The BIOCAP Research Integration Program

Research Insights

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BIOCAP CANADA

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The Synthesis Reports discussed in this document were supported by BIOCAP through a targeted research program.

The reports reflect the research findings and opinions of the research team and not necessarily those of BIOCAP Canada.

Launching the *Research Integration Program*

BIOCAP recently launched an innovative new program called the *Research Integration Program* (RIP) to extract and integrate biosphere research insights to better inform policy and investment decisions in government and industry.

The process began in July 2005, when BIOCAP polled stakeholders for questions or issues that could be used to feed a Call for Proposals (CFP); by early August, we used the input to shape 12 questions in the first *Research Integration Program* CFP.

The *RIP* attracted tremendous interest from researchers, with a total of 89 proposals received. The CFP was open to university, government, NGO and private sector applicants. A rigorous, multi-stakeholder review process identified 13 projects for funding; support was provided through a combination of federal (53%), provincial and industry contributions. By December, successful applicants had been notified, contracts signed and synthesis and integration work began.

BIOCAP established 13 project-specific advisory committees, comprised of stakeholders with relevant expertise and a willingness to actively support the project, as strict timelines were enforced. The committees were engaged with the research teams between January and March through teleconference, and by March 15th, just 3 months after project work began, BIOCAP received a total of 14 superb final reports. BIOCAP extends a heartfelt thank-you to each of the research teams for their co-operation with the process and dedication to accuracy and quality; thank you also to the Project Advisory Committee members (listed at right) for their tireless support and guidance.

On April 27th, BIOCAP brought the Program full circle by hosting representatives of the 13 research teams along with over 100 guests from the stakeholder community at the first *Research Integration Forum* in Ottawa. The Forum engaged industry, government, NGO and university representatives who reflected on the 14 synthesis reports that were generated in response to their initial suggestions, provided feedback on how the reports will be used in the months ahead, and offered further guidance on useful next steps and projects for further integration work.

This report offers a summary of insights from each report, along with highlights from the stakeholder feedback and suggested directions for new work; copies of the final reports are available for download at www.biocap.ca.

Sincerely,

Dr. Susan Wood
Associate Research Director
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1. Forest Health and Productivity: Adapting to the Impacts of Climate Change

1.1 Threats and Impacts of Exotic Pests under Climate Change: Implications for Canada's Forest Ecosystems and Carbon Stocks

PI: Shelley Hunt, University of Guelph
Coauthors: Jonathan Newman (University of Guelph), Gard Otis (University of Guelph)

Purpose

A changing climate facilitates the spread and establishment of non-native insect pests and pathogens. In this study, the impact of several potentially invasive non-native forest pests on Canada's forest ecosystems and forest carbon (C) stocks is assessed under a range of climate and atmospheric conditions.

Key insight

The most important single impact of climate change that will permit the invasion of non-native pests is likely to be warmer temperatures. Warmer winters will increase winter survival rates and warmer summers will increase the range over which some pests can produce multiple generations in a single season. Carbon storage will be negatively affected at the stand level through pest induced changes in tree productivity, nutrient cycling rates and tree species composition, and at the landscape scale through pest induced changes in age class structure and fire risk. The greatest impact on forest carbon will likely be by pests that favor the dominant tree species.

What it means

Current knowledge about the specific roles of insects and pathogens in Canada's forest ecosystems and their influence on forest carbon dynamics is incomplete, but supports predictive trends. Additional information on the effects of insect outbreaks on successional pathways, tree growth, C sequestration rates, and soil C dynamics as well as implications for other disturbance patterns such as fire will enhance our ability to accurately predict the scale of impacts. From work completed so far, the best long-term insurance against invasive insects and pathogens lies in management strategies that maintain large areas of intact forest ecosystems, and strive to maximize diversity.

1.2. Combined Forest Management Effect on Landscape Carbon Stock Changes in West-Central Canada

PI: Chao Li, Canadian Forest Service
Coauthors: Jianwei Liu (Manitoba Conservation), Hugh Barclay (Canadian Forest Service), Harinder Hans (Canadian Forest Service)

Purpose

Using a modeling approach, this study examines how the size of the living biomass carbon (C) pool in Canadian boreal forests is influenced by different combinations of forest fire regimes and harvesting rates. The results of the simulations are compared to IPCC values used in international reporting to identify conditions under which forest productivity and C sequestration could be enhanced.

Key insight

Changes in C sink size are largely due to the dynamics of forest age distribution that determine the mean annual increment (MAI), which is highest in young and middle-aged

forests. Increasing the mean forest age through management regimes would not be a good strategy for enhancing C stocks.

What it means
Understanding the impact of disturbances and forest management practices on forest age dynamics is important for achieving C sequestration goals. Emulating natural fire patterns in harvest planning could increase the number of age classes with a high MAI and increase the size of the carbon sink from the IPCC default value for boreal forests of 0.46 t/ha, up to 1.2 t/ha.

1.3 Adapting Forest Management to the Impacts of Climate Change in Canada

PI: Mark Johnston, Saskatchewan Research Council
Coauthors: Tim Williamson (Canadian Forest Service), David Price (Canadian Forest Service), David Spittlehouse (British Columbia Ministry of Forests), Adam Wellstead (Canadian Forest Service), Paul Gray (Ontario Ministry of Natural Resources), Daniel Scott (University of Waterloo), Sue Askew (University of British Columbia), Shelley Webber (C-CIARN Forest Sector)

Purpose
To examine the anticipated impacts of climate change on human and economic systems related to forest management, as well as the capacity of those systems to adapt, with a goal of identifying regions and systems with a high degree of vulnerability.

Key insight
Vulnerability of forest ecosystems may be reduced through integrated assessment of system vulnerabilities, ongoing research in climate change impacts and adaptation science, forest policy, planning and management strategies that incorporate climate change science, enhance risk management capacity and improved networking and communication strategies.

What it means
Current forest policy does not contain adequate provision for climate change impacts and adaptation, but this deficiency may be corrected by incorporation of sound understanding of the biophysical and socio-economic impacts.

1.4. A Conceptual Comparison of Using Bioenergy Options for BC's Mountain Pine Beetle Infested Wood

PI: Amit Kumar, University of Alberta

Purpose
An estimated 1 billion merchantable cubic metres of British Columbia lodgepole pine has been damaged by the mountain pine beetle (MPB). This study evaluates the economic and engineering feasibility of producing bio-ethanol and bio-oil from MPB-killed wood at two locations with differences in density of MPB-killed trees and remoteness of the location from consumer, rail transportation and other related infrastructure.

Key insight
The cost of producing bio-ethanol from a centralized plant using MPB infested wood is competitive with grain based alcohol but the technology for production of bio-ethanol from softwood is still in the developmental stages. A bio–oil plant processing 220 dry tones of MPB-killed wood per day could support a 10 MW power plant if all the bio-oil produced

was used to generate electricity. However, electricity generation form bio-oil is not currently competitive with existing electricity prices in B.C.

What it means
Emerging conversion technology makes production of bio-ethanol from MPB damaged wood an economically viable alternative, particularly if support for a demonstration facility became available in the near term. While bio-oil is more costly to produce, the opportunity to extract high-value chemicals could make this option economically viability.

2. Emission Reductions and Offset Potential in Agriculture

2.1. Whole Farm Modeling to Evaluate Economic and Production Implications of BMPs Designed to Reduce Greenhouse Gas Emissions: Case study of dairy production in coastal British Columbia

PI: Mary Lou Swift, Pacific Agri Technologies Ltd.
Coauthor: Shabtai Bittman, Agriculture and Agri-Food Canada

Purpose
To examine the role of the Integrated Farm System Model (IFSM) to improve understanding of the whole-farm effects of agricultural best management practices (BMPs) known to reduce GHG emissions.

Key insight
Based on a case study of a dairy farm in coastal BC, the IFSM was capable of tracking the carbon and nitrogen dynamics related to the implementation of BMPs for feeding, cropping and manure handling. This provides the basic data needed to calculate farm GHG emissions based on IPCC equations while generating the potential economic returns for producers considering implementing these BMPs on their land.

What it means
The IFSM model is comprehensive in its ability to evaluate nutrient management on agricultural units and the economic costs and benefits of BMP implementation. It is recommended that the IFSM be modified to include a sub-model that fully calculates GHG emissions from a whole-farm context.

2.2. The Potential for Agricultural Greenhouse Gas Emission Reductions in the Temperate Region of Canada through Nutrient Management Planning

PI: Greg Wall, Soil Resource Group
Coauthors: Ann Huber (Soil Resource Group), Don King (Soil Resource Group), Chris Duke (Ontario Ministry of Agriculture, Food and Rural Affairs),

Purpose
To determine the potential for greenhouse gas (GHG) emission reductions in agriculture in the temperate regions of Canada through the use of known beneficial nutrient management practices, specifically those related to nitrogen management.

Key insight
Nutrient management practices that could also have potential for GHG mitigation in the temperate region of Canada were assessed for their value in reducing GHG emissions. Alterations in the timing and placement of nitrogen fertilizers used in corn production,

along with changes in manure handling and storage offered the most significant reductions in GHG emissions.

What it means
The study concludes that full adoption of agricultural practices recommended for nutrient management planning in eastern Canada could lead to reductions in the order of 35% of the annual agricultural soil and manure GHG emissions from this region, and offers additional cost savings to the producer through reduced nitrogen inputs. Full adoption in the near term is unlikely because of the infrastructure costs associated with changes in manure handling techniques.

2.3. Disputes and Dispute Resolution in the Offset System

PI: Alastair Lucas, University of Calgary
Coauthor: Olurotimi Williams Daudu (University of Calgary)

Purpose
Under the proposed Offset System there is potential for a variety of disputes to arise between program authorities (PA), project proponents and interested 3rd parties. This research assesses the procedural fairness rights, relevant alternative dispute resolution techniques (ADR) and judicial review that must be accorded under common law and relevant legislation to proponents and third parties that are affected by decisions of the PA. The research addresses disputes about ownership of sequestered carbon, quantification and verification of GHG emissions reductions and removal and liability for non-compliance with Offset System requirements.

Key insight
Persons directly affected by PA decisions are required under common law to receive basic procedural fairness rights including the right to receive notice of proposed decisions, to receive written reasons for decisions, and to have the opportunity to respond both orally and in writing. Parties to an Offset System dispute should be able to choose from a range of ADR options such as hearings, mediation, and negotiation in order to arrive at an agreement on issues of common concern. Under common law, persons or parties directly affected by PA decisions can challenge decisions through judicial review actions.

What it means
As the Offset System is intended to be market driven, the legal framework should provide quick and efficient mechanisms for dispute resolution. The provision of legislation that specifies procedural fairness rights, and that gives clear guidance on the use of ADR techniques would improve the time and cost efficiency of dispute resolutions. The provision of legislation that provides the right to statutory appeal would grant greater deference to the courts and correspondingly less deference to the PA on specific legal issues such as sequestration contracts and ownership of sequestration rights.

2.4. Offsets for Carbon Sequestration in Agricultural Soil and Tradable Emission Permits for Large Final Emitters

PI: Elizabeth Wilman, University of Calgary
Coauthor: Eduard Vojtassak (University of Calgary)

Purpose
Under the offset program, large final emitters (LFE) in Canada will be required to meet intensity targets. This study investigates the benefits and costs of a GHG reduction

program based on intensity targets relative to absolute targets when used alone or in combination with a per tonne price cap and/or sequestration offsets.

Key insight
Intensity limits are designed to keep the marginal abatement cost for large final emitters low in order to support the continued competitiveness of industry. However, there are negative consequences to a program based on intensity targets. Unless the emissions intensity target is adjusted downward as output grows emissions may increase. Intensity targets used in combination with cheap offset credits or a price assurance mechanism creates further incentives to increase output and emissions.

What it means
The Canadian Offset System that is being proposed to assist LFE in achieving GHG reductions in a manner that supports the continued competitiveness of industry will have negative consequences because it neither penalizes growth in emissions output nor rewards a decline in output. A better alternative would be to allow offset credits and/or a price assurance mechanism in combination with an absolute cap on emissions. This arrangement would provide reduced marginal abatement costs without increased emissions.

3. Agricultural Biomass as a Feedstock for Energy and Bioproducts: Cost Benefit Analyses

3.1. A Critical Cost Benefit Analysis of Oilseed Biodiesel in Canada

PI: Martin Reaney, University of Saskatchewan
Coauthors: W. Hartley Furtan (University of Saskatchewan), Petros Loutas (Northstar Engineering)

Purpose
To identify areas and opportunities for cost savings along the entire oilseed-based biodiesel production chain, from producer inputs and crop management to transportation, processing, and value-added products.

Key insight
At existing petroleum oil prices, biodiesel made from virgin canola oilseed can compete on price with diesel fuel in Canada. However, return on canola production is not sustainable from a producer's standpoint, so to compete in the longer term, producers must look to value-added products for added revenue streams. In addition, processing plants must be large and gain economies of scale to justify higher-return (and cost) solvent extraction processes.

What it means
Existing oil prices are still not high enough for biodiesel producers to sustainably compete using high-quality virgin seed under the existing policy framework. Producers must look to multi-product biorefineries to generate sufficient revenue, despite the added complexity.

3.2. Benefits and Cost of Shifts to Biomass Crops: Producer and Public Perspectives

PI: Jim Fenton, Jim Fenton & Associates
Coauthors: Shahab Sokhansanj (University of British Columbia), Sudhagar Mani (University of British Columbia)

Purpose
To assess the major issues faced by producers, industry (users/customers), and policy makers for bioenergy crop production.

Key insight
Significant risks are perceived (and present) by both producers and industry for bioenergy crops and the bioeconomy; the former concerned with a stable market for a new crop type and the latter with reliable biomass availability, quality, and price.

What it means
To encourage bioeconomy growth in Canada, policy development should target feedstock risk reduction, specifically stable markets for biomass. Producer education and technology transfer to industry are also activities that will speed bioenergy implementation.

3.3. Cost Benefit of Biomass Supply and Preprocessing

PI: Shahab Sokhansanj, University of British Columbia
Coauthor: Jim Fenton (Jim Fenton & Associates)

Purpose
To determine the cost components of agricultural biomass supply, from harvest to arrival at the processing plant, and given the cost components, to identify the major price restrictions and opportunities for cost reduction.

Key insight
Biomass characteristics, namely bulk density and moisture content, along with distance traveled and biomass transfers, are the major factors determining biomass delivered price on an energy basis.

What it means
High feedstock quality is essential for bioenergy operations, especially if the biomass is transported any significant distance. Multipurpose machinery, performing a number of tasks such as harvest and preprocessing, could significantly reduce costs by reducing the handling and number of transfers required.

4. Developing the Bioeconomy: Issues of Scale, Technology and Policy

4.1. Economic, Environmental and Social Benefits of 2nd Generation Biofuels in Canada

PI: Warren Mabee, University of British Columbia

Purpose
To examine the potential for transportation biofuels to be made from lignocellulosic biomass (wood and woody materials). These biofuels can be derived in two ways: 1) Using a thermochemical platform that employs a combination of pyrolysis, gasification and catalysis processes to transform wood into syngas, then converts syngas into fuels and chemicals, or 2) Using a bioconversion platform, in which pretreatment and hydrolysis processes break down lignocellulosic materials and convert the carbohydrate components into fuels and chemicals.

Key insight
Net environmental benefits of biofuel production are greater using a thermochemical platform; however, because ethanol (derived from a bioconversion platform) is seen as a replacement to gasoline, its relative environmental benefits are greater in terms of GHG emission offsets. The development of biofuels in a biorefining facility will maximize the economic return of biofuel production by generating valuable chemicals and energy as co-products.

What it means
A substantial opportunity exists in Canada for the production of lignocellulosic-based biofuels. The production of biofuels as part of a biorefinery will capitalize upon the economic benefits of generating coproducts while gaining the environmental benefits of biofuel production and use.

4.2. Policies to Stimulate Biofuel Production in Canada: Lessons from Europe and the United States

PI: Allan Walburger, University of Lethbridge
Coauthors: Danny Le Roy (University of Lethbridge), Krishan Kaushik (Himachal Pradesh University), Kurt Klein (University of Lethbridge)

Purpose
To compare international policies designed to stimulate the production and consumption of biofuels and identify their strengths and weaknesses. Drawing upon global experience, a set of policy recommendations for consideration and adoption in Canada were developed.

Key insight
Given Canada's high labour and land costs and relatively strong energy security, the production of biofuels in Canada is not as economical as biofuel production in developing countries or in the U.S and Europe. However, there is political and social desire in Canada to promote a biofuel industry for its environmental benefits and its ability to stimulate rural development.

What it means
To allow a competitive biofuel industry to develop in Canada, four economic factors should be considered: the removal of inter-provincial barriers to trade; the promotion of large biofuel plants to achieve economies of scale; enhanced assistance for biofuel research and development; and the identification and removal of food-focused grain and oilseed regulations that increase the costs of supplying feedstocks necessary for biofuel production.

4.3. Optimum Sizing for Anaerobic Digestion

PI: Peter Flynn, University of Alberta
Coauthor: Emad Ghafoori (University of Alberta)

Purpose
To develop a specific model of power production from anaerobic digestion (AD) of manure using detailed data and to draw conclusions about the optimal sizing of AD facilities and the implications of scale on process alternatives.

Key insight

Small farm-based manure digesters are less cost effective than centralized units that receive manure from many producers because the savings on capital cost per unit of input/output realized in a larger facility are greater than the cost of transporting manure to and digestate from the plant. Additional benefits of a centralized facility include more efficient treatment of the liquid fraction, opportunity for refinement of pipeline grade methane and optimization of transportation costs.

What it means

AD offers potential benefits, but is a costly process for power generation, at approximately 25 cents per KWhr. Revenue from pipeline quality biogas offers a better return and is made possible by centralization of AD facilities where livestock concentrations are high. Digestate processing is an important element that will dramatically improve the economics and offers additional benefits, particularly where soil phosphate levels are high or water supply limited.

Forum Feedback

At the Research Integration Forum, BIOCAP facilitated a "Roundtable Response" session after each of 4 panel presentations. Guests of the Forum responded to 3 questions.

1. In what way(s) does this project fit your needs? How do you envision using the insights?
2. What new research or synthesis work would help meet your needs
3. Additional comments or suggestions?

The over 100 Forum participants were encouraged to participate in the "Roundtable Response" sessions to help in assessing the usefulness and relevance of the Research Integration Program reports. As well, participants were asked to make suggestions on further research work needed to help shape the scope of the next *Research Integration Program*.

In the sections that follow, an overview of the feedback received for each panel is presented in the box entitled "what we heard", along with more detailed responses to the three questions shown in the bulleted lists below.

Forest Health and Productivity: Adapting to the Impacts of Climate Change

What we heard: The expected impacts of climate change must be included in forest management strategies and planning to ensure a sustainable supply of forest fibres and healthy ecosystems into the future. Increased threats from forest fire, invasive species and pest and disease proliferation will have profound effects on the future health of Canadian forests and the communities and industries that rely upon them, as the recent MPB infestation in BC has demonstrated; best near and longer-term solutions will be devised by integrating biological and meteorological modelling with economic impact assessment.

1. **In what ways does this information fit your needs? How do you envision using the insights?**
   - The presentations put in perspective reforestation of marginal land for biofuel production.
   - Good background information on Mountain Pine Beetle infestation, and potential of other pests and diseases not yet on the radar screen.
   - BIOCAP reports could be used for risk and opportunity assessments.
   - We will use the reports to develop examples of integration models.
   - These assessments will assist in a review of a current strategic plan and especially the research and management priorities described in the plan.

2. **What new research or synthesis work would help meet your needs?**
    - What does re-growth of a MPB infected forest look like? How large are 're-growth trees' going to get? What are the nutrients removed and sent back to the forest in these scenarios?
    - Further economic cost/benefit analysis of bioenergy solutions would be helpful for policymakers working to promote greener solutions or competitiveness.
    - Economics of smaller scale systems that fit into agricultural landscapes such as pyrolysis from crops and research on short rotation woody crops.
    - Examinations of the landscape connectivity and percolation effects that will help tree species migrate and adapt.
    - Incorporate culture/function changes required in government and other sectors to employ forward-thinking adaptive management.

3. **Additional comments or suggestions?**
    - Very good info/data; the research on the economics of bioenergy is particularly good information.
    - Without research integration, you cannot see the scientific results. BIOCAP is the only funding organization to host this valuable type of forum.

Emission Reductions and Offset Potential in Agriculture

What we heard: Management practices intended to reduce emissions of GHG from agricultural production or to enhance soil carbon sequestration should be considered as a part of a whole-farm strategy to optimize environmental and economic benefits and to provide a substantial foundation for verifiable offsets. While the proposed offset system would benefit from the addition of upper limit emissions caps, as well as the emission intensity targets, the system does offer a mechanism with potential benefits for both Large Final Emitters and agricultural producers. Current legal precedents offer workable alternatives for dispute resolution, but dispute resolution would progress more quickly and with better cost efficiency if the terms for resolution were clearly articulated as a part of the proposed system framework.

1. **In what ways does this information fit your needs? How do you envision using the insights?**
    - Information on integrated farm approach for nutrient management and GHG reduction economics of offset program will be useful to help us assess offsets and potential.
    - The project on BMPs designed to reduce GHG emissions could be really useful in Quebec: lot of dairy farms and so little research already done. A lot of my colleagues could use the insights in current projects and programs evaluation.
    - Legal and economic analyses of offsets system are very helpful - I will take them to my EC colleagues responsible for systems development because Alastair Lucas' presentation showed that Program Authority procedures and decisions can be legally challenged.
    - Ag work very interesting; energy plantations/crops on ag land will force some of these issues.
    - Marylou Swift's presentation showed that GHGs can and should be linked to other environmental issues (scale issues not addressed though).
    - It's interesting to look at the impact of setting emission reduction targets for utilities.

2. **What new research or synthesis work would help meet your needs?**
    - Additional nutrient management research to reduce GHG emissions, yet looking at alternate systems such as energy from manure and effect on field N_2O emissions.
    - Research focusing in pork production would help Quebec to assess the GHG reduction in that field.
    - Move beyond a theoretical framework to applied research that can be more easily transferred to practitioners (farmers).
    - Would like to see further work on bioenergy transportation solutions.
    - Would use an analysis on conflicting water use: nitrogen use in Fraser Valley, oilsands filtration in Alberta and North.
    - Need an action plan (and alternatives) for biodiesel/ethanol coop for farmers.
    - What is the impact of cuts to extension programs on small farms?

3. **Additional comments or suggestions?**
    - Very interesting information; I liked that economics were part of the research projects
    - These exercises need to be held periodically; the timing was very good for this forum, new government, etc.
    - BIOCAP's role of information transfer, clearinghouse very important
    - The Conservative government may look at climate change differently in terms of air quality, for example.

Agricultural Biomass as a Feedstock for Energy and Bioproducts: Cost Benefit Analyses

What we heard: With current petroleum prices, biomass feedstocks offer a competitive alternative; canola for biodiesel transportation fuel is currently cost-effective, but the sustainability of production is questionable. A full feedstock-to-product assessment shows that a bio-refinery approach that facilitates the extraction of higher-value commodity chemicals offers a substantial improvement on return, despite the additional complexity. Producers are hesitant to make a shift from known commodity crops to biomass crops. Improved technologies to make feedstock handling more efficient, along with policy structures to stabilize markets would help producers to manage the risks of shifting biomass crop production.

1. **In what ways does this information fit your needs? How do you envision using the insights?**
    - It fits the need of more revenue potential for producers. The research needs to be scaled up to applied-field scale and provide economics.
    - The research presented is interesting and relevant. In economic terms (i.e. hydrocarbon prices) new technologies are only now in the margin of viability.
    - Offered energy prices/cost for various biomass agricultural crops a new window of opportunities, for example - biodiesel - excellent potential!
    - The first project could be really useful to advise producers who want to try new types of production like biodiesel crops and will help frame the concept of biofuel production in Ontario.
    - Diversification studies are valuable as this is the future of farming. Profit models help inform farmer decisions especially in biodiesel. There is a utility in establishing the price point where biodiesel becomes valuable. Value is only really added once a

biodiesel (processing) plant is established. Cost-benefit analysis is really important to show clients their benchmark.

- The work by Reaney addresses an important element in biodiesel production in that it identifies total costs along the chain, rather than just focusing on production technologies or processing of seed to oil cost.

2. **What new research or synthesis work would help meet your needs?**
    - There is need to continue feedstock research to improve characterization, identify traits which enhance energy content, combustion suitability and to move towards sustainable crops, flexible crops, crops tailored to specific climates and soil types.
    - Information on the practicality of growing energy crops is needed. Farmers need/want to know what the potential benefits are. Bankers need this data as well to help them with lending decisions.
    - Broader questions about this emerging sector: 1) Can we describe overall ecological footprint and net carbon budget? What is impact on biodiversity if we increase monoculture? 2) Need to understand impacts on air quality (smog, etc) and engine systems depending on application. 3) What impact does increased fuel cost have on the input side of biodiesel production?
    - Questions include: What would a biofuel economy look like? Is the relevance of biofuel largely limited to industrial rather than transportation use? What incentives (decreased taxes or increased venture capital) are needed?
    - How much biofuel can we produce and how much fossil fuel industry can be displaced? More work on co-products and residue streams (distiller's grains for example).

3. **Additional comments or suggestions?**
    - Good technologies are available. More refinement is needed but most importantly we need policy and tax implications incorporated. What role should government play in kick-starting this bioeconomy and why aren't policy makers being more proactive?
    - The question session was good!! Entertaining, which I think adds a lot to the forum.

Developing the Bioeconomy: Issues of Scale, Technology and Policy

What we heard: Canada has a large untapped potential for production of transportation fuels from lignocellulosic feedstocks that can be addressed most effectively by using a bio-refinery approach that yields a suite of valuable commodities as well as fuels. Policy structures adopted by other countries suggest that changes to Canadian policy are needed to enable full emergence of a biofuels sector; there is strong willingness by Canadians to embrace biofuels. Economic modelling of the potential for power production from anaerobic digestion points out the need to consider positive non-economic values that may be important drivers, and value-added opportunities to enhance competitiveness.

1. **In what ways does this information fit your needs? How do you envision using the insights?**
    - I am an economist and the research has motivated my interest in researching the economics of biofuels.
    - These presentations will be useful as a basis for commercialization assessments and the numbers are valuable as they are readily accessible.

- Liked overview of what policies worked in other geographic jurisdictions. Dan Le Roy's paper stimulated debate about the most profitable way to use resources. Should we open our markets to places like the Philippines?
- Helpful in evaluating needs in strategic planning work.
- Like the use of lignocellulose focus and realization of importance of certification.

2. What new research or synthesis work would help meet your needs?

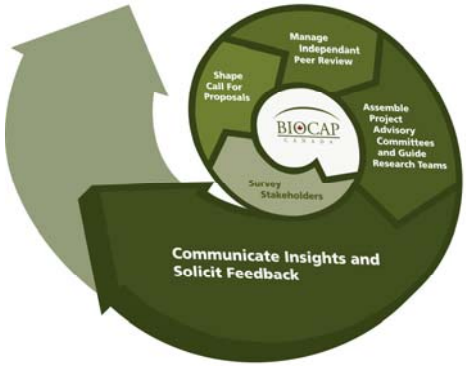
- What are the broader social costs of building biofuel plants and infrastructure?
- A comparison between Canadian and global subsidies to the petroleum industry would be useful. Oil and gas industry subsidies (royalty, deferral, depletion, tax treatment, etc.) are to some degree relics of the depressed state of the energy sector that existed only a few years ago. Can we create a more balanced playing field that will allow a biofuel industry to emerge, or are protectionist policies necessary?
- Need to develop a bioenergy vision for Canada.

3. Additional comments or suggestions?

- Interesting, informative!

The *Research Integration Program* Process

A carefully crafted, inclusive process was created in order to orchestrate the *Research Integration Program.* The diagram on the right outlines the steps taken to produce the 14 Synthesis Reports, and serves to demonstrate that this first *Research Integration Program* has been completed, but the process will feed the next iteration of the program.



i. BIOCAP started the process by **surveying our stakeholders**. Representatives from industry, government and universities were polled to submit questions or issues that they felt required synthesis and integration.

ii. The survey generated many suggestions, and BIOCAP used the input to **shape the call for proposals** (CFP).

iii. The proposals were then put through a rigorous **independent review process,** which BIOCAP managed, and that identified 13 successful projects.

iv. A unique element of this program is that BIOCAP **assembled 13 project advisory committees**, one committee dedicated to each project. The committees were actively engaged with the research teams.

v. The *Research Integration Forum* provided an opportunity for researchers will **communicate the insights** gleaned as a result of their work, insights that will help to inform good policy development in industry and government. The Forum also provided an opportunity for BIOCAP to actively **solicit feedback** from industry, government, NGO's, consultants, and academic representatives.

Next Steps

Feedback received from the *Research Integration Forum* will help to develop the next *Research Integration Program.* Two related key messages emerged from the studies presented in this first Research Integration Forum that will provide the foundation for future work:

1. The need for an integrated ecosystem approach to understanding and devising optimal management strategies is essential, whether the focus is on agricultural systems, forest management or development of a biofuels industry.
2. There is a profound need to develop solutions that are ecologically and economically sustainable, and inherently reliant upon the development of a vision for Canada's future; well-developed solutions will emerge from solid partnerships between the industry, government and academic communities.

Some specific research themes were articulated as well. These include:

- A need for feedstock-to-product analysis of various biofuels and biopower, including assessment of energy, emissions, net carbon budget and economic opportunities;
- Longer-term strategic planning to ensure sufficient and sustainable biofuels feedstock production from agricultural, forest and agroforestry sources, as well as understanding the biological and social implications of shifting focus away from traditional commodities;
- A mechanism for measuring and allocating value for ecological sustainability in production systems, along with a legal framework to protect contractual parties;
- A vision for Canada's bioeconomy, with better understanding of how global competitiveness can be preserved or enhanced;
- Further discussion of enabling policy and regulations, along with harmonization between the municipalities, provinces and federal governments.