased Economy

Issues and Challenges Paper

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Executive Summary

In Canada there is an increasing interest in shifting to a biobased economy, which relies on biomass, such as agricultural crops, mill waste and fast-growing trees, instead of fossil fuels. Such an economy builds on Canada's existing strengths and industries while holding out the promise of a cleaner environment and increased energy security.

Industry Canada commissioned Pollution Probe to prepare this report on a biobased economy for two reasons. The first is to outline some of the issues around the production and use of bio-fuels and products. The second is to act as a catalyst for dialogue about those issues among representatives from universities and industries, as well as environmental and health groups and farm organizations. The hope is to have such a dialogue early in the day to make sure that a biobased economy solves problems rather than creates new ones.

To research this report, Pollution Probe talked to representatives of industry, environment, university, research and farm organizations across Canada. The researchers asked each person interviewed questions based on seven topics — communications, land use, biotechnology and genome issues, research and development, commercial development and marketing, governance and policy framework, and the importance to Canada's economy and the environment. Not surprisingly, given the breadth of each topic, the people interviewed raised many issues, but only one came up repeatedly, either directly or indirectly — the place of genetically modified organisms in a biobased economy.

- **Genetically Modified Organisms:** The women and men interviewed were generally receptive to the idea of a biobased economy that included the usual protections for the environment provided by civil society. They were divided over the issue of genetically modified organisms, specifically whether or not they could or needed to be contained. And if it was possible to contain genetically modified organisms, how long was long enough? When would Canadians know whether the level of risk was acceptable and manageable or too great, for example, to permit genetically modified plants to grow outdoors, if at all?
- **The Role of Governments:** Almost all of the men and women interviewed said governments had a role to play, especially in the early days of a biobased economy. What the primary role was — protector or promoter — depended on who was talking. Some said governments should promote the biobased economy by providing tax breaks. Others said governments should be the protector by, for instance, regulating the use of genetically modified organisms and establishing protective policy frameworks. One representative said governments could play both roles provided they worked within an overarching policy framework.

- **Policy Framework:** Canadians need a policy framework that reflects the benefits and drawbacks of a biobased economy, as well as explains and orders the roles of governments. Such a policy framework would set out governments' priorities and give Canadians a big picture perspective so they could make informed decisions about the new economy and biobased industries.
- **Communications:** Almost everyone interviewed identified the need for better communications and thought governments should either lead or play a major role. Some said governments should promote a biobased economy in Canada and abroad. Others said governments should organize public consultations for stakeholders to explain in an honest way the technologies, ethics, benefits and costs of biobased industries, and to distinguish between the technologies that include genetically modified organisms and those that do not. Further, one representative said a multi-stakeholder group would have to prepare the educational materials for public consultations because no sector — government, industry, research or environmental — had the trust of the general public.
- **Research and Development:** The issue for non-government organizations was the imbalance of existing research. Right now, governments and industry are investing money in researching the technology required for a biobased economy, but are not adequately researching the environmental protections needed in such an economy, especially when the processes and products involve genetically modified organisms.

Other issues were identified, including the brain drain and the possibility of losing Canadian research to foreign companies, as well as the technologies that do not involve genetically modified organisms but do need to be part of ongoing public consultation because they may impinge on the environment or the lives of people.

Next Steps

There is much that is promising in a biobased economy, not the least of which is shifting the energy used for industrial production from fossil fuels to bio-fuels. But as the results of this report suggest, there are areas of real concern, which, if ignored, have the potential to polarize stakeholders and public discussions. The next step after this report should be consultation with stakeholders to find common ground on what can and should be done, and to identify needs for further research and discussion.

Introduction

Industry Canada commissioned Pollution Probe to prepare this report for two reasons. The first is to outline key issues around the production and use of bio-fuels and products. The second is to stimulate a dialogue about those issues among representatives of universities and industries, as well as environmental and health groups and farm organizations.

The Benefits of a Biobased Economy

A biobased economy can build on some of Canada's strengths and existing industries — agriculture, forestry and biotechnology — while at the same time protecting the environment and holding out the promise of energy security. Important benefits include the following:

- Cleaner air because biobased fuels generally burn more cleanly than fossil fuels;
- Fewer emissions of greenhouse gases, such as carbon dioxide and methane, associated with a changing climate;
- Lower risk of oil spills in the ocean, inland waterways and highways;
- More easily degradable and less toxic wastes;
- Economic renewal of rural communities; and,
- Creation of new technologies, products and jobs through the production of advanced and specialty biobased chemicals, materials and pharmaceuticals.

On this last point, the list of materials and products that can be made from renewable biological resources instead of petrochemicals is impressive. Cosmetics, shampoo, crème rinse, adhesives, solvents, plastics, paints, fabrics, fuels, fertilizers and pesticides, as well as lubricating oils, biodegradable packaging and composite construction materials, such as fibreboard, are some of the products now available or under development.

Governments in other countries have noted the potential benefits and have already taken steps to foster the growth of biobased economies. In Germany, for example, a supportive tax policy has resulted in anticipated sales of 750 million gallons of biodiesel automobile fuel in 2002. In Brazil, 30 to 40 percent of vehicles are powered by 100 percent ethanol that is produced from sugar cane. Brazil's substantial consumption of this biobased fuel, roughly four billion gallons per year, is largely attributable to a law requiring 20–24 percent ethanol in cars. In this way Brazil reduces its dependence on expensive foreign oil. In Scandinavian countries, governments are encouraging the use of fast-growing trees such as poplar, willow and aspen to make paper products and composite construction materials. By using these trees for such products, the governments are not only helping to grow a biobased economy but are also helping to preserve their forests.

The United States is working towards tripling its use of biobased products and energy by 2010 in an effort to reduce greenhouse gas emissions by 100 million tons. To reach that goal, the federal

government has issued a 30-point plan. It includes incentives to help industry create and adopt the technologies needed to make bio-products and energy cost-competitive with fossil fuels and petrochemicals, as well as policy actions, such as tax incentives, that support the industry. In addition, the federal government will increase its purchases of biobased energy to five per cent, and of biobased products to 10 per cent, by 2010.

In Canada, governments, industries and universities involved in the research, development and production of bio-fuel and products want to keep pace for many reasons — one of which is the prospect of a cleaner environment. They are also keen to prevent the technologies invented, tested and proved in Canada from being bought and commercialized overseas.

The Concerns About a Biobased Economy

Many environmental and other non-government organizations (NGOs) support a biobased economy, but they have concerns about biotechnology, bio-fuels and bio-products. Some representatives of NGOs interviewed for this report were worried that the enthusiasm for a biobased economy simply masks the underlying problem of constant economic growth and expansion. To paraphrase one environmentalist, growing smarter is still growing. The question for these interviewees is how much growth can the Earth sustain?

Almost all environmental groups and NGOs interviewed were concerned about the lack of a comprehensive policy framework to guide the development of both biotechnology and a biobased economy. They were particularly worried that there is no framework for dealing

with plants, such as corn and soy, that are being or have been genetically modified to give them the traits needed by industry. Are the risks of genetically modified organisms manageable, or are they so great that they cannot be mitigated? Can these plants be contained so that their pollen does not contaminate other plants, and if so, how can they be contained?

Similarly there were concerns about the lack of a policy framework for land use in rural Canada. What happens when one industry moves into an area and buys up the land to grow crops needed as feedstock? Rural Canada could end up with a number of one-industry towns based on, for example, the production of biobased fuels from corn, which in time and for much the same reasons, could share the fate of similar communities based on mining or forestry. There are other related questions that follow when land is used to grow crops for industry:

- What happens to biodiversity when thousands of hectares are devoted to one crop?
- Will Canada lose the ability to feed its people, at least in part, from its own crops when land is dedicated to crops for industry?
- Will the soil deteriorate because some bio-products use the parts of the plants or trees once left behind to decompose and nourish the soil?
- Will local communities suffer when tracts of land are planted with fast-growing trees, such as aspen, willow and poplar, that draw more water from aquifers and groundwater than slower growing trees?

How This Report was Researched

To research this report, Pollution Probe talked to representatives of industry, environment, university, research and farm organizations across Canada.

The researchers asked each person questions based on seven topics. Not every person interviewed answered questions on every topic:

- **Importance to Canada** — How important is the development of bio-products and fuels to Canada's economy and to its environment?
- **Research and Development** — What has to be done to nurture research and development in this area? What are the roles of the different sectors? How can each help stimulate research and development of new products and technologies?
- **Biotechnology and Genome Issues** — What are some of the issues centering on biotechnology, specifically genetically modified organisms, and what needs to be done to allay the public's fears or mitigate the risks?
- **Commercial Development and Marketing** — What has to be done to get bio-products and energy that have been invented, created or developed in Canada into production and then to the market? What needs to be done to prevent these new products or ideas from being bought and developed in other countries? What are the current regulatory or tax barriers to a biobased economy?
- **Land Use** — What are some of the issues over land use that will arise as the economy shifts to bio-products and fuels? For example, what happens when companies start buying the land in one area to grow one crop to use as feedstock for its product? Will land use policies be set by the province or territory or by the municipality?
- **Policy Framework, Regulation and Governance** — What policies and regulations should governments put in place to protect Canadians and the environment and to foster the research and development of bio-industries?
- **Communications** — How important is communications? What needs to be done? Who needs to be engaged and by whom?

Industry

Importance to Canada

All the industry representatives interviewed agreed that the development of bio-products and fuels was important to Canada and its environment. A biobased economy is logical for a country with a lot of arable land as well as mature agricultural and forest industries. In addition, most of the low-hanging [easily accessible] fossil fuels have been picked, said one representative. The issue was not scarcity, but cost. In the future when extracting fossil fuels from tar sands and seabeds becomes more expensive, biobased fuels would become more cost competitive.

Commercial Development and Marketing

The governments have various roles to play in the commercial development of biobased industries. But, the preferred role changed depending on who was speaking. One representative said Canada needs an intellectual property policy framework and a pan-Canadian approach to innovation before commercial development can take off. For its part, the industry needs to develop more company builders and leaders, as well as find financing from venture capital.

Another industry representative said the industry needs government support as a facilitator and as a source of information. Governments could assist by learning about the technologies being developed in other countries and passing that information along, as well as by helping the industry to get organized. Right now the industry is fragmented and there is some duplication of effort. Governments

could provide opportunities for companies and researchers to meet and talk at workshops or trade shows. The representative also said governments could help the industry by providing incentives. He cited the example of Scandinavia, which has imposed a carbon tax and provided other incentives to increase the amount of bio-energy used. In Canada, incentives are needed to mitigate the cost of transporting fuels made from plants and trees, which grow in rural areas, to markets, which are usually in urban areas.

Yet another industry representative said governments must help Canadian companies that have invented new bio-processes and products to develop them here so they — the companies — do not sell to foreign industries. He stated the governments should alter the corporate tax structure, reduce taxes on bio-fuels and change their procurement policies to boost biobased industries. He also said governments should attend every international trade show to sell the country and market its biobased industries.

Research and Development

As with the question of commercial development and marketing, questions about research and development elicited a variety of responses. One industry representative said that research and development was important to the economy, but not as important as commercial development. Nonetheless, governments could help research and development by supporting biobased industries as they — governments — had supported the film industry. Another industry representative said research was

vitaly important and must be funded with long-term grants. Research needs windows of opportunity that are larger than two or three years, especially for studies on forests, some of which require decades. A third representative took another tack. He said the first priority was to give researchers an appreciation for the breadth and width of a biobased economy, help them see its potential and their roles in it, then fund the research. He said governments, industries and universities must cooperate for research and development in bio-fuels and products to succeed.

Biotechnology and Genome Issues

To questions about biotechnology and genetically modified organisms, one representative said the risks were real but not significant — for two reasons. First, many biobased products are natural, coming from plants. Second, some of the proteins needed by industries for their products do not require vast tracts of land.

Another industry representative looked at the opportunities afforded by bio-products and fuels to preserve old growth and natural forests by sourcing raw materials from fast-growing trees, mill waste or the slash left after clear-cutting. (Slash is the term used to describe the small branches, needles and bark that are removed when trees are cut and prepared on-site for transportation to the mill.) Lumber companies have typically left the slash behind to decompose and replenish the soil. Today, some companies have started to use it as fuel for boilers or to process it into fibreboard, he said. Other companies have planted fast-growing trees as raw material for bio-fuels and products.

While considered more expensive than using slash or the waste from lumber mills, this has the advantage of location as they — the companies — can plant trees close to the processing plants or on previously non-productive or marginal lands.

Land Use Planning

The sheer number of jurisdictions having some say, however remote, in land-use planning could be a deterrent and was certainly a consideration for companies making bio-fuels and products, said one representative. But for some rural and remote communities, the advantages of using bio-fuels could over-ride that. Right now many of these communities use diesel fuel, imported at considerable cost. By turning to bio-fuel they could reduce their reliance on fossil fuels, employ local residents to process the bio-fuel and keep the community's money at home.

Communications

One of the first jobs was to define the terms commonly employed in a biobased economy, according to one representative. Some people confuse the processes and products used in a biobased economy with genetically modified organisms and biotechnology. A biobased economy, which might include biotechnology, is about changing feedstocks and processes to make products and fuels. A generally agreed upon terminology is needed, and that terminology needs to be communicated widely. Another job is to collect and disseminate the information about the biobased economy and related products and fuels, perhaps by using the Internet.

Universities and Research Organizations

Importance to Canada

There was general agreement by the university representatives interviewed that a biobased economy is important to Canada. First, it is fueled by renewable resources, which is the right direction to go. Second, Canada is unique in the world because of the scope and diversity of its resources. This gives the country's researchers the flexibility to experiment with new technologies using a variety of sources of biomass. Third, a biobased economy moves the country closer to reducing its emissions of greenhouse gases, such as carbon dioxide, and creates carbon sinks that absorb carbon dioxide emissions. Fourth, a biobased economy builds on Canada's existing strengths and industries — agriculture, forestry and biotechnology. Finally, it increases Canada's energy security. After the events of September 11, 2001, energy security has become a major objective in North America. One representative also called a biobased economy key to Canada's economic development and said Canada has a global responsibility to invest in this economy because of its vast resource base.

Research and Development

Not surprisingly, research and development figured heavily in the conversation of this group. One university representative said Canada came up short in research and development when compared to other G-8 countries — the United States, Japan, Italy, Great Britain, France, Germany and Russia. Canada should invest more of its gross national product in research and development. As worrisome, he said, is that universities are losing their bright young researchers — in particular

engineers — to the private sector because academic institutions cannot match the salaries industry offers. At the end of the day, the lack of researchers and professors could stymie the development of new technologies.

For the time being, though, universities continue to be seats of innovation because they understand the importance of the issue. The need now is to reach out to other sectors, such as government, industry and environmental organizations, to exchange information and discuss how each sector can play a part in the new economy. Sharing information reduces the possibility of researchers working in silos unaware of what is going on in different, but connected, silos and being completely oblivious to the ethical and moral concerns their research is raising. On this last point, one representative said science and engineering students should be required to take courses in ethics and social issues.

Commercial Development and Marketing

All of the university representatives agreed that governments have a role to play in boosting commercial development to keep Canadian research in Canada. The suggestions ranged from funding pilot projects to providing tax credits and supportive tax structures. One representative said Canadians would use bio-fuels only when it makes economic sense, so Canada needs a workable carbon and greenhouse gas credit system that will give companies the incentive to reduce their emissions.

Another representative said there might be some merit in mandating that a

certain proportion of fuel must be bio-fuel. But another representative said such regulations could hinder the development of the bio-economy, because the regulations would put governments in the position of being both the regulator and the advocate. How could governments properly apply the precautionary principle, when one of its jobs is to promote the product or process?

Biotechnology and Genome Issues

Little was said about this area. One representative said at present most Canadians are not as concerned about genetically modified organisms when crops are used by industry as they are when the same crops are used to produce food. But the representatives realized that this lack of concern could change.

Policy Framework, Governance and Regulations

As a framework for a biobased economy, the Kyoto Protocol on climate change is a start, said one university representative. There is a new group of industries that want the protocol ratified because of the opportunities it provides for growth.

Land Use

On land use planning, one representative said issues could arise when companies want to control large areas of land to grow one crop. Historically, companies have not been sensitive to local needs and conditions. Governments might need to provide a combination of regulations and incentives to help companies become good citizens of the communities in which they operate.

Communications

All the university representatives interviewed said better communications are necessary and most said the government is the appropriate body to do it. One representative said communicating about a biobased economy is a challenge because it is a complicated area. She also said communicators must be careful not to link a biobased economy with biotechnology research and industry.

Another representative said governments should promote bio-fuels and products to senior politicians who do not understand what is involved. They need to see the economic analysis on the biobased economy. Governments should also promote bio-fuels and products to farmers. Farmers are aware of the potential value of some crops and their potential for development. But there is a high level of cynicism out there, especially in the west over the “latest new thing,” particularly if it requires heavy investment. If new equipment and technology are needed, they will listen, but they will not be an easy sell.

Farm Associations

Importance to Canada

The reviews by the farm association representatives were mixed. One representative said a biobased economy holds great promise for his members, as it might help them find new markets and uses for their products. Another representative said such an economy has interesting possibilities, but how important it will be to Canada is unknown because knowledge [about it] is limited. For instance, corn farmers might be able to reap new value from corn by using the parts of the plant that they do not harvest for food to make bio-fuels or other products. On the other hand, using 100 per cent of the plant requires multi-faceted processes, and more research and development is needed to determine how to do this economically.

Research and Development

Both representatives interviewed said governments must be involved in research and development. They are doing a good job now, one said, but more needs to be done. The other representative said governments should be involved in stimulating research into the building blocks of the plants. If governments leave that research to industry, then the private sector will own the rights to those building blocks. It is important to ensure the broad availability of those research tools or else farmers will be beholden to the private interests that own them. Even today, farmers see little benefit from improvements to the technology. The benefits are captured elsewhere — not on the farm.

Commercial Development and Marketing

Governments need to develop a long-term vision of sustainable development that should be reflected in economic policies, said one farm association representative. For example, climate change and the increase in carbon dioxide are related to the loss of organic matter, such as trees and plants. When thinking about the potential of new technologies, a holistic vision should take into account not only the economy, but also the need for organic matter. In this picture, it is clear that bio-fuels are a middle step. Training and education should also be part of this vision. The need is to entice young people to return to the farm, he said, adding that agricultural colleges and universities should be located closer to farms.

On the subject of bio-fuels, one representative said governments should help to create markets for bio-fuels. For example, most of the soy crop harvested in Ontario is crushed and used for feed. The crushing also produces soy oil for which new markets and uses are constantly sought. Domestic manufacturing of bio-diesel fuel, which is currently produced in the United States but not in Canada, could offer such a market. While bio-diesel fuel costs more to produce than diesel fuel from petroleum, governments in Canada could make bio-fuels more cost competitive by offering relief from some taxes (e.g., road and capital investment taxes) and by including bio-diesel fuels as an alternate fuel for fleet owners. Fleet owners do not need to modify newer model vehicle

engines to burn bio-diesel fuels, since previous problems with the degradation of engine seals have been overcome. Engine manufacturers now specify the levels of bio-fuels that their engines can burn.

Echoing the representatives from industry and universities, the farm association representative said Canada risks losing some of the products and processes its researchers have developed to foreign companies if there is not enough support to keep the researchers in the country.

Policy Framework, Regulation and Governance

The process for discussing and deciding on the biobased economy policy framework and accompanying regulations should be an open and transparent process in which everyone can have a say, said one representative. Equally important, the technologies used in a biobased economy must be better than those in place now. A bio-diesel fuel refinery must be more environmentally friendly on all counts than existing refineries that make diesel from fossil fuels.

Land Use

If the farming community is to reap some of the benefits of a biobased economy, then the factories need to be located in the country, said one farm association representative. Otherwise, Canadians will continue to be drawers of water and hewers of wood, and badly paid for both. The issue is how to add value while at the same time protecting the environment so that rural communities continue to be good places in which to live. The technologies and uses of the land must benefit the communities, not just the people who own the land and technologies.

Biotechnology and Genome Issues

One farm association representative said there is a need to communicate to the public the risks and opportunities related to genetically modified organisms, especially those used in industrial crops. Governments are doing good work, but they have to communicate the issues or people will think they are hiding something.

In contrast, another representative said the need is to contain genetically modified organisms. If farmers or companies grow these crops for medicines, vaccines or other products, then those plants, including what is left over after they are harvested, must be contained to prevent contamination. There is a need to develop appropriate safeguards. If the crops are grown in the open, they should have a terminator gene so that, if there is an accidental release, it will not affect neighbouring crops.

Environmental and Other Non-government Organizations (NGOs)

Importance to Canada

The answers by the NGOs interviewed to the question about the importance of a biobased economy covered the spectrum from not particularly good for the economy or the environment, to very important, for two reasons. First, a biobased economy is viewed as something that will help move Canada closer to the targets set in the 1997 Kyoto Protocol on climate change. Second, the opportunities afforded by such an economy are particularly attractive for Canada, largely because of the country's substantial resource base and productive agricultural lands, and in part because of the enormous amount of waste average Canadians and Canadian industries produce.

One person commented that Canadians have the opportunity to be world leaders in bio-fuels and products. Other NGO representatives had similar assessments. One said bio-fuels and products have a place in the economy, but are not the panacea some think they are in terms of climate change. Another said that although it is important to make the transition and to stop using fossil fuels, it is as important to avoid the downside of dedicating land once used to grow crops for food to crops for industry.

Another representative said he could not answer the question because no one knows what the benefits are. Bio-fuels and products might serve the public interest, but it is important to make sure they do so before pouring money into them. Canadians need to know the results of life-cycle assessments that calculate and compare the growing, processing and waste disposal impacts of industrial crops with the benefits of the end products. If the net benefit is only marginal (e.g., it takes as much energy to grow, harvest and process the crop as the energy value of the resulting fuel product), the shift may not be justified.

Finally, two representatives said a biobased economy is not good for the environment or the economy. One representative said Canadians already over-harvest forests. A biobased economy could stress the forests beyond what they can bear. Another representative said the new economy does not address the issue of unrestricted growth and the associated demand for resources. The fundamental problem is the need for the economy to grow continually, but growing smarter still means growing. A biobased economy is still growth-oriented. It simply uses different raw materials. And such an economy does not address the growing disparity between rich and poor nations. Now countries are growing corn for fuel. Why not use it to feed people?

Policy Framework, Governance and Regulation

Almost all NGOs interviewed advocated the need for an overarching policy framework, for many reasons:

- To identify what and whose needs will be met by the new technologies;
- To ensure that the technologies are justified;
- To explore the potential of bio-fuels;
- To ensure that the benefits of bio-fuels outweighed all the costs — environmental, social and economic;
- To ensure that there are approvals processes in place across Canada for the new technologies.
- To ensure that research money is invested logically and wisely;
- To ensure that rural and remote communities benefit from biobased industries in their area; and,
- To ensure that the environment benefits, or at least, that it is protected when biobased industries are established.

Research and Development

The comments by NGOs about research and development covered many concerns, with most touching on the desirability of this new economy and some of its products. One representative said that before investing in more research, governments and stakeholders should put a policy framework in place. Otherwise, they might dole out research dollars “helter skelter” into programmes that do not fit together. She also said researchers in this area need to make room for the public interest at the table.

Another representative said more research is needed before money is invested in new technologies. Such research would help to answer the basic questions — what are the alternatives and would the public buy the products? Researchers should also determine if the applications and processes support sustainable development or are simply addressing the symptoms of a deeper problem. An analogy is the development of fat free French fries as a solution to obesity, as opposed to the underlying health, exercise and overconsumption problems.

A third representative said researching the production of ethanol from wood wastes is a better investment than research into biotechnology-based products, such as ethanol from genetically modified corn. Another representative put forward the opinion that there is a big opportunity in researching the use of wheat straw instead of trees to make paper.

Biotechnology and Genome Issues

Most of the NGO representatives were skeptical about the benefits of genetically modified organisms. Any technological innovation that relies on genetically modified plants that are grown in the open makes poor sense, said one representative. There are no acceptable risks because no one knows the ultimate effect of these crops or how these organisms interact with other organisms. He said that anyone thinking of building an industry based on growing genetically modified crops in the open should forget it now. If they are contained, perhaps in a mineshaft, then such crops might be all right. Two other representatives also said genetically modified crops must be contained, with one adding that containment costs would result in a different set of economics.

Another representative said the real issue is not about containing genetically modified organisms. All containment technologies leak, which is a problem for farmers who sell crops to markets that will not buy genetically modified organisms. As long as there are naturally occurring organisms that do the job, there is no need to use genetically modified organisms. He added that companies could polarize debate or discussion about a biobased economy if they use genetically modified organisms in bio-fuels and products.

One representative suggested that this might be an area in which the precautionary principle could be used effectively. Another representative suggested using the less stringent precautionary approach, which identifies the risks and attempts to determine the extent to which they are manageable.

Communications

Most of the NGO representatives said communications around the biobased economy are important and should engage all stakeholders, especially the general public. Most agreed this is not happening. There have been no communications around these issues at all, said one representative. So far the approach has been for the governments to hand out money, then circle the wagons when people ask questions. Two other representatives added that governments and industry are not trying to engage the public. One said governments must provide an honest and even-handed way of explaining the technology. Another said individuals need to be engaged in the discussion because they are affected, especially if companies plan to use genetically modified organisms or to replace native species with non-native species. For example, when fast growing aspens replaced the native lodgepole pine in British Columbia, the water table dropped because the Aspen needed more water than the lodgepole. One representative said the benefits and drawbacks of a biobased economy should be debated in Parliament.

Another representative said the educational materials needed for public consultations should be researched and written by a multi-stakeholder group. Stakeholders have to form partnerships because the public does not trust governments, industries and even environmental groups. But it would be worth it. There is more than science here, although the science, which includes the building blocks of life, is critical. There are social, economic and ethical concerns. The parties involved must lay out the benefits and the risks, and this must happen before long or else the debate will become polarized.

Communications and educational materials, it was argued, should cover not only the science of bio-products and technologies (including the fundamentals about the building blocks of life), but should also include social, economic and ethical concerns. The benefits and risks must be clearly identified in the short term to prevent polarized positions around the issue.

Land Use

Long-term planning is crucial. Governments need to do environmental, social and economic analysis of bio-industries before they move in and start building. One representative expressed concern that without good land use policies, rural Canada could conceivably end up with a number of single-industry towns, which in time could share the fate of other single-industry communities that grew up around now defunct mining or forestry operations. To avoid such scenarios in the new bio-economy, it was suggested that governments could consider requiring companies to post bonds, which they would forfeit if they left. Another representative said rural municipalities should be given more power and that rural land-use management boards should be set up with democratically elected members.

Commercial Development and Marketing

There were two seemingly different perspectives on commercial development. One NGO representative said he preferred not to be stampeded by those who said all would be lost if Canada does not act immediately. Canada needs to properly assess the costs and benefits first and answer the unanswered questions before charging in. He said Canada moved too quickly into genetically modified organisms in food and lost some of its European markets as a result.

Another representative said governments should help companies develop their products in Canada through direct grants and tax incentives. At the same time, the stakeholders need to do a big picture analysis, which includes public discussions. There are many opportunities, but they come with challenges, she said, citing the example of flax straw. Until now the residual straw from flax harvest has typically been burned as it is considered too tough to plough back into the land. However, commercial initiatives in Manitoba and other parts of Western Canada to manufacture fibreboard or building panels from flax, wheat and barley straws is being encouraged. The challenge is that the process requires harsh chemicals and caustic solutions while the feedstock, the flax straw, has a tendency to deteriorate if stored too long.

Key Issues

One of the purposes of this report is to identify the key issues associated with advancing a bio-economy in Canada. Five main themes were identified, but one issue came up repeatedly and elicited the strongest views — the place of genetically modified organisms in such an economy.

- Genetically Modified Organisms:** Regardless of the sectors represented, most people interviewed were generally receptive to the idea of a biobased economy that includes protection of the environment provided by civil society. However, they were divided over the issue of genetically modified organisms. Some environmentalists are adamant that genetically modified organisms for industrial purposes are inappropriate and unacceptable under any circumstances, regardless of final end use. Virtually all of the environmentalists interviewed are categorically opposed to open air growing of genetically modified crops for any purpose. However, there is significant receptivity to the concept of growing genetically modified crops under secure conditions in which the risk of accidental release may be mitigated using various containment strategies (growing in mine shafts, greenhouses or commercial reactors). On this point, a common question arose, specifically, whether or not any form of containment can be deemed reliable over time in preventing the migration of pollen or other genetically modified material through the air, water or soil. It was generally

recognized that contained growing of genetically modified crops would substantially increase the cost of the by-products derived. Clearly, one of the most contentious aspects of this debate is around risk assessment and management. Opponents of genetically modified crops for industrial purposes argue that the risks are simply unknown at this time, and therefore any element of risk is not unacceptable. Even if risks can be adequately determined, the process for agreeing on what is acceptable and manageable will be difficult. Those concerned about the proliferation of genetically modified organisms could fairly be categorized as mistrustful of governments and industry to provide a full and public airing of the issues if commercial development is placed at risk. However, failure to address concerns about genetically modified organisms in a meaningful way and to differentiate genetically modified and non- genetically modified bio-products in the marketplace could very well result in polarized debate that taints all bio-economic developments.

- The Role of Governments:** Virtually all those interviewed believe that governments have a central role to play in the development of a Canadian bio-economy. This is especially true in the early developmental stages; however, views on the role of government varied widely. Interviewees identified a fundamental problem of governments

playing the dual role of protector and promoter. Not surprisingly, industry organizations were more concerned with governments creating favorable conditions for commercialization of bio-fuels and products through tax breaks, procurement policies, and support of research and development. Others argued that governments should be more focused on protecting public interests and the environment by regulating land use, setting guidelines for genetically modified organisms and establishing policy frameworks. One representative commented that it is possible for governments to play both roles provided it works within an overarching policy framework. Virtually all agreed that governments should be involved in communicating the issues and opportunities to the public, industry and special interest groups, and domestic and potential foreign investors.

- **Policy Framework:** The environmental and other non-government organization representatives stressed the need for an overarching policy framework to both assess the benefits and drawbacks of biobased initiatives and define the roles of government. A policy framework would have two obvious benefits. First, it would establish governments' priorities and objectives in promoting a biobased economy, including land use policies, testing and evaluation protocols, investment in research and development of new bio-products and technologies, and so on. Second, a policy framework would provide Canadians with a better understanding of the issues to help them make

informed decisions when planning for the future; for instance, whether or not to support the establishment of biobased industries in their communities. Such a policy framework would require broad input in its development and would incorporate scientific, economic, environmental and social considerations.

- **Communications:** Almost every person interviewed identified the importance of effective communications strategies, given the diversity and complexity of many biobased issues. In this regard, virtually all participants stated that the (federal) government should lead or play a major role. However, it is interesting to note that the suggested nature of such communications differed. Some thought governments should actively promote Canadian biobased opportunities here and abroad through a heightened presence at conferences, trade shows and trade missions. To this end, governments should be equipped with the information and data (tax advantages, market demand, agricultural yields and productivity, supply industries, and relative geography to North American markets) to attract domestic and foreign capital investment. Others said governments should focus on engaging all stakeholders, especially the general public, in consultations about a biobased economy. The purpose of the consultations would be to explain in a balanced and honest way the technologies, benefits, costs and ethical questions associated with various biobased initiatives and to distinguish between the technologies

that rely on genetically modified organisms and those that do not. An objective of such public consultations would be to prevent subsequent discussions and public dialogue from becoming polarized. It was also recommended that communications and educational materials for public consultations be prepared and/or vetted by a multi-stakeholder group because no single sector — government, industry, research or environmental — has the full trust of the general public.

- **Research and Development and Commercialization:** When asked how much priority should be placed by governments on research into bio-fuels, products and technologies, the range of responses was broad. Understandably, those in academia felt that continued funding of research and design must be even more of a priority in future and that the research should be multi-disciplinary. A recurring theme is that research with potentially broad applications and implications is often conducted in isolation or silos. An interdisciplinary approach would provide those working on various aspects of the bio-economy with a greater appreciation of the value of their work in the broader scheme of things.

But industry representatives, while acknowledging and appreciating the important advancements made in Canadian universities and research institutions, generally believe that, when it comes to allocating tax dollars, it is more important to implement fiscal policies in the immediate term that will encourage commercialization of Canadian technologies and attract foreign investment. They were adamant that failure to implement more supportive measures will result in the loss of investment to the United States. An associated problem is that of the so called brain drain, in which qualified personnel educated in Canadian universities relocate to other countries where there are better opportunities in emerging bio-economy fields.

Some people interviewed commented that most of the research to date has focused on the development of new products and technologies and has not devoted enough effort on related environmental questions and the protections needed in such an economy. This is especially the case when the processes and products involve genetically modified organisms.

Environmental concerns were not directed solely at products involving genetically modified organisms. A number of those interviewed identified the need for research and public consultation on the harvesting of biomass from other sources. For example, if lumber companies increase their utilization of slash as feedstock for industrial boilers, as opposed to leaving it on the ground to fertilize the soil, will this jeopardize future forest growth? At this point the answer is not clear, and more investment in long-term research on forest regeneration was

identified as a funding priority.

Unfortunately, research funding does not generally extend to projects that require a number of decades to undertake. On this same subject, one person commented on the need for comprehensive research into the overall eco-balance of Canadian forests to determine if changes in forest practices resulting from an enhanced bio-economy would significantly alter the carbon sequestering capacity of the forests. For example, will harvesting of fast growing tree species for ethanol production or boiler fuel really provide a net gain in reducing carbon dioxide in the atmosphere when compared to using the same land to grow older trees that will be manufactured into durable products?

Next Steps

There is much that is promising in a biobased economy, not the least of which is shifting the energy used for industrial production from fossil fuels to bio-fuels. But as the results of this report suggest, there are areas of real concern, which, if ignored, have the potential to polarize stakeholders and public discussions. The next step after this report should be consultation with stakeholders to find common ground on what can and should be done, and to identify needs for further research and discussion.

People Interviewed

(in alphabetical order by last name)

David Coon — Executive Director,
Conservation Council of New Brunswick

Elbert Van Donkersgoed — Strategic
Policy Adviser, Christian Farmers
Federation of Ontario

Peter Flynn — Poole Chair, Management
of Engineers, University of Alberta in
Edmonton

Randall Goodfellow — BioProducts
Canada Inc. (an Ottawa-based
association with members from industry,
governments and economic development
organizations)

Brian Harvey — University Coordinator,
Agricultural Research, University of
Saskatchewan in Saskatoon

Jennifer Hillard — Vice-President,
Consumers' Association of Canada

Mathew McLean — Board Secretary,
Ontario Soybean Growers

Anne Mitchell — Executive Director,
Canadian Institute for Environmental
Law and Policy

Holly Mitchell — Executive Managing
Director, Peter Christie — Science Writer
and Tina Bailey — Network Facilitator all
of BIOCAP Canada, Queen's University
(BIOCAP is national organization, which
was formed to help Canada meet the
challenges of climate change and reduce
its emissions of greenhouse gases)

Jim Richardson — IEA Bioenergy (an
international association representing
governments and industries)

Chris Rolf — Executive Director, West
Coast Environmental Law Association in
Vancouver

Gord Surgeoner — President, Ontario
Agri-Food Technologies (an association
of agricultural companies that supports
the industry by researching the
productivity of crops and genomics)

Peter Tabuns — Executive Director,
Greenpeace Canada

Mark Winfield — Pembina Institute for
Appropriate Development

Glossary

Biobased products — are commercial or industrial products, other than food or feed, that come from biomass feedstock. These products include green chemicals, renewable plastics, natural fibres and natural structural materials.

Biobased technologies — are technologies that use biomass feedstocks as the raw material for making products or for producing energy.

Bio-diesel fuel — is produced through a process in which organically derived oils are combined with alcohol — either ethanol or methanol — in the presence of a catalyst to form ethyl or methyl ester. The biomass derived ethyl or methyl ester can be blended with conventional diesel fuel or used as a neat fuel — 100 per cent bio-diesel. Biodiesel fuel can be made from soybean oil, animal fats, waste vegetable oils and microalgae oils.

Biobased economy — is an economy based on biological sciences and advances in related engineering disciplines and physical sciences.

Bio-energy — is the energy contained in material produced by photosynthesis, including organic waste. It may be used directly or indirectly to manufacture other fuels and substitutes for petrochemicals and other energy intensive products. The production of energy from biomass, for example, can be direct, that is through combustion, or indirect, that is through conversion into ethanol or through gasification.

Bio-fuels — are fuels made from biomass resources including the liquid fuels ethanol, methanol, bio-diesel, Fischer-Tropsch diesel and the gaseous fuels hydrogen and methane.

Biomass — is organic matter that is renewable. Biomass includes forests and mill residues, agricultural crops and residues, wood and wood residues, animal wastes, livestock operation residue, aquatic plants, fast-growing trees and plants and the organic portion of municipal or industrial wastes.

Biomass residues — are the by-products and waste streams from biomass. They have significant potential for energy and further processing. For example, when solid wood products are made from logs, the residue is bark, shavings and sawdust as well as the spent pulp liquors. Since these residues are already collected at the point of processing, they can be conveniently and relatively cheap source of biomass for energy or for processing into other products.

Bio-power — is the use of biomass feedstock to produce electric power through direct combustion of the feedstock through gasification and then the combustion of the resultant gas or through other thermal conversion processes.

Carbon dioxide — a colourless, odourless noncombustible gas with the formula of CO₂ that is present in the atmosphere.

Carbon sequestering — is the physical, chemical or biological storage of carbon so that it does not reach the atmosphere for centuries or longer. Methods of sequestering include the physical storage of carbon dioxide in depleted oil or gas and biological storage in forests.

Ethanol (C₂H₅OH) — is a colourless liquid that is the product of fermentation. It is used in alcoholic beverages, industrial processes and as a fuel additive. Ethanol is also known as grain alcohol.

Ethanol-gasoline blend — is a blend of unleaded gasoline with ethanol, usually in a ratio of 9 to 1. It is used as a motor vehicle fuel to reduce emissions of carbon monoxide.

Fossil fuels — are solid, liquid or gaseous fuels that are formed in the ground after millions of years by chemical and physical changes in the plant and animal residues under high temperatures and pressure. Oil, natural gas and coal are fossil fuels.

Genomics — is the study of genes and their functions.

Greenhouse gases — are those gases which are transparent to solar radiation but which reflect infrared radiation, or the long-wave radiation produced by the solar heated earth, to trap this heat in the earth's atmosphere. Greenhouse gases include water vapour, carbon dioxide, methane, ozone, chlorofluorocarbons (CFCs) and nitrous oxide.

Methanol (CH₃OH) — is the simplest of all alcohols. It is used for the production of formaldehyde as well as for the production of other chemicals and for jet fuels, anti-freeze and solvents.

Natural gas — is a hydrocarbon gas obtained from underground sources usually in association with petroleum.

Organic — describes chemical compounds that are based on carbon chains or rings and contain hydrogen.

Pharmaceuticals — are drugs and medicinal products.

Precautionary principle — was defined at the Earth Summit in Rio de Janeiro in 1992 as “Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation.”

Stakeholder — is any group or person that derives benefit from or incurs cost in an organization.

The glossary was adapted from US Department of Energy. *Fostering the Bioeconomic Revolution in Biobased Products and Bioenergy: An Environmental Approach*. Golden, Colorado: 2001. Available on [http:// www.bioproducts-bioenergy.gov](http://www.bioproducts-bioenergy.gov)