New Brunswick Bio-energy Industry SWOT Analysis

Final Report

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Project CCDO11-003 Capturing Crop Development Opportunities
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EXECUTIVE SUMMARY

With the introduction of the Canadian Renewable Fuel Standard by the Government of Canada a number of developers in the Province have pursued or are currently pursuing various bio-energy projects to add value to existing agricultural crops. However, to date, there has not been a concerted effort to determine which options (solid, liquid or gas) might offer the best return or probability of success. Given the current global and provincial economic situation, it is critical to identify potential winners and make the most efficient use of research, development and technology transfer investments. To accomplish this, the New Brunswick Bio-energy Industry SWOT Analysis was undertaken to provide an overview and critical analysis of the industry. The specific objectives for the analysis undertaken are:

1. Describe the current state of development of the bio-energy industry in New Brunswick
2. Identify the short, medium and long term actions required to move the industry forward
3. Promote awareness and understanding of bio-energy activities in the region and NB
4. Outline an action plan to capitalize on the existing strengths and opportunities while minimizing the weaknesses and threats to the NB bio-energy sector

The New Brunswick Bio-energy Industry SWOT Analysis will better position the NB agriculture industry stakeholders to exploit identified strengths, knowledgably choose the opportunities with the best chances of success and capture additional development opportunities, as well as maximize the uses of selected crops for non-food/feed products.

The forms of bio-energy that can be produced on the farm are solid (biomass), liquid and gas. The solid forms can be grain or seed, cereal residue (straw), purpose grown grass or oilseed cake. Biodiesel and ethanol are liquid fuels that require secondary processing. Bio-gas (methane) from the digestion of manure and other organic waste is a gas commonly used for heating to generate electricity. The increasing awareness of wood pellets as a viable domestic heating fuel makes whole grain (corn) and straw or grass pellets worthy of consideration as marketable bio-energy products. Biomass processing and utilization for energy can be a major new employment opportunity in many rural communities as New Brunswick has a larger percentage of its population living in rural areas than many other Canadian provinces.

Historical and current farm gate crop values suggest that there is a greater potential economic benefit from the production of energy from agriculture crops in New Brunswick, than is normally available from the prevailing commodity markets. New Brunswick certainly has a significant capacity to produce rapidly renewable sources of energy from crops with over 2,776 farms using a total of 976,629 acres of land, or 5.6 percent of the province's total land area. However, New Brunswick's agricultural bio-energy production potential will only be realized if the crops can be produced profitably for bio-energy use. Establishing cost of production is important to set the basis for a solid value added business chain that does not short change the primary producer and insures a fair share of the added value.

Agriculture products have a real potential in the energy market as a heating fuel. The difficulty for agriculture to realize this value is that it must develop market awareness for the appropriate combustion appliances and operation at the same time as awareness for agricultural products as a fuel.

The current state of the potential agriculture bio-energy options in New Brunswick were considered in a workshop conducted September 14, 2011. The strengths, weakness, opportunities and threats are identified below:

STRENGTHS
- Resource and Infrastructure
- Market
- NB has a small flexible bio-energy community
- Established research and development community

WEAKNESSES
- Lack of Promotion and Market Understanding
- Public Policy
- Combustion technology

OPPORTUNITIES
- Available Capacity
- A "green field" opportunity
- Government Policy
- Market

THREATS
- Competing ideology
- Competing capacity
- Absence of defined public policy
- Delaying
- Consumer Awareness
- Producer Awareness/Organization
- Public Safety

The development of agricultural bio-energy fuels can stimulate economic activity in rural communities. Biomass fuel for heating and combined heat and power generation can create jobs, offset imported fossil fuels, and promote the sustainable use of natural resources. Thermal energy is the most efficient energy pathway for biomass compared to electricity generation or transportation fuel. Biomass from local rapidly renewable sources provides a secure alternative to electricity and heating oil from expensive fossil fuels. Finally, stimulating the development of biomass energy serves as a spring board to 2nd generation-torrefaction or other cellulose options, such as bio-polymers/composites. The use of biomass fuel as a replacement for fossil fuel (heating oil) and electricity for space heating should be given equal consideration to alternative methods of generating electricity for heating, such as wind and solar.

Liquid bio-fuels such as ethanol and biodiesel are convenient forms of bio-energy that can be produced from agriculture feedstock but the value of these crops in the commodity market is greater than the value that can be realized in the regulated motor fuel price markets unique to the three Maritime Provinces. In unregulated markets, the biofuels can realize a competitive market value based on local supply and demand, but in regulated markets this price is referenced to some distant point. Although the Irving Oil refinery in

Saint John is a very large and local market for ethanol and biodiesel, its sheer size and demand for uniform product makes it difficult for small local start-ups to compete in terms of supply assurance and quality.

A limited opportunity exists for agricultural biogas. Biogas generation depends on the "one of" or a unique location with available feedstock and access to the electric grid. Successful biogas generation depends on sufficient available feedstock such as manure, industrial waste or some combination thereof. The economic viability or business case is currently dependent on tipping fees for waste management.

Agricultural biomass in the form of a pelleted fuel represents the best immediate renewable bio-energy option for New Brunswick. The BTU value of most grains, hay or crop residue for heating is greater than the prevailing commodity market value realized by the farmer as feed for these crops. Compared to liquids and gas the start up cost for biomass fuel processing is significantly lower.

In conclusion, the following recommendations are identified for the further development of New Brunswick's bio-energy potential from agriculture:

1) Create a unified agriculture stakeholder voice- it is recommended that the NB Soil and Crop Improvement Association work with the NB Agricultural Alliance to establish a legal entity mandated to advance agricultural bio-energy opportunities within the Province and become a leading advocate of agricultural bio-energy and work with other regional organizations to capture bio-energy opportunities.

2) Establish commercial scale or working biomass pilots-Four small scale pilot models should be established to demonstrate different scenarios for using local biomass feedstock and the related combustion options. These strategic pellet fuel demonstrations would facilitate the development of a local grass bio-energy system, from "production to consumption

3) Government should subsidize infrastructure and create a guaranteed market- government can create a minimum sustainable demand for agricultural bioenergy simply by insuring that any publicly funded combustion installations have dual capability and can accommodate biofuels such as biodiesel and agriculture biomass. All pellet fuel installations should be capable of handling both agriculture based pellets and wood pellets.

4) The Case for Government- the replacement of heating fuel and electricity generated from imported fossil fuels in domestic or residential heating applications with heat generated from agricultural biomass provides an immediate opportunity for economic benefit in rural communities. An economic impact analysis of this import replacement for the Province and for local communities must be undertaken to determine the sustainability of investments.

5) Biomass Inventory and Consumption Logistics- the location of suitable land, and type and quantity of agriculture biomass should be identified and referenced to the areas of greatest potential consumption of bio-energy within New Brunswick.

6) Life Cycle Analysis - the net carbon benefit and greenhouse gas reductions should be validated for specific feedstock and systems from New Brunswick.

INTRODUCTION

Since the Government of Canada introduced the Canadian Renewable Fuel Standard for biofuel there has been a wide range of projects undertaken in the Province to produce energy from biological sources or to add value to existing crops. However, to date, there has not been a concerted effort to determine which areas might offer the best return or probability of success. A number of stakeholders are working by themselves in a partial vacuum, sometimes pursuing avenues which have proved fruitful in other areas but which don't transfer directly to the NB situation. It is critical to identify potential winners and make the most efficient use of research, development and technology transfer investments.

A number of developers in the province are currently pursuing various bio-energy projects. There has not, however, been a well documented study that identifies the potential opportunities and various strengths that NB holds for the production of bio-energy from agriculture. In fact, various areas of the province may well have different natural resources or options that should be pursued. Synergies may exist by working together with other developers within the province, or it may well be that the most efficient development might involve forging connections with nearby provinces or states.

In order to achieve this type of approach a reliable overview and critical analysis of the industry is required. The objectives of this New Brunswick Bio-energy Industry SWOT Analysis are to:

1. Describe the current state of development of the Bio-energy Industry in New Brunswick
2. Identify the short, medium and long term actions required to move the industry forward
3. Promote awareness and understanding of bio-energy activities in the region and NB
4. Prepare a report outlining an action plan to capitalize on the existing strengths and opportunities while minimizing the weaknesses and threats to the NB Bio-energy sector

This Bio-energy Industry analysis will be restricted to activities that are generated from primary agricultural production such as the growing of crops and the raising of livestock. For example, the establishment of wind or solar farms by agricultural producers or on agricultural land is not considered as primary agricultural activities, compared to biogas generation from agricultural waste.

The NB Energy Commission identified several major challenges facing the New Brunswick energy sector that should be considered in evaluating the strengths, weaknesses, opportunities and threats of an NB agricultural bio-energy sector:

- Changing supply and demand profile in electricity;
- Existing electricity generation capacity and debt associated with under-utilized facilities;
- Desire to move to a more renewable-energy-based electricity system when we have excess capacity in electricity generation;
- Keeping the cost of all forms of energy affordable and competitive for residents and the economy;
- Environmental targets already established as well as those which will be established by various government agencies;
- Demographics of the province's residents and the overall financial position of the Government of New Brunswick;
- Regulatory control and structure associated with the energy sector;

• Lack of access to education and knowledge about the energy sector for residents in a format they can access easily;
• Protecting jobs in the province that face global competition from other jurisdictions which can provide subsidies and have different cost structures for energy usage;
• Time-of-use rates for electricity and the cost of implementing them;
• Electricity peaks and total demand in the province;
• Natural gas pricing (demand, cost of delivery, conversion, success with subsidies);
• Cost of delivery of energy sources in a rural province;
• Cost of transportation for delivering manufactured products to the market;
• Dependence on outside energy supplies and price volatility;
• Alternative fuels for motor vehicles; and
• Contributions for energy efficiency programs and access for all energy users.

The Commission also identified three specific targets for renewable bio-energy:

1. To maximize the use of renewable and clean sources of energy with the objective of reducing carbon and other emissions in an approach that is affordable and timely.
2. To increase the use of renewable electricity as the system needs additional capacity and has the ability to balance additional renewable energy.
3. To maximize the use of local biomass, wood and agricultural materials in the production of renewable energy fuel sources. Developing a residential biomass pellet system should be a priority.

On October 19, 2011 the Government of New Brunswick moved to provide policy direction for energy development. The NB Energy Blueprint identified five key energy objectives that will impact agricultural bio-energy development.

1. Low and Stable Energy Prices
2. Energy Security
3. Reliability of the Electrical System
4. Environmental Responsibility
5. Effective Regulation

In practice, these objectives mean energy will be regulated to insure low prices from a secure supply of environmentally friendly fuel. Although NB agriculture may be able to provide a stable, secure supply of environmentally friendly fuel, the low price objective may be at odds with the prevailing commodity market, which means the energy market for crops may not be competitive with other options. Therefore, the NB Energy Blueprint poses a threat to development of an agricultural bio-energy sector, without significant rational and co-ordinated input from agricultural stakeholder advocates.

This New Brunswick Bio-energy Industry SWOT Analysis, with the identification of short term, medium term and long term action items, will better position the NB agriculture industry stakeholders to exploit identified strengths, knowledgably choose the opportunities with the best chances of success and capture additional development opportunities, as well as optimize uses of crops for non-food/feed products.

SITUATION ANALYSIS

With the increased discussions about climatic change, the feasibility of producing energy from sources other than fossil fuels in a viable and economically sustainable method is being looked at by a number of widely varying interests.

Different regions of the country have been taking inventory of possible alternate energy sources, seeking to optimize the uses of resources in their area, including such things as solar, wind, tidal, purpose grown crops, wood or other waste material that could be used to produce energy.

The forms of bio-energy that can be produced on the farm are solid (biomass), liquid and gas. The solid forms can be grain or seed, cereal residue (straw), purpose grown grass or oilseed cake. Vegetable oil is the only liquid form of energy produced on the farm that can be used in the natural state without extensive further chemical processing. Biodiesel and ethanol are liquid fuels that require secondary processing. Bio-gas (methane) from the digestion of manure and other organic waste is a gas commonly used for heating to generate electricity. The increasing awareness of wood pellets as a viable domestic heating fuel makes the whole grain (corn) and the straw or grass pellet the most topical agriculture product to market as a bio-energy source. Biomass processing and utilization for energy can be a major new employment opportunity in many rural communities.

New Brunswick has a larger percentage of its population living in rural areas than many other Canadian provinces. In fact, over 50% of the population lives outside urban centers. As a consequence, NB and the other Maritime Provinces have a large number of single detached households using primarily electricity, furnace oil and wood for heating. Given the opportunity to purchase renewable energy, these households represent a large potential local market for bio-energy from the local agricultural community.

Although estimates vary, a single detached home may consume from 3 to 5 tonnes of fuel pellets annually. As illustrated in the TABLE 1 below this average household consumption creates a substantial potential market for solid fuel from agriculture and forestry. Developing the consumer (homeowner) or domestic market provides a greater return than competing in the industrial (greenhouse, shop, etc) market which has the capacity to use lower cost “hog” fuel from forest residue.

TABLE 1:Number of Single Detached Household by Energy Source

Source	N.B.	P.E.I.	N.S.
Electricity	128,950	949	64,193
Natural Gas	8,387	0	5,075
Heating Oil	36,693	31,460	148,178
Others*	1,887	455	4,820
Wood	35,645	5,085	31,462

Source: Statistics Canada, 2006 Census of Population; Steve Roberts/ Policy Advisor / N.B. Dept. of Energy, October 2009

The strong existing market for soybean meal as a protein feed in the Region, the inclusion of vegetable fat as oil in livestock and aquaculture feed and the potential use of soybean derived heating oil and biodiesel creates the greatest opportunity for added value from a traditional oilseed crop.

Processed oil such as biodiesel may not provide a near term opportunity established as a parameter for this SWOT analysis but does warrant consideration. Biodiesel blends of heating oil are normally more expensive than 100-percent petroleum heating oil, but the potential added cost may be worth the benefits afforded to consumers. Biodiesel-blended heating oil burns cleaner and more efficiently than conventional heating oil and its solvent properties help keep heating systems free of build up which can reduce performance and heating efficiency. Higher efficiency and cleaner systems mean lower heating oil bills and less required maintenance, resulting in significant cost savings to users.

Raw or straight degummed vegetable oil extruded from the oilseed can be used as a heating fuel. Degummed soybean oil – is unrefined and hence a cheaper product than the methyl esters (biodiesel) for inclusion in a fuel. *"Degummed soybean heating oil (SHO) is a renewable energy resource, which can reduce dependence on foreign oil and create a new market for the soybean industry. This study demonstrated that SHO 20 (20% degummed soybean oil and 80% No. 2 fuel oil) is suitable for application in residential furnaces without modification"*. [Teshome E. Jiru, Bradley G. Kaufman, Klein E. Ileleji, Daniel R. Ess, Harry G. Gibson and Dirk E. Maier (*Fuel, Volume 89, Issue 1, January 2010, Pages 105-113)*] A 20 percent blend is approximately 2 to 3 percent lower in heat content per unit volume than pure fuel oil, but that difference could be balanced by the price stability of soybean oil relative to standard fuel oil and more efficient combustion, resulting in no real net loss of performance.

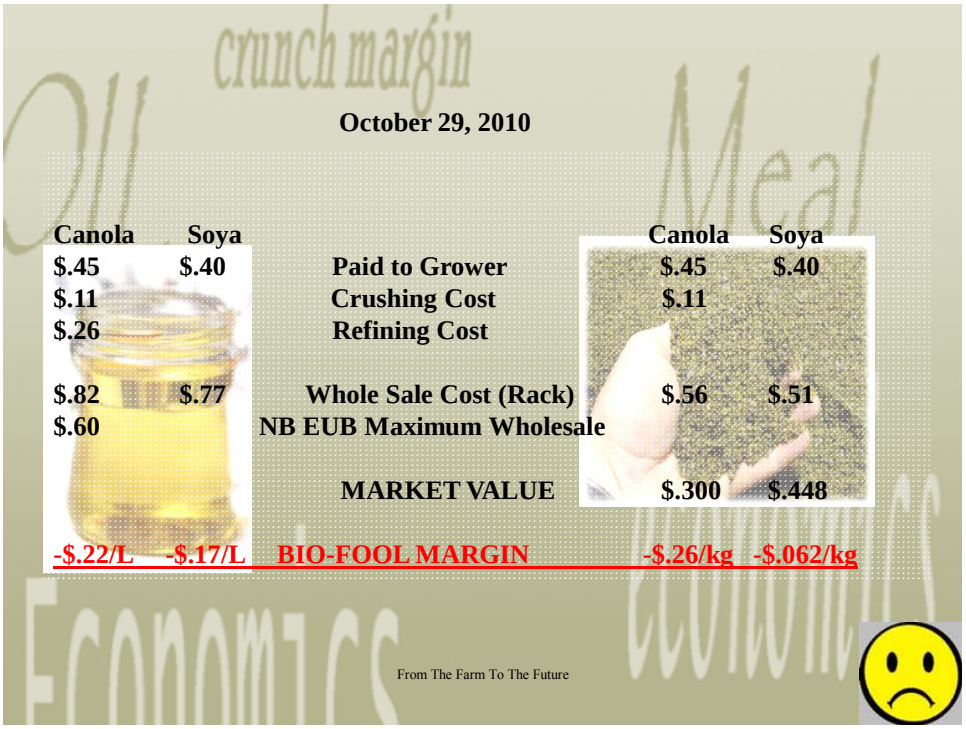
The potential market for soybean heating oil (SHO) in the region is very significant. Approximately 50% of the No 2 petroleum distillate in Atlantic Canada is used for heating fuel applications. Therefore, inclusion levels of 10-20% in heating fuel (furnace oil) would very easily exceed the 2% national inclusion in transportation and heating fuel mandated by the Federal Government. As illustrated in TABLE 2 below, inclusion of up to 20% biofuel in heating fuel would create a potential market far exceeding local crop production capacity in the near term.

TABLE 2: Maritime Province's Final Demand (2003) light fuel oil with estimated SHO 20 quantities

.	m^3	litres
	Light Fuel Oil	SHO 20
PEI	171,000	34,200,000
NS	895,200	179,040,000
NB	303,200	60,640,000
	TOTAL	273,880,000

Appendix Table 1 presents the comparative energy value based on No 2 heating oil from various sources and the comparative farm-gate value of these commodities in agricultural markets. However, as illustrated

in the figure below, the dynamics of competitive commodity market pricing for the oil seed crops and fossil fuel sources rarely makes the use of virgin vegetable oil grown or produced in NB cost competitive in the local energy market. **Appendix Table 2** presents the comparative energy value based on electricity, with an associated feed in tariff (FIT), from various sources and the farm-gate value of these commodities in agricultural markets



These data would suggest that there is a greater potential economic benefit from the production of energy from agriculture crops in New Brunswick, than is normally available from the prevailing commodity markets. A similar potential may exist for oilseeds (soybeans) if a market for the meal from cold pressed processes can be established.

New Brunswick certainly has a significant capacity to produce rapidly renewable sources of energy from crops. The 2006 census of New Brunswick lists 2,776 census farms using a total of 976,629 acres of land, or 5.6 percent of the province's total land area of which 375,590 acres are cropped. The area cropped is down 82,000 acres from 1996. Currently 32% of New Brunswick agricultural land or 310,000 acres produces forages, consisting of 80% (248,000 acres) improved forage and pasture and 20% (62,000 acres) unimproved pasture. In addition, NB has unused natural forage producing areas, (75,000 acres of marshland) in Southeastern New Brunswick with great potential for the production of a biomass industry.

Furthermore, the potato industry in NB uses approximately 50,000 acres annually for potato production. The potato crop requires rotation with other crops for its long term sustainability. As profit margins shrink or disappear, producers are seeking more profitable rotation crops. The completion of the Twin Rivers Technology facility in the Province of Quebec, which is seeking supplies of oilseeds for its operation, is making the production of soybeans and canola more attractive and is stimulating a critical mass of feed

stock for the production of bio-energy crops in New Brunswick, however, as previously illustrated, the competitive margins for energy from oilseed crops remains uncompetitive under global market conditions for vegetable oil.

New Brunswick's agricultural bio-energy production potential will only be realized if the crops can be produced profitably for bio-energy use. Determining a realistic cost of production for various crop enterprises that addresses opportunity costs and returns to management labour can be difficult and debatable. Establishing cost of production is important to set the basis for a solid value added business chain that does not short change the primary producer and insures a fair share of the added value. To accomplish this, may require that the primary producer to becomea shareholder in the new energy company and realize value from this corporate investment.

The information presented in **Appendix Table 3** provides a methodology and identifies basic assumptions for comparative cost of production budgets for several crops and the breakeven yield values to assist in calculating the potential economic advantage of crop production for energy in New Brunswick. Land cost represents the largest single cost item in these budgets. Choosing a value for land costs can have a significant impact on the determination of profitability of crop production in any particular region of the Province. Land value is closely associated with the market value of the crop it can support. Obviously not all land in NB is equal in value to that of the potato belt, nor is all land within the potato belt of equal value.

The NB Potato Cost of Production Report February 2010 (2008 year) reported the market value for all land in rotation to be $6,069 per acre of potatoes (as reported in the study). Assuming a minimum industry average rotation of 2.3 years, an average land value of $2,639 is determined. Using an opportunity cost of 4.4%(as reported in the study) for land owned, the average annual cost per acre of all land in crop is $116. Using a land cost less than this in the "Potato Belt" significantly undercuts the real investment in land and presents a "false" impression of the cost of production. Ignoring such a competitive opportunity cost or return on equity investment calculation effectively means the farmer, as a land owner, is subsidizing the production through asset depreciation or lower returns on assets and management labour. *NOTE: The average land rental paid by the study group was $65 per acre of land rented; implying a land value of only $1500 per acre.*

Agriculture products have a real potential in the energy market as a heating fuel. The difficulty for agriculture to realize this value is that it must develop market awareness for the appropriate combustion appliances and and their operation at the same time as developing awareness for agricultural products as a fuel.

Agri-fibres are more difficult to burn than wood residues and this has been a major limitation for their commercial development as combustion fuels. A main factor limiting conversion of energy crops and crop residues into commercial domestic bio-heat applications has been the quantity of ash and deposit formation.

Pellets from biomass coming from agriculture will always have higher ash contents than wood pellets. This means that the boilers and burners must be adapted to handle higher ash volumes compared to equipment developed for wood pellets. The boiler chamber and burner, as well as the ash handling unit, must have a larger dimension. The tendency for clinker formation and corrosion of the boilers has also

resulted in slower commercialization of the agriculture feed stocks and limited use, especially in small scale boilers and residential hot air stoves. All of these issues not only depend on the fuel characteristics, but also on the design of the combustion equipment and the way it is operated. The majority of home owners expect simplicity and convenience. Proponents of any new energy source must be prepared to provide service and after sales support for their product.

The current state of the potential agriculture bio-energy options in New Brunswick were considered in a workshop conducted September 14, 2011. The strengths, weakness, opportunities and threats identified in this workshop are discussed in detail below.

STRENGTHS

Resource and Infrastructure

The NB Energy Commission identified the following available resources for renewable energy fuels; hydro, wind, tidal, biomass, solar and a strong infrastructure capability in highway, marine and air transportation for import and export services and telecommunications services as major strengths for the NB energy sector. Also, NB has a highly capitalized and modern agriculture industry at the farm level.

Overall, NB has approximately 2100 farms reporting an average capital investment of more than $350,000 in 2006 plus an average equipment investment in excess of $140,000. In particular, the New Brunswick dairy and potato industries are each recognized to be highly capitalized and efficient by industry standards, and there remains an undefined potential on beef and hog farms that have experienced a downsizing or cessation of operations. Depending on the age demographic of the owner, this infrastructure should be capable of quickly ratcheting up to produce energy crops. In addition, New Brunswick has approximately 162,000 acres of land that is prepared for seeding annually. A number of these crops could be readily substituted for production of crops for renewable bio-energy production that could provide a greater net return over time (TABLE 3).

TABLE 3:Area of Selected Annual Crops in NB	
Selected NB Crops	***Acres***
Wheat	***2,892***
Oats	***24,978***
Barley	***33,238***
Mixed Grain & Buckwheat	***1,651***
Corn	***11,120***
Canola	***886***
Soybeans	***1,884***
Alfalfa	***30,954***
Tame hay	***175,227***
Potatoes	***59,870***
Source: Statistics Canada, 2006 Agriculture Census	

Market

The U.S. Energy Information Administration reports that worldwide energy consumption is expected to grow by 53% between 2008 and 2035. Much of this growth will be spurred on by emerging economies like China and India. China is projected to use 68% more energy than the US by 2035. Although renewable energy will be the fastest growing source of primary energy over the next 25 years, fossil fuels will remain the dominant source. Clearly, there will be a continuing demand for energy in the future providing an opportunity for agriculture bio-energy in the local market.

Within this global demand, the New Brunswick market for energy produced from NB agricultural sources is essentially unlimited relative to the agricultural production capacity. Based on Statistics Canada data there were 222,560 single detached and moveable dwellings in the Province of New Brunswick. Electricity is the main method of heating (59%), oil (17%) and wood/wood pellets (23%). Assuming a household energy use for heat of 60, 64 and 111 gigajoules for electricity, oil and wood/wood pellets respectively, this would require 332,923 acres of grass or 221,140 of grain corn. This amounts to 88% and 59%, respectively, of the area reported in crops in 2006. Note that this energy requirement does not include fuel for heat in commercial or industrial applications.

Based on Natural Resources Canada data, the mandated National Renewable Fuels Standard will create an opportunity or requirement for 95,500,000 liters of ethanol, 12,680,000 liters of transportation biodiesel and 9,280,000 liters of biodiesel for heating. Assuming 3000 liters per acre of ethanol from sugar beets this would require 32,000 acres; at typical oil contents for canola and soybeans, the biodiesel requirement would be 30,000 acres and 60,000 acres, respectively. This combined requirement for transport and heating oil is clearly a possible market for New Brunswick's agricultural capacity.

New Brunswick is a rural province where close to half of the population, of just over 750,000 people, live in urban centres. This has a direct impact on the type or form of energy chosen by the end user. For example rural residents have easy access to fire wood. The rural character of the province has an impact on the type of energy produced and marketed, as infrastructure from the energy sector and the transport sector must be present in all areas of the province. For example, electric power lines may not be readily available in all locations for new construction. This means that the type of energy consumed and distributed in the urban centres may be different than in the rural communities and creates a real opportunity for bio-energy, particularly biomass from agriculture. Rural community energy initiatives provide a real possibility for economic development. Alo, a significant market for energy exists within the primary agriculture enterprises themselves,-farmers can be their own best customers. Whether it is energy as heat or for transportation, farmers can become net energy producers and have a logistical advantage over sources from outside the rural community.

NB has a small flexible bio-energy community

In as much as it can be a weakness, the small size of the bio-energy community in NB can also be a strength as it makes communication simpler. Currently co-ordination within the region comes from the Atlantic Canadian Regional Bio-Energy Development Group, lead by Mike Price, NBDAAF, which is

divided into three working groups chaired as follows, Research- Dr. Ron Smith, UNB/WSTC, Policy- Gerald Post, NSDAM and Communication-Irenia Roussel, BNB.

Established research and development community

Overall, there are approximately 30 researchers from the Maritimes working on bioenergy related research (much of it is indirect not direct). For applied research and technical support of actual bioenergy projects and companies promoting the projects, the Canadian BioEnergy Centre (CBEC), Fredericton and Biorefinery Technology Scale-up Centre (BTSC), Grand Falls are good points of access. This does not mean that either centre works independently of other research bodies and consultants in the region or that they work independently of each other. There has to be a coordinated network of all researchers, consultants, and engineers to provide companies with the best support they can get.

Institutions like BTSC, CBEC, Food Technology Centre in PEI and NSAC in NS are more applied and work directly with the industry. Other researchers (universities, Ag Canada, NRC etc) are a necessary part of the network although the technologies they produce are usually a few years away from being "industry ready". The centres help this transfer happen. It is also important that the government departments in NB coordinate with the research centres and industry to develop policy and programs that help the research centres assist the agriculture industry with the implementation of new technologies and business opportunities. A strong well organized and coordinated regional technology network that includes all the people with the ability to contribute is essential to development of an agriculture bio-energy sector.

The centres also need to work with the existing consultants. The consultants are often experts in very specific areas. The centres and the research network in the region should be able to provide resources to these consultants (technical and financial data) so they can help the companies in implementing a bioenergy project (all companies in our region that are launched by individual entrepreneurs need a lot of "hand-holding" and support for them to be successful).

The CBEC, BTSC and other research centres that work with the private sector on contract research with specific companies do not share the information publicly. The new emerging opportunities do not attract enough attention by the producer associations and government until the markets have been already filled by the first adopters. By the time they do and the research is conducted that is publicly available to everyone, there is often no real opportunity left. Therefore, governments need to lead and facilitate the development of emerging opportunities for the greater good of all, not just react to individual requests from industry.

WEAKNESSES

Lack of Promotion and Market Understanding

As identified in the STRENGTHS discussion the weakness is not the lack of a market for agriculture bio-energy but a lack of understanding of the market, a defined business case and a specific strategy with which to enter the market profitably. There is no clearly defined or visible customer or market specifically

demanding "agricultural bio-energy". The market for agriculture bio-energy is as a replacement or supplement for existing energy sources and must be developed with promotion and competitive pricing through a cost benefit analysis to the consumer and the environment. The economic and environmental sustainability must be articulated to the community at-large.

On an energy efficiency and availability basis (TABLE 4), the advantage appears to be in the form of solid biomass for heat; — "eat local-heat local"— from a purpose grown grass or grain crop. The profitability within New Brunswick of ethanol, biodiesel and biogas production without subsidization has yet to be proven.

TABLE 4 Comparative Energy Efficiencies of Selected Energy Sources	
Energy Source	***Energy Out:Energy In***
Gasoline	***0.85 : 1***
Diesel	***0.83 : 1***
Rapeseed Biodiesel (with meal)	***3.36 : 1***
Soybean Biodiesel (with meal)	***3.2 : 1***
Straight Vegetable Oil (SVO)	***5.8-6.1 : 1***
Corn Ethanol (with DDG)	***1.67 : 1***
Corn Grain(heat)	***6.5-7.7 : 1***
Wood Chips (heat)	***10.5 : 1***
Grass –Heat- @3.5 tons/ac	***11.0 : 1***
Grass-Cellulosic	***9.1:1***
Source: Andrew Plant, University of Maine Co- **Operative Extension Service,** ***New Brunswick Bio-energy Industry Workshop, September 14, 2011***	

Currently, there is no processing capability available for biodiesel and ethanol, nor is there sufficient raw feed stock available to create a business case for construction of a plant to create a local market for the oilseed crops. A classic example of the importance of a market close at hand is the impact that the oilseed crushing plant, recently opened in eastern Quebec, has had on canola acreage in NB. In 2006, there were less than 1000 acres of canola reported in the Province. In 2011, approximately 10,000 acres were produced, primarily as a result of a net increase in return to the grower of $30.00 per tonne. Establishment of an even more local market, providing a logistical advantage, could have a similar impact on acreage. The Quebec crusher has a stated objective to draw 100,000 tonnes of oil seed from of the Maritime Provinces. Unofficial reports indicate that approximately 35,000 tonne were delivered from PEI and NB in 2011, after only the second season of full production, creating a local critical mass of feedstock that could be diverted to energy, if economically competitive. Even with local or regional processing capability, the economics of biodiesel production would be questionable. Milligan Bio Tech Inc., Canada's only canola biodiesel manufacturer relies on off spec seed that it purchases at 40-60% of the commodity price for canola, thus allowing the company to be competitive in the diesel fuel market.

The awareness of the potential to heat homes with wood pellets has not been fully exploited in New Brunswick. Pellet stoves are mostly used for single unit (zone) space heating. In more mature European markets, pellet-fueled furnaces are commonly used as central heating units. Such an evolution in North America will be aided by improvements in pellet delivery logistics. Bulk home delivery in specialized trucks, similar to the delivery of heating oil, would simplify handling and improve convenience for all customers. A considerable amount of misinformation exists within the retail value chain on the appropriate combustion of agriculture bio-mass, further confusing the end user. This misinformation needs to be addressed if heating from biomass is to be successfully pursued.

The lack of data and information on energy choices for the public to make business decisions was also identified by the NB Energy Commission, which recognized "the need to compile New Brunswick information in one place where consumers can have access to the information. ***Government should direct the Department of Energy to develop a centralized source of information for consumers, including Internet sites and demonstration projects.*** The information should be accessible and user-friendly to help New Brunswick residents be aware of the costs and benefits of various energy options. The Department of Energy should co-operate on this initiative with the many nongovernmental agencies involved in the energy sector in the province. This would help guide New Brunswick residents in their various projects to make more environmentally and economically responsible decisions when it comes to energy." Energy Literacy, Education and Skills Development is also identified as a key action in the NB Energy Blueprint.

The market and customer are clearly identified for bio-energy from liquid and gas. The challenge is to produce the products competitively from agriculture and substitute or replace energy from fossil fuel sources. The national renewable fuel standard represents a start at creating a base demand but it has limitations. Obligated parties are only going to blend the minimum amount to meet their mandate, or meet whatever self-imposed limitations they have on pipeline transportation. Those same parties are only going to blend where it is the lowest cost to do so, so it is up to a downstream blender to maximize and create the advantage of blending biodiesel into heating oil. There are no defined downstream blenders in NB so it is unlikely the Province will achieve the maximum B20 blend possible for heating oil, without significant promotion or incentives. The centralized supply system in the region does not lend itself to "maverick marketers."

The market and customer for solid or biomass is not readily defined because biomass it is an emerging market in New Brunswick, even for pelleted wood products. However, recently released U.S. Census figures show the number of households heating with wood grew 34 percent between 2000 and 2010, faster than any other heating fuel. Electricity showed the second fastest growth, with a 24 percent increase over the past decade. Wood as a primary heat source more than doubled in Michigan (135 percent) and Connecticut (122 percent) and grew by more than 90 percent in New Hampshire (99 percent), Massachusetts (99 percent), Maine (96 percent), Rhode Island (96 percent), Ohio (95 percent) and Nevada (91 percent). The rapid rise in wood heat as a primary heating fuel is mainly a rural phenomenon and rapidly becoming a suburban trend. According to the U.S. census, 57 percent of households who primarily heat with wood live in rural areas, 40 percent in suburban areas and only 3 percent in urban areas. Recent renewable energy legislation in the United Kingdom is expected to accelerate the global demand for biomass fuel from North America.

Census data also shows that low- and middle-income households are much more likely to use wood as a primary heating fuel, making low- and middle-income families growth leaders of the residential renewable

energy movement. According to the U.S. Energy Information Administration, residential wood heat accounts for 80 percent of residential renewable energy, solar 15 percent and geothermal 5 percent.

Any expressed lack of customer identity or market for agriculture biomass may be a denial of the obvious or a lack of economic competitiveness for a given project. In New Brunswick the obvious large scale or industrial biomass fuel source is wood chips or "hog fuel". At approximately $35.00 per green ton, this is the least cost fuel available and will remain a preference as long as supplies last. The abundance of this fuel source will dictate its use in industrial or large scale district heating systems. Choice of other products such as briquettes or pellets depends on transportation costs and increased ease of handling by the consumer.

The factory cost of wood pellets is around $120.00 per ton; with 8000 hours of plant operation (also depends on logistic cost for raw material and plant size). Therefore, agriculture biomass must compete with wood and to do this biomass yields must exceed 3.5 tonne per acre and similar plant efficiencies must be achieved. For the near future, the best chance for agri-products (biomass) is to piggy back on wood pellets in local markets. There are several obvious characteristics of agricultural biomass listed below that, if recognized, will help define production technology, customer and the market.

Pellet properties from agricultural products, (especially for export to Europe)

- High ash content
- Acidic combustion gases
- No standard for broad market approach
- Volume too low for use in power plant
- Manufacturing costs too high for power plant customers

Logistics of production

- Large volumes need to travel long distances to plants
- High energy cost for portable systems
- Need to be in close range of shipping port
- Cost of storage

The inability or unwillingness of industry stakeholders to accept the reality of a competitive market and product performance contributes to consumer confusion and confidence in the agriculture product. This is a weakness that can be addressed by a clear single voice representing the agricultural industry stakeholders with solid factual information. Canadian Biofuels provides an excellent example of a business model to be followed for agricultural biomass. http://www.canadianbiofuel.ca/

The current need to export pelleted wood biomass fuel is the simple result of surplus production capacity relative to North American market penetration for pellet fuel systems and more favourable public incentives in the European Community. Given the near zero state of agricultural biomass production in New Brunswick, the export market may not be a critical one for provincial producers.

The singular absence of any significant recognition of agriculture in the New Brunswick Energy Blueprint is the most graphic illustration of the need for a champion for the potential and benefits of agriculture bio-energy. As further evidence, the NB Energy Commission recommended that "*the government should work*

with the federal government to remove the requirement for non-petroleum based content in gasoline and diesel in New Brunswick until there is a viable and economic provincial source of non-food based biofuel available." This reflects the classic "chicken versus egg" argument, without demand how would there ever be development of a biofuel alternative? The identification of a clear champion for agriculture bio-energy is essential to future development.

Public Policy

The Maritime Provinces are a small geographic region with three separate governments. Without balanced incentives for bio-energy, a potential exists to distort the natural competitive advantage within the region. This, in turn, could reduce a critical mass of feedstock or service sector capacity for the bio-energy industry.

Further complicating the progress of the bio-energy sector development within the Maritime region is the different pricing controls for motor fuel and heating oil in the three Provinces. The NB EUB maximum price for diesel fuel, heating oil and gasoline in effect sets the maximum price allowable for biodiesel and ethanol. This price is independent of the bio-energy market and largely reflects world oil price. The price for renewable fuels in the rest of Canada is set by competitive forces of supply and demand. Consequently, NB produced ethanol or biodiesel must remain within the maximum price and cannot take advantage of agricultural commodity price cycles. Therefore, farmers will be reluctant to commit to a provincial biodiesel or ethanol producer working under such price regulation. Biomass energy is sandwiched between the regulated maximum price for heating oil and the competitive price for wood energy sources.

The lack of awareness within the public domain of the potential applications for bio-energy results in the lack of incentives to help with system conversions. There is also a lack of understanding of how to convert to bio-energy systems. For example, Eastern Greenway Oils Inc. has successfully operated regular oil fired furnaces on B-100 for four heating seasons and research has demonstrated that up to 20% straight vegetable oil can be blended with regular heating oil. Pellet fired boilers can easily replace oil or electric and oil water heaters and boilers, either in new construction or residential upgrades.

Combustion technology

The primary difficultly in jumpstarting an agricultural biomass industry in Atlantic Canada is that both a pellet supply and a pellet demand need to be developed simultaneously. At this point in time, the single most limiting factor to the development of a grass bio-energy industry is the lack of incentives for industry to develop and supply combustion units appropriate for grass. Considerable effort is expended by many to expostulate on the demerits of burning agriculture biomass. There is also insufficient support from manufactures for their products, particularly in the home and small business market and the dealer networks do not emphasize service.

Over the past three years, however, the Catskill Grass Bio-energy Project has reported very little problem with the combustion of grass pellets in the appliances being demonstrated. The typical problems of ash, clinkering, corrosion and emissions have been addressed in the newer appliances or with management of

the grass in the field. Ash is simply managed by the size of ash box or automated removal. Stainless steel and ceramic coatings have eliminated corrosion and a mechanical apparatus has been developed that can remove clinkers with the ash. Harvesting mature grass with mineral leaching in the field also reduces clinkers and gas emission, although this process differs for warm and cool season species. Grass pellets can also be engineered with the addition of limestone to reduce the formation of solid deposits.

At the current time, the Harman corn stove appears capable of handling grass pellets that contain up to 5.2% ash content, without any modifications to the stove. http://forages.org/bioenergy/faq_bio.php. LST Energy Inc. patented a solution to the practical difficulties of burning hay for heat. This start-up company based in Nova Scotia, Canada, has developed a pellet-burning furnace that eliminates the clinkers found in previously marketed biomass burners when hay was used as a fuel. Other appliances with the capability to burn agriculture biomass are identified in **Appendix Table 4**.

New generation pellet stoves have very low emissions. Since any particulate matter from burning biomass, like the ash residue, is likely to be very alkaline, this small amount of material should not contribute to acid rain or health problems. Comparatively, pellet appliances are considered clean burning, as illustrated in TABLE 5 below.

TABLE 5: Relative Emissions of PM2.5

Appliance	Lbs/MM Btus
Fireplace	28
Uncertified Woodstove	4.6
EPA Certified Woodstove	1.4
Pellet Stove	0.49
Oil Furnace	0.013
Gas Furnace	0.0083
The particulate emissions must be less than or equal to 2.5 grams per hour for catalytic wood stoves and 4.5 grams per hour for non-catalytic wood stoves	
Source: NB Lung Association Shaping NB Pellet Industry Workshop, May 25,2011	

Over 53% of the particulate matter ($PM_{2.5}$) emissions in New Brunswick come from burning residential fuel wood, so conversion to pellet combustion appliances would provide a significant reduction in particulate emissions from the combustion of wood or agriculture biomass.

Furthermore, REAP Canada estimates that every 100 ha of switchgrass converted to pellets and used to displace domestic heat derived from fossil fuels (enough heat for about 200 homes), would prevent the release of about 1800 tonnes of CO2 annually.

OPPORTUNITIES

Available Capacity

NB is the first of the Maritime Provinces to have in excess of 1000 acres of purpose grown grass established and producing biomass. Grass energy farming as a low-technology, small-scale energy system can result in rural jobs and economic diversification, absorb excess crop production capacity and redirect some funds from conventional energy into the local economy.

The name plate capacity for present NB wood pellet producers is listed in TABLE 6. Obviously the production capacity exceeds the current local market. Each of these facilities would require retrofitting to process agricultural biomass. With a surplus of wood pellet capacity and flooded markets, it is economically impractical for these operators to consider using agricultural feed stocks. In addition to this surplus capacity, a number of feed mills would have a pelleting capacity that could be diverted if demand warranted it and it became economically viable.

TABLE 6: NB Wood Pellet Producers

Producer	Location	Capacity (tonne/yr)
Crabbe Lumber	**Bristol**	**40,000**
Groupe Savoie	**St-Quentin**	**55,000**
Marwood	**Tracyville**	**12,000**
Nashwaak Valley Wood Energy	**South Portage**	**17,500**
Shaw Resources	**Belledune**	**75,000**
TP Downey	**Hillsborough**	**40,000**
	TOTAL	**239,500**

Source: Wood Pellet Association of Canada, Shaping NB Pellet Industry Workshop, May 25,2011

This pellet capacity can serve as technical support and part of the critical mass of knowledge and technology but, in reality, any agricultural biomass densification or pellet initiatives will require the construction of dedicated pellet production capacity.

In terms of biogas potential, at present, in Atlantic Canada, there is only one publically available source of information, Laforge Bioenvironmental. Information from the other biogas company producing electricity, Cavendish Farms, is not available. The Laforge business case includes tipping fees and waste transported less than 5km from its source; it includes 400kW+ of electricity at 9.5 cents/kW and some small income from the fertilizer. The value of the tipping fees and electricity are sufficient to provide a 5-6 year ROI with an approximate investment of about 3 million dollars. Because of the low value for electricity, the additional revenue from tipping fees improves the ROI. If the electricity rate was similar to that in Ontario of 18 cents/kW, it would mean that you could have the same ROI with no tipping fees. The value of the fertilizer is hard to determine, especially when it is in the raw liquid form. This product cannot be transported more than a 10km radius from the farm for spreading and remain viable. However, for an

additional $1 million in capital cost, a reverse osmosis and solids separation system can be installed which can produce a commercial like fertilizer product that can be transported like more traditional fertilizers.

The information from Laforge Bioenvironmental suggests that a biogas project in NB can be feasible. However, every project must be evaluated on its own merit as there are many things that are factored into the project economic feasibility model and some of these are:

1) Available Waste (manure or off farm waste) – this will dictate scale (size of the system)
2) Scale will determine the volume of biogas that can be produced and the amount of electricity that can be produced (and revenues generated). Note: electricity is not the only product. Heat is generated and can be the only energy generated if the biogas company has a buyer for heat (hospital, school, apartment building etc.)
3) Price of electricity/heat will make a huge impact on the feasibility of the project (for example smaller systems will be viable if there is a higher return from energy produced)
4) Proximity to large sources of organic waste that currently are costing the company tipping fees to dispose of , are available to the project and can be utilized in a way that can somehow save the company incurring the fees some money (lower tipping fee or less transportation than the landfill)
5) Scale will also determine the capital cost of the system
6) The scale will determine the amount of fertilizer that will be produced and the associated revenues

The greatest spinoffs would come from UNB and U d M in such areas as new pyrolysis technologies, new ways of making diesel from biomass (green diesel); new biogas reactor technologies, new combustion techniques etc.; however, none of this technology is industry ready and will require at least 5 years additional development work before it can be commercialized. The Biorefinery Technology Scale-up Centre (BTSC) can help with the five additional years. However, such university research is driven by available funding. If the province created an agricultural bioenergy fund, then there would be projects initiated and completed with lots of spin-off opportunities.

The intent of research should not be to re-invent the known but to set the stage and provide the tools that will allow industry to make development decisions based on their own interests and evaluations.

A "green field" opportunity

The emergence of grass energy is a new renewable energy technology. New Brunswick has a real opportunity to become a leader in this technology by carefully selecting the best from other areas and adapting it to the local condition; that is "build from the ground up and build right".

The rural demographic of the Province will dictate local development or community initiatives that fit the available feedstock to minimize the miles to market. There may not be a "one shoe fits all" policy or business case that works for the entire Province.

Generally biomass is a low value product, with green wood (50% moisture) currently around the $32 to $38 MT range. Such a product cannot be to far from the market or point of consumption. The New Brunswick Federation of Woodlot Owners reports typical trucking costs as follows: 0 – 50 km $9 – $12 MT; 51 – 100 km $13 – 16 MT; and, 101 – 150 km $17 + MT. Such economics provide a real opportunity

for agriculture biomass via the "eat local-heat local" approach, assuming the product can be produced at a competitive cost per tonne

The environmental costs associated with CO_2 emissions must be factored into the economic equation. CO_2 emissions can be reduced by approximately 1800 tonnes for every 100 hectares of reed canarygrass converted to pellets and substituted for fossil fuels used to generate heat. The prospect of accumulating carbon credits for clean burning fuels or the imposition of a carbon tax on fossil fuels would further narrow the gap between agriculture biomass fuel and fossil fuels.

New technologies, such as geothermal heat pumps, may be a competitive alternative to pellet boilers for heating but may also provide an opportunity. Geothermal systems in NB require a supplemental heat source for periods of peak demand in winter and pellet boilers could provide a nice complement, particularly in new construction without an existing heating system.

The concept of capturing carbon for credit and emission trading is an administrative approach used to control pollution by providing economic incentives for achieving reductions in the emissions of pollutants, such as carbon dioxide. A central authority (usually a government or international body) sets a limit or cap on the amount of a pollutant that can be emitted. Companies or other groups are issued emission permits and are required to hold an equivalent number of allowances (or credits) which represent the right to emit a specific amount. The total amount of allowances and credits cannot exceed the cap, limiting total emissions to that level. Companies that need to increase their emissions must buy credits from those who pollute less. The transfer of allowances is referred to as a trade. In effect, the buyer is paying a charge for polluting, while the seller is being rewarded for having reduced emissions by more than was needed. Thus, in theory, those that can easily reduce emissions most cheaply will do so.

Presently, in a regulated system such as the Alberta Offset System, carbon is trading $13-15/tonne. In the voluntary marketplace a typical range might be $3-$6/tonne. The carbon package size can influence pricing. In the regulated market, there is a requirement for validation and verification and the costs associated with these 3rd party audits. The minimum carbon offsets package size to be considered is in the 10,000-tonne range. The voluntary market may take smaller packages in order to capture the 'public relations' value of getting on board with a project. The validation and verification requirements in the voluntary market are more relaxed, so carbon can be transferred at a lower cost due to the lack of regulatory compliance. In reality, it is difficult to make a project work. Even in the regulated Alberta carbon market, if it were practical, the best opportunity for agriculture would be biomass heating to replace fuel oil or electric heat generated from fossil fuel sources.

The carbon offset for a typical home consuming up to 3000 litres of heating fuel would amount to approximately 8 tonne annually of CO_2. At $13/tonne ($104/year), assuming 20-years of operation for the new heating appliance, would give a public incentive rate of $2,080, less the emissions for processing and transportation as agriculture crops are considered carbon neutral to this point. Pellets are estimated to have 5 kg CO_2e/GJ net emissions. Grass biofuel pellets emit up to 90% less greenhouse gasses than conventional energy sources such as oil, coal and natural gas.

While the opportunity to market carbon today is limited, emission reductions can be banked for later sale or to amass a package large enough to market. So, if NB were to start replacing fuel oil with biomass or

bio-oil, the Province should track the displacement and calculate the carbon emission reductions going forward and capture the value once the opportunity arises.

Government Policy

As of December 2010, a federal regulation required that gasoline consumed in Canada contain five-per-cent renewable fuels. This means oil companies need to blend some of the motor fuels consumed in the country with ethanol. In practice, regular gasoline is being blended with 10 percent ethanol. The federal regulation will also require that heating oil and diesel be blended with 2 percent biodiesel by January, 2013. New Brunswick is not a significant producer of biofuels - either ethanol or biodiesel. In fact, the Irving Oil refinery will have to import the biofuels from other jurisdictions, including jurisdictions overseas in the case of biodiesel.

NB Energy Commission proposed a number of policy recommendations that could impact the development of an agricultural bio-energy sector. These recommendations are encompassed in New Brunswick's energy policy "The New Brunswick Energy Blueprint" released October 19, 2011. This policy is the result of government's review of the Final Report of the Energy Commission. In his introduction of the Blueprint, the Premier clearly states the overall objective: "to find efficiency in our energy consumption while transitioning toward renewable energy sources at a pace that will keep the price of energy competitive for economic growth and affordable for residents in a reliable and stable system." The Energy Action Plan section of the Energy Blueprint takes the 67 recommendations of the Energy Commission and integrates them into a comprehensive list of twenty government actions for the energy sector for the next three years. So, while the vision of each objective is a long-term view, each action item is a specific goal that government has set out to implement within the next three years, and which will contribute to one or more key objectives.

"Conventional energy sources have shifted over time. Until the late 1800s coal, biomass and wind supplied much of the world's energy for heat, production and shipping. Oil and natural gas are now dominant sources of energy, with coal, hydro, nuclear and renewable resources adding to the mix of primary sources. Many of our key energy choices are driven by supply and demand economics which are affected by multiple global and local factors, including government policies, emerging technologies, economic development, the weather and world events, to name a few. In a free market economy, price volatility and dynamic energy markets are inevitable and largely uncontrollable by any single jurisdiction.

It is likewise impossible to predict the long-term path of energy markets, and how they may affect New Brunswick's energy outlook. The unexpected growth of natural gas supply in North America in the past several years, and its impact on electricity prices, is an example of how energy markets take unexpected and fundamental turns. Another key factor is the growing concern about fossil fuel energy, its effect on greenhouse gases and how governments around the world are seeking to address the issue." Source: NB Energy Blueprint

Market

The greatest opportunity for NB bio-energy is import replacement of foreign fossil fuels used for thermal energy or heat. Of the three primary forms, solid, liquid and gas, biomass requires the least capital investment to start and is easily scalable as demand grows. The standards required for transportation fuels are harder to achieve and maintain in small scale facilities.

Using biomass to produce electricity or transportation fuels requires a series of conversion processes, all of which are subject to energy losses. The final result is that the overall efficiency of these end uses is often quite low. For example, the conversion process of distilling 100 Btu's of corn ethanol requires an input of 60 Btu's of energy. Electricity production requires that the thermal energy from combustion be converted first to mechanical energy, and then to electrical energy, with the majority of the potential energy being lost along the way. On the other hand, biomass for heating can be upwards of 85% efficient, allowing for the user to utilize more of the energy stored in the fuel.

Therefore the easiest market for bio-energy to access is biomass for residential space heating. The agriculture commodities can provide a competitively priced fuel for heating; however, the cost of the appliance for biomass combustion must be considered when a consumer is considering converting his heating system. Therefore, the best opportunity to introduce biomass (pellets) as a heating fuel is new construction before the investment in a combustion appliance has been made. Bio-oil (biodiesel), on the other hand, does not require a new investment.

New Brunswick's rural character is not conducive to large scale district heating projects common in many European countries. For instance, in rural NB areas, the comparatively large building lots within municipalities add considerable cost to distribution lines for heating systems relative to volume. Therefore, the primary market here will be for individual systems in commercial, light industrial, institutional and residential applications rather than in district heating projects.

The potential to offset farm input costs has to be evaluated on a farm by farm basiswhere the unit being evaluated can be an individual farm or a farm cooperative (2 or more farmers working together to trade items that the other requires). The most important input costs for a farm are:

1) Transportation fuels
2) Animal Feed or Crop Seed
3) Electricity-Heat
4) Fertilizer
5) Waste disposal (this isn't that much of an issue in NB, but in some other regions farmers are required to provide full waste treatment of manure, similar to the expectation for processing companies)

The goal is to limit the inputs one purchases from off the farm or from outside the region. Obviously, the self-production option needs to be cheaper than the option of purchasing from outside sources. This has lots of potential but it is complex and needs a lot of data to be generated from NB to identify the opportunities.

THREATS

Competing ideology

Conversion of land use to bio-energy crops in New Brunswick would not have a significant impact on food production, as less than 40% of this area is in potato production and it is doubtful that energy crops could compete with this land use. The issue of indirect land use change (ILUC) is not a significant concern for New Brunswick because land producing food is not anticipated to be diverted to energy crops.

Furthermore, a report for the Canadian Renewable Fuels Association points out that since 2008, food commodity prices have fallen steeply and global biofuels production has continued to increase significantly – indicating that the presumed causal link between biofuels demand and food crop prices was, at best, simplistic, and more to the point, invalid.

In truth, there is plenty of food to feed the world's population. According to the UN FAO (Food and Agriculture Organization of the UN), the world produces at least twice the grains required to feed the planet's population. Poverty, harmful economic systems, conflict and climate change are the key underlying causes of hunger. The remedies, in turn, are to be found in better public policies – in distribution, infrastructure, corruption and local politics. UN Secretary General Ban Ki-Moon and Food and Agriculture Director-General Jacques Diouf have stated emphatically that the world produces more than enough food to feed all people. In 2009, North America produced two billion more bushels than required for all uses – food, animal feed, and biofuels. Continued improvements in agricultural practices and land management will allow us to both increase yields and minimize some of the negative effects of agriculture. Some areas that hold much promise include: better pest management, water-conserving irrigation, conservation tillage, and development of new crops through breeding or genetic modification.

Within New Brunswick there is an ever increasing demand on land area for ecological and recreational use that threatens the available land area in some areas of the province and will certainly generate local land use conflicts. This urban-rural split in opinion will remain and can only be countered with factual information. Experience from other areas suggests that with the introduction of purpose grown fall harvested grass, bird and wildlife populations increase as a result of better nesting protection. Bio-diversity can actually be increased as a result of bio-energy development.

Competing capacity

The NB Energy Commission identified two strengths for the energy sector in New Brunswick that are potential threats to the bio-energy industry; *"a large oil refinery capable of processing various grades of oil into refined petroleum products that meet all environmental standards, and a liquefied natural gas facility that provides natural gas from foreign sources and a storage opportunity for peak demand. The net impact of these facilities will establish a globally referenced benchmark price for energy that alternative energy sources must meet in a competitive market place."* Agricultural bio-energy cannot

escape the economic impact of these facilities but should seek equal public support for building infrastructure capacity.

Absence of defined public policy

"New Brunswick does not currently produce significant amounts of biofuels at a competitive cost and in a sustainable manner. The province's only refinery, the Irving Oil Refinery, must therefore have the biofuel component that is required by regulation to be included in the fuel to be shipped to the province. The federal requirement to blend biofuels with gasoline has provisions to permit exemptions to the requirement in particular circumstances. Therefore, government should work with the federal government to remove the requirement for non-petroleum based content in gasoline and diesel in New Brunswick until there is a viable and economic provincial source of non-food based biofuel available. This will give the time for the province to work with industry to find ways of producing sufficient and sustainable biofuels in New Brunswick or the region." (Source: NB Energy Commission, Final Report, 2011) If this became policy, as recommended by the NB Energy Commission, it would be a significant barrier to the development of biodiesel and ethanol from agriculture in New Brunswick.

Government has an important role to play in shaping New Brunswick's energy future. It is the responsibility of government to protect the public good by creating a policy and regulatory framework that facilitates investment in energy infrastructure and technologies that support access to safe, reliable and competitive energy. However, it must be recognized that energy supply and pricing issues are influenced by competitive market forces extending well beyond the geographic borders of our province and country. (Source: NB Energy Commission, 2011) It is also the responsibility of the agriculture stakeholders to provide recommendations to Government that work for all.

In 2006, the Province introduced the Petroleum Products Pricing Act, which allocates a maximum retail price for gasoline, diesel, heating oil and propane used for heating. On the upside of the market, this Act effectively sets the maximum price that can be charged for biodiesel and ethanol produced and sold in New Brunswick. Similarly the current rate framework set for natural gas is designed to ensure that natural gas consumers achieve target savings (20% for residential customers) compared to heating oil or electricity.

The cumulative impact of this price regulation means that bio-energy as a fuel for residential heating has to be 20% lower than the maximum EUB rate for heating oil in areas (large market cities) with natural gas service. Outside these areas, bio-energy must remain competitive with the price set for furnace oil or electricity to be a competitive heating fuel. Consequently the rural areas of New Brunswick become the primary target market area for agricultural heating fuels.

Led by the Department of Environment and in collaboration with other government departments, stakeholders and industry, a new 2012-2020 NB Climate Change Action Plan is under development. The Plan will identify a number of initiatives in the areas of energy use, transportation, waste management, industrial sources, partnerships and communication. The plan will play a leading role in New Brunswick achieving its current target of reducing GHG emissions to 10 percent below 1990 levels by 2020.

New Brunswick is unique in that it is one Province without a clearly defined policy for renewable energy. Saskatchewan provides a 35% rebate (max $35,000) toward the cost of installation of grid certified renewable energy systems, provided the energy comes from wind, low-impact hydro, biomass, heat reclamation, flare gas or photovoltaic(solar). Furthermore, selected incentives such as Feed In Tariffs (FITs) for wind, solar or biogas generated electricity are disincentives for other renewable energy alternatives that might equally as well reduce the consumption of electricity from fossil fuels, such as residential biomass pellet heating systems. A kWhr of electricity replaced should be worth as much as one generated with alternative renewable sources. The real cost to NB Power of buffering unreliable sources of electricity generated from wind and solar should be credited to the more reliable (constant) sources available from agriculture bio-energy.

Similarly, geothermal space and water heating installations receive a $5,000 grant from Efficiency New Brunswick. A comparative pellet system to replace fossil fuel heating does not.

Delaying

With any new technology, it is important to get started and build a critical mass of knowledge and infrastructure. Waiting for the perfect answer does not necessarily insure success. The critical thing is to have a plan and work in steps to achieve the goal. For example, the combustion of agriculture biomass in current appliances may not be perfect but the emissions are clearly better than burning cord wood in older appliances. Therefore, it is a better public health option to initiate the conversion to pellet appliances now and build a critical mass of expertise or the value chain than wait for the perfect appliance.

Consumer Awareness

The pellet or biomass market is a very young market and its extremely rapid growth has inevitably led to a number of diverse problems. These problems, such as variable quality and standards, lack of understanding of the technology, and a lack of market transparency, are typical for emerging markets. In contrast to other renewables, like wind or solar, the pellet fuel business faces not only the issue of selling combustion devices, but also establishing sophisticated logistics solutions that support delivery of a supply over large geographic areas. Developing a reliable supply of a consistent quality product is of fundamental importance for market development given the “institutional memory” of the public for a single bad experience.

Non-binding, voluntary standards for product grading and classification are currently a weak link in the industry’s marketing approach to fuel pellets. In difficult procurement environments, producers desperate to meet contractual obligations can be tempted to use whatever source of fiber is available, without regard to quality. This can lead to inconsistency in performance and hamper consumer acceptance of all biomass. Mature industries producing a minimally undifferentiated commodity would typically submit to third party inspection and verification to assure buyers of their product’s quality and consistency. No such capacity exists for agricultural products.

The collective advantage wood fuel pellet producers have over agricultural producers is that the market standards for pellet combustion appliances suitable for wood pellets and the voluntary heating pellet standards are written for wood. Agriculture biomass will only attain a lower or utility grade as a fuel pellet, due primarily to the elevated ash content.

The NB Energy Commission reported that *"New Brunswick residents and consumers want to know and understand what's best for them when it comes to energy options. They want to know what is the real cost? Who pays? How reliable is the technology? How long does it take to recover the investment? Does it have an impact on jobs (existing and new)? What protection they have against fluctuation of energy prices? Which renewable resource has the least impact on the environment (visual, sound, affected landscape, material use, origin of the energy sources, etc.)?"* This is why the Energy Commission strongly recommended investing in the research and development of alternative energy options and making available educational and awareness tools that provide useful information and that are in meaningful, unbiased formats that are easy to understand.

Furthermore the Energy Commission recommended that the Government direct the Department of Energy to develop a centralized source of information for consumers, including Internet sites and demonstration projects. The information should be accessible and user-friendly to help New Brunswick residents learn about the costs and benefits of various energy options. The Department of Energy should co-operate on this initiative with the many non-governmental agencies involved in the energy sector in the province.

Producer Awareness/Organization

Agricultural bio-energy has no single voice or advocate, hence no political support and public awareness. Promotion comes from single disparate initiatives that often lack sufficient funding or critical mass for a solid business case. There is limited human capital available to start a value chain centered on a single technology because each agricultural producer is approaching the potential based on the best use of existing resources. Such resources of land, equipment and capital vary from farm to farm.

Bio-energy from agriculture is not a distinct commodity with clearly defined stakeholders as compared to dairy, potato or soil and crop improvement sectors of the agriculture industry. Essentially, everyone's business is nobodies business, thus resulting in a lack of human and capital resources to develop bio-energy as a distinct sector within the agriculture community.

In the near term, any bio-energy systems must be able to effectively integrate with existing farming systems to achieve widespread adoption. Grower acceptance should be very high as they are familiar with the production techniques for potential energy crops. Grass management is relatively simple and has maximum compatibility with existing dairy and beef farm operations.

Public Safety

Pellet stoves have extremely low particulate emissions due to their high burn efficiency and the density of the fuel (<1 gm/hr). Source: US Environmental Protection Agency. The Dell Point stove is EPA-certified to have emissions no more than 0.5g/hr. This is over 10 times lower than EPA limits on emissions. Considerable evidence exists confirming that the emissions from agricultural products are similar to wood pellets when properly managed.

The issue of home insurance is dependent upon the individual situation and the particular insurance underwriter. In general, a home owner currently burning firewood should have no problems converting to a CSA or ULC approved biomass appliance installed by a certified technician.

GOVERNMENT POLICY- THE NB ENERGY BLUEPRINT

Released on Oct 19, 2011, the New Brunswick Energy Blueprint defines the latest public policy thinking on energy strategy for New Brunswick. The NB Blueprint identifies three policy actions, which although not specific, may be of some value to the development of an agricultural bio-energy sector:

Energy Action Plan

1. Reintegration of NB Power –Not Applicable (NA)
2. Electricity Market and New Brunswick System Operator–NA
3. NB Power - Debt Management Plan –NA
4. NB Power – Regulatory Oversight and Integrated Resource Plan –NA
5. Regional Electricity Partnerships –NA
6. Smart Grid Technology and Innovation –NA
7. Large Industrial Renewable Energy Purchase Program

   This action item has the potential to create a demand for agricultural biomass. However, it is unlikely that any agriculture specific facilities will be constructed by large industrial users, because forest biomass (hog fuel) is readily available at a lower cost. In reality this element has low to non-existent potential for agricultural.
8. Renewable Portfolio Standard

   If pellet fuel heating became a strategy to reduce thermal generated electricity demand, hence increasing NB Powers Renewable Portfolio percentage, this action item could create a demand for agriculture bio-energy (biodiesel and biomass). This would require a significant new policy strategy and in reality in the near term this element probably has low to non-existent potential agricultural potential.
9. Future Development of our Renewable Energy Resources

   Local and First Nations Small Scale Renewable Projects - provide opportunities for non-profit organizations, associations, co-operatives and municipalities to develop renewable energy projects for the greater benefit of the community, and will play a significant role in achieving our new 40 percent Renewable Portfolio Standard. NB Power will procure new renewable energy resources through competitive Requests for Proposals (RFP) and projects will be evaluated on criteria to be released prior to each RFP. These criteria will include the net economic and social benefits to the community, cost of energy production, rate of return, business plans, size of project, and cost of integrating the generation into the grid.

   Theoretically this action item could create a demand for agricultural bio-energy as a component of a project. However, the attached conditions-community project, competitive pricing to cheap imported oil and potential cost of integrating the generation into the grid are major impediment's and there is likely to be few if any projects of benefit to agriculture.

   The Department of Energy must serve as an information conduit regarding emerging clean and renewable energy technologies and foster their development and adoption where applicable. The Department of Energy's efforts in developing a Provincial biomass resource map and encouraging further investigation of bio-fuel development have some potential benefit for agriculture. However, solely promoting and distributing wood based pellet industry research and best-practices, without note of the potential use of agriculture biomass, is offsetting any benefit from the first action. This item will require constant input from agricultural stakeholders.
10. Wood Based Biomass Resources

Developing and implementing supporting policies to optimize the energy output from our Province's wood based biomass resources with a specific focus on pellets, could benefit agriculture biomass if it were to be accorded equal billing as a fuel option. However, adopting Pellet Fuel Institute or similar standards for manufactured pellets, without due consideration to the unique characteristics of agricultural biomass, will offset or negate any real potential benefit to agriculture.

11. Energy and Climate Change

    The Climate Change Action Plan focus on reducing GHG emissions through a number of specific actions in the following areas: renewable energy and energy efficiency, transportation, waste reduction and diversion, industrial sources, government leading by example, adaptation, partnerships and communication could prove to be a benefit for agriculture bio-energy awareness. In reality this will provide low to non-existent benefit to agriculture.

12. Electricity Efficiency Plan –NA
13. Energy Efficiency Building Code Standards –NA
14. Energy Efficient Appliances and Equipment

    Regulated minimum efficiency levels of appliances and equipment under the Energy Efficiency Act will be upgraded on a two year cycle. In general, pellet appliances are energy efficient, however constant lobbying will be required to insure that agricultural biomass capable appliances are considered for rating or this could have a negative impact on agricultural development.

15. Natural Gas Distribution Rates -NA
16. Petroleum Products Pricing

    The Province of New Brunswick will perform a comprehensive review of the Petroleum Products Pricing Act and Regulations for the purpose of ensuring its continued effectiveness in achieving the objectives of petroleum price stability, while ensuring the lowest possible price to the consumer without jeopardizing the continuity of supply. The result of this action will insure that agricultural biodiesel and ethanol must always compete with the lowest possible price from imported sources of petroleum or lower cost biofuels from other countries produced under foreign subsidy schemes. This scheme will continue to have a negative impact on agriculture.

17. Energy and Utilities Board -NA
18. Office of the Public Energy Advocate -NA
19. Energy Literacy, Education and Skills Development

    The Province of New Brunswick will develop a centralized source of energy information as a knowledge resource for residents. A supporting education and awareness campaign will also be developed with multiple information tracks and delivery channels geared towards students, the public, New Brunswick First Nations and commercial and industrial users. Combined with a strong advocacy from the agriculture community, this has the potential to create awareness of the agricultural potential.

20. Energy Research and Development

    The Province of New Brunswick will develop and implement a New Brunswick energy sector research and development strategy supporting the adoption of emerging clean energy technologies. The Province will establish a coordinated approach to facilitating research with respect to the sustainable and economic use of New Brunswick's natural resources, including natural gas, biomass, and wind, solar, geothermal, tidal and hydro. As a strategy, this provides

an opportunity for agriculture bio-energy to become a recognized player in the renewable energy sector. However, it will require a constant lobbying effort to produce even a moderate impact on agriculture.

Although there is no specific biomass mandate in the Province, the New Brunswick Energy Blueprint (October, 2011) clearly identifies the potential for biomass energy, particularly from forest sources. There are a number of areas within the NB Energy Blueprint where, with considerable lobbying, agriculture can be recognized. However, there is no direct mention or defined effort such as is accorded the forestry sector. Agriculture should not expect an advocacy from the NB Energy Blueprint. Overall the Blueprint is agriculturally neutral.

CONCLUSION

By its very nature, the development of agricultural bio-energy fuels can stimulate economic activity in rural communities. Most significantly, biomass heating and combined heat and power can create jobs, offset imported fossil fuels, and promote the sustainable use of natural resources. Some estimate that 70 to 80 percent of the money spent on hay (biomass) fuel would be re-injected into the local economy versus only 10 percent for heating oil. Thermal energy is the most efficient energy pathway for biomass compared to electricity generation or transportation fuel. With the fossil fuel dominated thermal energy sector comprising about 1/3 of the energy use in the United States, biomass can meet the challenge of moving to a sustainable energy future by directly displacing the use of these fuels. Biomass from local rapidly renewable sources provides a secure alternative to electricity and heating oil from expensive fossil fuels. Finally stimulating the development of biomass energy serves as a spring board to 2nd generation-torrefaction or other cellulose options, such as bio-polymers/composites.

As the sole shareholder of NB Power, the Government of New Brunswick is conflicted in developing an energy policy as evidenced in the NB Energy Blueprint. The single minded obsession with electricity and renewable electricity generation in the NB Energy Blueprint is a threat to agriculture bio-energy because it fails to recognize alternative approaches to the problem. Rather than the Government providing incentives and effectively picking a single winner, the market place should define the choice, whether it be conversion to biomass heating to replace electric base board or a pellet appliance to replace an oil furnace, the consumer would get the credit for making the investment. The replacement of fossil fuel and electricity for space heating should be given equal consideration to alternative methods of generating electricity for heating.

Liquid bio-fuels such as ethanol and biodiesel are convenient forms of bio-energy that can be produced from agriculture feedstock but the value of these crops in the commodity market is greater than the value that can be realized in the regulated motor fuel price markets unique to the three Maritime Provinces. In unregulated markets, the biofuels can realize a competitive market value based on local supply and demand, however, in regulated markets, this price is referenced to some distant point.

Although the Irving Oil refinery in Saint John is a very large and local market for ethanol and biodiesel, its sheer size makes it difficult for small, particularly biodiesel, start-ups to compete in terms of supply

assurance and quality. The refinery needs to be assured of a consistent supply of a similar quality product and this product is most likely to be soybean biodiesel.

New Brunswick and the other Maritime Provinces have a greater potential supply of feedstock for biodiesel than ethanol. In all reality, there is no single crop that could support the capital investment for an ethanol facility in the region. There is some suggestion that sugar beets might emerge as a potential crop but the economic viability has yet to be proven. Soybean biodiesel would be the best option for success because of the ready acceptance the meal has as a livestock feed compared to canola meal. This market is essential to avoid a negative crush margin.

The capital cost for a biodiesel plant is more easily scaled up from a start up than an ethanol plant and achieving ASTM specifications for the fuel is more easily accomplished. Biodiesel also works well in own use applications where meeting the rigid ASTM specification may not be required and smaller volumes are sufficient. In fact, vegetable oil does not require transesterification to be mixed with furnace oil for heating.

A limited opportunity exists for agricultural biogas depending on the "*one of*" or unique location with available feedstock and access to the electric grid. Successful biogas generation depends on sufficient available feedstock such as manure, industrial waste or some combination thereof. The economic viability or business case is dependent on tipping fees for waste management.

Agricultural biomass in the form of a pelleted fuel represents the best immediate renewable bio-energy option for New Brunswick. The BTU value of most grains, hay or crop residue for heating is greater than the prevailing commodity market value realized by the farmer as feed for these crops. Compared to liquids and gas the start up cost for biomass fuel processing is significantly lower. However, large volumes of a consistent quality feedstock available at a central location are required for economic viability. Although logs or briquettes may be a simpler form of densification, these forms do not have the market penetration of the wood pellet. To be successful the agriculture product will need to follow the wood product in the market place and will not be strong enough to support separate combustion systems.

The recent decline in the global price of natural gas and shale gas discoveries and their development in North America have many dismissing agriculture bio-energy as a competitive option for the future. While natural gas may be a competitive source of heat for those consumers with access to the grid or pipeline, natural gas is not an option for those in rural communities throughout the Province. Given a level playing field for public incentives agricultural bio-energy can be a viable renewable alternative for fossil fuels, particularly heating fuel.

RECOMMENDED ACTION

Based on the information available and discussions by the working group the following recommended actions were identified for the short, medium and long term to advance the most viable agriculture bio-energy options.

SHORT TERM

1) Create a unified agriculture bio-energy stakeholder voice

Presently in New Brunswick there is no clearly defined advocate for bio-energy from agriculture sources. Given the diverse nature of the agricultural industry compared to petroleum, solar or wind where a single proponent can benefit from a lobbying effort, it is unlikely that a single private entity or individual will come forward as a champion for all possible options—biomass, liquid and biogas. Therefore, it is recommended that the NB Soil and Crop Improvement Association work with the NB Agricultural Alliance to establish a legal entity mandated to advance agricultural bio-energy opportunities within the Province and become a leading advocate of agricultural bio-energy and work with other regional organizations such as the Atlantic Council for Bioenergy Co-opertive Limited to capture bio-energy opportunities. Membership in this organization should include all value chain stakeholders, such as ─primary producers, equipment manufacturers, distributors, consumers (residential, institutional and industrial).

Independent or third party public awareness is critical to building consumer confidence. This can be accomplished by Government as suggested in the NB Energy Blueprint in cooperation with an advocacy group for all value chain stakeholders, as previously outlined.

Research and technology development specific to agriculture is critical to successful development of the sector. Creation of a value chain working group with individuals orientated specifically to agriculture is strongly recommended.

2) Establish commercial scale or working biomass pilots

Four small scale pilot models should be established to demonstrate different scenarios for using local biomass feedstock and the related combustion options. Such pilot projects should operate over a number of years (3) and would sponsor outreach and education with the farmers, service providers and the public regarding agricultural biomass production and utilization. Demonstration sites, featuring burning technologies, could be set up with individual home owners and through local municipalities where the general public could be invited to open houses to observe the use of biomass and learn about management of various burning technologies.

Data from each demonstration should be collected in such a manner as to support Public Safety concerns and build value chain confidence in agricultural biomass.

These strategic pellet fuel demonstrations would facilitate the development of a local grass bio-energy value chain, from “production to consumption”. The basics elements for the pilot models would include the following:

> Work with farmers to develop production systems and demonstrate grass biomass feedstock suitable for combustion. The performance of grass species in a commercial production system from establishment to harvest requires better definition.

Establish local grass biomass processors, to produce grass fuel pellets and demonstrate the economic value chain from field to furnace and better define the economic, social and environmental benefit to the Province.

Demonstrate residential and small business/municipality scale combustion technologies (pellet stoves and outdoor boilers) that are known to work with agriculture biomass (grain, corn and grass pellets)

MEDIUM TERM

3) Government should subsidize infrastructure and create a guaranteed market

The recently announced initiatives for the use of wood biomass and pellets will enhance the opportunities for agriculture biomass in New Brunswick. Incentives are necessary to make biomass heating more competitive in the marketplace with non-renewable sources of thermal energy. Because of relatively small market penetration, biomass heating systems can cost twice the amount of a similarly sized oil or gas system. Additionally, fuel transport logistics have to reach critical mass ;presently there are a few customers spread over large geographic areas resulting in increased unit cost of fuel distribution. In time, with increasing market penetration, these incentives can be scaled down or eliminated.

Directly incenting the replacement of fossil based space heating, whether from heating oil or thermal generated electricity would add to the base market demand. An excellent program example would be the first of its kind in the world Renewable Heat Incentive (RHI) scheme implemented in the United Kingdom in March 2011 in which direct payments will subsidize the cost of installing qualifying renewable heating systems. In return for the payments, participants will be asked to provide some feedback on how the equipment works in practice and suppliers will be asked to provide a follow up service on any issues that are raised. This will boost confidence in the technology and the information received will help enable Government, manufacturers, installers and consumers to better understand how to maximize performance of the various technologies.

Government can create a minimum sustainable demand for agricultural bioenergy simply by insuring that any publicly funded biomass combustion installations have dual capability and can accommodate biofuels such as biodiesel and agriculture biomass. All pellet fuel installations should be capable of handling agriculture based pellets, not exclusively wood pellets. Such a policy will create a minimum demand for pellet fuels, wood or agriculture, upon which entrepreneurs can build a business plan

4) Biomass Inventory and Consumption Logistics

An inventory of the location of suitable land, and type and quantity of agriculture biomass should be completed and referenced to the areas of greatest potential bio-energyconsumption within New Brunswick. Such data is of value to help potential developers establish a business plan.

5) Life Cycle Analysis

Numerous estimates of the net carbon benefit and greenhouse gas reductions are available for bio-energy from agriculture; these should be validated for specific feedstock and systems from New Brunswick.

LONG TERM

6) The Case for Government

Combined heat and power (CHP) generation is the most efficient use of any fuel source. Due to the high initial capital cost and the need to match the use of heat and electricity generated, CHP installations are most applicable for district heating or institutional and large industrial applications. Combustion of any material to generate electricity, without using the heat is less efficient than using the material for direct thermal (heat) applications.

Alternatively the replacement of heating fuel and electricity generated from imported fossil fuels in domestic or residential heating applications with agricultural biomass provides an immediate opportunity for economic benefit in rural communities. The replacement of peak power demand has been identified as a priority for the Province by the NB Energy Commission.

Bio-energy developments (forest or agriculture) should be directed at the replacement of energy products being imported to Atlantic Canada. An economic impact analysis for the Province and local communities from this import replacement must be undertaken to define the sustainability of investments.

Governments should consider agriculture biomass for fuel as the first generation and recognize the potential for the future. A classic example of second generation can be seen at Nott Farms (Ont.) Ltd which began growing switchgrass for biofuel and is now producing for bio-composite applications that were developed at the University of Guelph. These bio-composite products include 25% to 30% of switchgrass or other bio-fibers in the plastic. A similar opportunity may exist from the vegetable oil based biodiesel capability at Eastern Greenway Oils Inc., now that there is a significant base of oilseed crops being produced and exported to a Quebec crusher.

APPENDIX TABLE 1: APPROXIMATE COMPARATIVE HEAT ENERGY VALUES OF ON-FARM FUEL SOURCES (BASIS FURNACE OIL)

DATE: 19-May-11				Average							
			%	%	BTU VALUE COMPARISON				COMMODITY VALUE		
Product	BTU per	Unit	Moisture	Heating Efficiency	Btu/ Unit	$ Per Unit	$ Tonne	Estimated Delivered**	NB Farmgate	FEED Truro,NS	Farmgate Differential
					Combusted					(selling)	
Low S F/O*	36,984	L	na	70	25889	0.7394		0.9385	na	na	na
Biodiesel	34,764	L	na	70	24335	0.6950			na	na	na
SHO(20/80)	35,874	L	na	70	25112	0.7172			na	na	na
Soybean Oil		L	na	70	0	0.0000			na	na	na
Shelled Corn (56lb/bu)	8,500	lb	16	65	5525	0.1578	$347	$441	$232	$328	$115
Wheat (60lb/bu)	8,700	lb	14	65	5655	0.1615	$355	$451	$215	$270	$140
Oats	7,732	lb	12.5	65	5026	0.1435	$316	$401	$220	na	$96
Soybeans	8,783	lb	10.3	65	5709	0.1631	$359	$455	$420	na	($61)
Soybean meal (48%)		lb	6	65	0	0.0000		$0	na	$426	na
Canola oilseed cake***	10,200	lb	6	65	6630	0.1894	$417	$529	na	$328	na
Corn Stover	7,540	lb	9.1	65	4901	0.1400	$308	$391	na	na	na
Barley Straw	8,047	lb	7	65	5231	0.1494	$329	$417	$220	na	$109
Wheat Straw	7,713	lb	11	65	5013	0.1432	$315	$400	$100	na	$215
Timothy Pellets	8,346	lb	8	65	5425	0.1549	$341	$433	$220	na	$121
Timothy Grass (Hay)	7,210	lb	10	65	4687	0.1338	$294	$374	na	na	na
Reed Canarygrass	7,042	lb	6.9	65	4577	0.1307	$288	$365	na	na	na
Reed Canarygrass Pellets	8,324	lb	4.8	65	5411	0.1545	$340	$432	$100	na	$240
Hemp(cube)	8,289	lb	12	65	5388	0.1539	$339	$430	na	na	na
Switchgrass(cube)	7,929	lb	13	65	5154	0.1472	$324	$411	na	na	na
50% sawdust+ 50% canola meal	9,127	lb	11.4	65	5933	0.1694	$373	$473	na	na	na
Willow Biomass	7,732	lb	20	65	5026	0.1435	$316	$401	na	na	
Wood Pellets #1	8,200	lb	5	65	5330	0.1522	$335	$425	$268	na	$67
Firewood****	6,900	lb	20	65	4485	0.1281	$282	$358	na	na	na
Kilowatt-h	3,413	kWh	0	100	3413	0.0975	na		na	na	na
Bio-Gas (methane)	24,633	m3	0	75	18475	0.5277			na	na	na

*Low S F/O NB Energy and Utilities Board Bench Mark Price; **Basis Local delivery competitive margin for furnace oil.; ***Not equivalent product comparison to solvent extracted product;
***Firewood value per cord $471 (3680 lb very sensitive to moisture and quality) Semi dry_2010=$195/cord; Hardwood pellets Retail $275-$330

APPENDIX TABLE 2: APPROXIMATE COMPARATIVE HEAT ENERGY VALUES OF ON-FARM FUEL SOURCES (BASIS ELECTRICITY "FIT")

DATE: 19-May-11				Average						
			%	%	BTU VALUE COMPARISON			COMMODITY VALUE		
Product	BTU per	Unit	Moisture	Heating Efficiency	Btu/ Unit	$ Per Unit	$ Tonne	NB Farmgate	FEED Truro,NS	Farmgate Differential
					Combust				(selling)	
Kilowatt-h	3,413	kWh	na	100	3413	0.11		na	na	na
Biodiesel	34,764	L	na	70	24335	0.7843		na	na	na
SHO(20/80)	35,874	L	na	70	25112	0.8093		na	na	na
Soybean Oil		L	na	70	0			na	na	na
Shelled Corn (56lb/bu)	8,500	lb	16	65	5525	0.1781	$392	$232	$328	$160
Wheat (60lb/bu)	8,700	lb	14	65	5655	0.1823	$401	$215	$270	$186
Oats	7,732	lb	12.5	65	5026	0.1620	$356	$125	na	$231
Soybeans	8,783	lb	10.3	65	5709	0.1840	$405	$320	na	$85
Soybean meal (48%)		lb	6	65	0	0.0000		na	$426	na
Canola oilseed cake***	10,200	lb	6	65	6630	0.2137	$470	na	$328	na
Corn Stover	7,540	lb	9.1	65	4901	0.1580	$348	na	na	na
Barley Straw	8,047	lb	7	65	5231	0.1686	$371	$220	na	$151
Wheat Straw	7,713	lb	11	65	5013	0.1616	$355	$100	na	$255
Timothy Pellets	8,346	lb	8	65	5425	0.1748	$385	$220	na	$165
Timothy Grass (Hay)	7,210	lb	10	65	4687	0.1510	$332	na	na	na
Reed Canarygrass	7,042	lb	6.9	65	4577	0.1475	$325	na	na	na
Reed Canarygrass Pellets	8,324	lb	4.8	65	5411	0.1744	$384	$100	na	$284
Hemp(cube)	8,289	lb	12	65	5388	0.1736	$382	na	na	na
Switchgrass(cube)	7,929	lb	13	65	5154	0.1661	$365	na	na	na
50% sawdust+ 50% canola meal	9,127	lb	11.4	65	5933	0.1912	$421	na	na	na
Willow Biomass	7,732	lb	20	65	5026	0.1620	$356	na	na	
Wood Pellets #1	8,200	lb	5	65	5330	0.1718	$378	$268	na	$110
Firewood****	6,900	lb	20	65	4485	0.1446	$318	na	na	na
Kilowatt-h	3,413	kWh	0	100	3413	0.1100	na	na	na	na
Bio-Gas (methane)	24,633	m3	0	75	18475	0.5954		na	na	na

*Low S F/O NB Energy and Utilities Board Bench Mark Price; **Basis Local delivery competitive margin for furnace oil.; ***Not equivalent product comparison to solvent extracted product; ***Firewood value per cord $471 (3680 lb very sensitive to moisture and quality) Semi dry_2010=$195/cord; Hardwood pellets Retail $275-$330

APPENDIX TABLE 3: 2011 AVERAGE COMPARISON OF COST AND RETURN/ ACRE **of wheat, barley, oats, soybean, canola, grain corn, sugar beets, hay and potatoes in New Brunswick**

	Wheat	Feed Barley	Oats	Soybean	Canola	Grain Corn	Hay	Sugar Beets	Potatoes
Operating Costs:									
Seed & Treatment	$28.50	$25.00	$22.00	$88.00	$42.15	$95.00	$8.00	$115.00	$193.00
Fertilizer	$48.00	$38.00	$28.00	$18.50	$77.50	$126.50	$39.00	$94.00	$330.00
Herbicide	$4.50	$4.50	$4.50	$8.00	$12.00	$12.00	$0.00	$31.00	$351.00
Fungicide&Insecticide	$18.50	$0.00	$0.00	$0.00	$24.00	$0.00	$0.00		
Fuel	$31.50	$29.50	$29.50	$29.50	$29.50	$38.50	$29.00	$58.00	$182.00
Machinery Operating	$27.25	$24.00	$24.00	$24.00	$26.50	$32.50	$25.00	$92.50	$267.00
Production Insurance	$12.11	$12.40	$12.30	$10.69	$14.42	$21.97	$0.00	$35.00	$138.55
Other Costs(Freight)	$7.50	$7.50	$5.50	$6.50	$32.00	$11.00	$11.00	$66.00	$49.00
Drying Cost	$0.00	$0.00	$0.00	$0.00	$0.00	$70.00	$0.00	$0.00	$0.00
Electrical									$0.00
Combine/swathing/custom	$48.00	$48.00	$48.00	$48.00	$48.00	$48.00	$0.00	$41.00	$0.00
Miscellaneous	$10.00	$10.00	$10.00	$10.00	$10.00	$14.00	$5.00	$14.00	$45.00
Total Operating:	$235.86	$188.90	$173.80	$233.19	$306.07	$469.47	$117.00	$546.50	$1,555.55
Interest on Operating	$12.97	$10.39	$9.56	$12.83	$16.83	$25.82	$6.44	$30.06	$85.56
Total Operating:	**$248.83**	**$209.29**	**$193.36**	**$256.02**	**$332.90**	**$495.29**	**$123.44**	**$576.56**	**$1,641.11**
Fixed Costs:									
Land Investment	$115.00	$115.00	$115.00	$115.00	$115.00	$115.00	$115.00	$115.00	$115.00
Machinery Depreciation	$44.56	$44.56	$44.56	$44.56	$44.56	$55.50	$42.56	$85.50	$246.00
Machinery Investment Interest	$14.10	$14.10	$14.10	$14.10	$14.10	$28.00	$13.10	$38.00	$88.00
Insurance & housing	$19.50	$19.50	$19.50	$19.50	$19.50	$19.50	$19.50	$25.00	$198.00
Storage/Building Cost	$2.50	$2.50	$2.50	$2.50	$0.00	$6.75	$5.50	$2.50	$176.00
Total Fixed:	**$195.66**	**$195.66**	**$195.66**	**$195.66**	**$193.16**	**$224.75**	**$195.66**	**$266.00**	**$823.00**
Total Operating & Fixed:	**$444.49**	**$404.95**	**$389.02**	**$451.68**	**$526.06**	**$720.04**	**$319.10**	**$842.56**	**$2,464.11**
Labour	**$25.00**	**$25.00**	**$25.00**	**$25.00**	**$25.00**	**$35.00**	**$24.00**	**$60.00**	**$549.00**
Total Costs	**$469.49**	**$429.95**	**$414.02**	**$476.68**	**$551.06**	**$755.04**	**$343.10**	**$902.56**	**$3,013.11**
		$/tonne						**$/tonne**	**$/ cwt**
Estimated selling price	**$302.00**	**$280.00**	**$160.00**	**$425.00**	**$535.00**	**$290.00**	**$100.00**	**$44.00**	**$11.00**
Breakeven Yields		**tonne/acre**						**tonne/acre**	**Cwt/acre**
Operating Costs	0.82	0.75	1.21	0.60	0.62	1.71	1.23	13.10	149.2
Operating and Fixed Costs	1.47	1.45	2.43	1.06	0.98	2.48	3.19	19.15	224.0
Total Costs required yields of	**1.55**	**1.54**	**2.59**	**1.12**	**1.03**	**2.60**	**3.43**	**20.51**	**273.92**
Average NB Yields T/Ac.	**1.50**	**1.00**	**1.00**	**0.95**	**0.85**	**2.70**	**3.50**	**17.60**	**240**
Loss / Gain in $/Ac.	-$16.49	-$149.95	-$254.02	-$72.93	-$96.31	$27.96	$6.90	-$128.16	-$373.11

*NOTE: Freight Cost quoted above in GREEN is delivered to Quebec Processing Plant

The grain and oilseed budgets were calculated from information provided by area growers. The potato budget was incorporated with information collected from the 2008 Cost of Production done for Potatoes NB by Andrew Lenehan,CA.

Crop Insurance coverage rates: 90% for Wheat, Barley,Oats; 80% for Canola, Soybean, Corn: 90% for potatoes

Sugar Beet cost of production based on Ontario published information from 2010.

APPENDIX TABLE 4: RESIDENTIAL AND SMALL-COMMERCIAL STOVES, BOILERS AND FURNACES

STOVES				
Dell-Point Technologies Inc.	4055 Lavoisier St., Boisbriand, QC, Canada, J7H 1N1 T: 450-979-6212 W :www.pelletstove.com	Dell-Point stoves run on wood pellets, shelled corn, and hulled wheat. Produce the Europa 75 model 10 kW pellet stove and are developing a 25 kW pellet boiler. Have an efficiency of 86%, 13.2 kW and a hopper size of 25 kg. A custom computer chip onboard monitors the burning process.		
Harman Stove Company	352 Mountain House Road, Halifax, Pennsylvania U.S.A., 17032; T: 717-362-9080 W: www.harmanstoves.com	Produces seven pellet stoves ranging from 2.4 kW to 17.9 kW with hopper capacities of 23 kg to 33 kg with extension on certain model 62 kg. Produces 1 corn stove with 13.2 kW and a hopper capacity of 80 lbs with an extension to 66 kg.	*Local Dealers:* **Au Feu De Bois Nadeau Inc.** 11-B Rue Crabtree Industrial Park Edmundston , NB E3V 3K5 CA T: 506-737-8771 **Dingees Energy Systems** 720 Central St, Centreville, NB E7K 2M5 T:506-276-4519	
MagnuM & Country Flame	150 Michigan Street SE, Hutchinson, MN U.S.A, 55350 T: 1-800-495-3196 W: www.americanenergysystems.com	MagnuM and Country Flame has 6 fully automated models flex-fuel stoves. The stoves range from 9.3 kW to a maximum of 16.4 kW, and will provide supplemental heat ranging from 2000 to 3500 ft^2. Hopper sizes range from 20 kg to 34 kg and maintains a 97% burn efficiency.	*Local Dealers:* **Adams Heating** 196 High Street, Caribou, Maine 04736 T: 207-498-6337 **Spudland Alpacas Inc.** 140 Bubar Road PO Box 43, Blaine, Maine 04734 T: 207-425-5121	

Quadra-Fire	Hearth & Home Technologies 1445 North Highway Colville, WA U.S.A., 99114-2008 W: http://quadrafire.com	Quadra-Fire fully-automatic pellet appliances heat including pellet stoves and inserts. Four pellet stoves ranging from 2.4 kW to 17.6 kW. Four pellet inserts ranging from 2.4 kW to 17.6 kW with hoppers ranging from 20 kg to 37 kg.	*Local Dealers:* **Dingees Energy Systems** 720 Central St, Centreville, NB E7K 2M5 T:506-276-4519 **Sunpoke Energy System** 844 Main St., Woodstock, NB E7M 2G1 T:506-324-8109 W:http://www.sunpoke.ca	
BOILERS				
Brandelle Biomass Systems	446 Harrop Drive, Milton, ON, L9T 3H2 T: 905-876-4617 E: biomass@brandelle.ca W:www.brandellebiomass.com	Produces two models of boilers BX85 and BX170 ranging from 25kW to 50 kW. Burns, wood pellets, corn, switchgrass and wood. Each model has a 240 L hopper size allowing for burn times at max power ranging from 14 h to 30 h. Ash pans range from 13 L in the BX85 and 20 L in the BX170. Options of remote hopper (up to 50 m) and self cleaning of ash from the burner chamber		
Grove Wood Heat Inc.	935 Pleasant Grove Rd., York, PEI, C0A 1P0 T: 902-672-2090 E: grovewoodheat@pei.sympatico.ca	Grove Wood Heat has been supplying wood residue boilers into the Eastern Canadian market for the past 20 years. In 2005 they began developing specialty burners to efficiently utilize off-specification barley and other feed grains. They are currently producing cereal grain burning boilers in the 25-250 kW range. A 75 kW cereal grain burner is shown installed in a small building to minimize fire risk.		
WOOD4HEATING Solutions bois	142 Crescent Street PO Box 6222 Sackville, NB E4L 1G6 Tel: (506) 364-7351 E:wayne@compactappliances.ca	BINDER biomass heating systems are fully automated for commercial, industrial and residential applications. Wood4heating specifies the Binder biomass Boiler, install the boiler turnkey on the customer's premises and supplies fuel from local sources.		

Harman Stove Company	352 Mountain House Road, Halifax, Pennsylvania 17032; T: 717-362-9080 W: www.harmanstoves.com	The Harman Stove makes two pellet boiler, the PB105 Pellet Boiler and the HydroFlex60. Both have automatic ignition, automatic temperature control, and Harman's patented pellet pro feeder and burn pot. The HydroFlex60 is a biomass boiler with 17.5 kW, 72 Kg hopper and heats 2000+ ft², while the PB105 packs 0 to 30.8 kW and has a 93 kg hopper capacity, and heats 2500+ ft².	*Local Dealers:* **Au Feu De Bois Nadeau Inc.** 11-B Rue Crabtree Industrial Park Edmundston , NB E3V 3K5 CA T: 506-737-8771 **Dingees Energy Systems** 720 Central St, Centreville, NB E7K 2M5 T:506-276-4519	
Pellagri Energy	P.O. Box 205 Hunter River, PEI C0A 1N0 Canada T: 902-314-3846 E ; info@pellagri.com W: http://pellagri.com/products	Pellagri Energy produces a BC 160 Pellet Burner; it is able to take advantage of less expensive and readily available local material and is suited for municipalities and small commercial applications up to 15,000 ft^2. Individual units are 50 kW but may be placed in parallel to up to 4 units to increase the energy requirements for larger applications. System prices start at $70,000 including fuel storage.		
FURNACES				
LDJ A-Maize-Ing Heat	1833 Hwy 163 Pella, Iowa 50219 E: info@ldjamaizeingheat.com http://www.ldjamaizeingheat.com	The LDJ A-Maize-Ing Heat design is by far one of the most advanced and safest biomass burning appliances in the market today. Available in a variable rate 165,000 BTU model, the LDJ furnace can be connected to the central hot air ductwork system. The furnace is a stand alone system and can operate with the air conditioning unit during the cooling season. Every LDJ unit is UL listed.		
	http://www.pellergy.com/contact-us			

NEW BRUNSWICK BIO-ENERGY INDUSTRY WORKSHOP ATTENDEES

September 14, 2011
Agriculture and Agri-food Canada
850 Lincoln Road, Fredericton, E3B 9H8

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REPORT REVIEW MEETING ATTENDEES

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850 Lincoln Road, Fredericton, E3B 9H8

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