P.E.I. Farm Energy Conservation Project

Farm Energy Efficiency & Renewable Energy Analysis

Final Report

Sponsored by:

YOUNG FARMERS of Prince Edward Island

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Executive Summary:

The P.E.I. farm sector is one of the largest industrial users of energy within the Province and as a result presents many opportunities for energy efficiency cost savings. The work undertaken through the Farm Energy Conservation project should be seen as only the first step in a farm energy efficiency path that can yield many environmental and competitive benefits to the P.E.I. Farm sector.

The P.E.I. Farm Energy Conservation project was unique simply because it was the first time that farm energy efficiency issues were examined in a co-ordinated way across a variety of sectors, within the P.E.I. agriculture industry. Through the analysis of on farm energy use, both in terms of quantity and application, a number of valuable opportunities for energy efficiencies have been identified.

Other benefits of the project are related to the development of a working relationship with others working in the same field in other Maritime provinces and in Ontario. Discussions with these individuals and attendance at their technical presentations have provided a number of insights and suggestions for technical resources that can provide significant benefit to P.E.I. farm energy efficiency.

In general the goals of the project was to lay out a “snap shot” or baseline of farm energy use across three different sectors(potatoes, dairy and pork) so as to determine to what degree energy conservation is financially advantageous to the farm sector’s bottom line and more specifically to recommend energy technological implementations that have a reasonable payback time (5-7 years)for farm operators .

The body of this report gives an explanation of the methodology of the actual on-site audit process. In addition to the specific recommendations for energy efficiency, the report provides the results of research analysis as well as an overview of some of the conclusions drawn from the recent Moncton Farm Energy Conference.

The on-site visits tended to lead to discussion with farm operators regarding renewable energy opportunities. Consequently, research efforts were expanded to include a variety of issues related to wind turbine energy and biogas production as well as other renewable energy opportunities. Additional research focused on the cost savings available through the installation of hot water heaters (within the dairy sector), variable frequency controllers and three phase power convertors.

Certainly the information obtained and the recommendations provided should be seen within the context of the scope and limitations of this pilot project. One limitation related to the number of farms surveyed for example was that only 5 dairy farms were surveyed for energy bench marking. This means comparing over all electrical consumption to the herd size so as to determine kilowatt hours used per year per head of cattle being milked.

While the sampling number was small, the data compiled provided some surprising results with regard to the variations on electricity used per head of cattle. These bench marking results confirmed our earlier findings that there are many opportunities for energy savings without major energy retrofits and thus cost expenditure. These results generally were in alignment with energy audit work competed in other Maritime provinces which found that most farms can save 15 to 20% of their energy costs through efforts such as regular maintenance programs, more efficient lighting and the installation of electrical timers.

One of the main messages from farm operators was that government farm energy policies and capacity building initiatives have an important role to play both in the farm sector's implementation of energy saving technologies. . .

One of the main messages from farm operators was that government farm energy policies and capacity building initiatives have an important role to play both in the farm sector's implementation of energy saving technologies as well as in the production of on-farm renewable energy production. In addition there is clearly a need within the industry for the farm sector to seek the support of government in order to determine the efficacy of various technologies such as solar hot-water heaters within the context of a dairy farm demonstration. This is also true within the area of renewable energy technologies, especially when dealing with the question of feedstock choices.

It is the conclusion of this report that the challenge of energy efficiency and renewable energy production, given the present low or non-existent farm profit margins, is generally too great for individual farmers to undertake. This is understandable as many of these energy initiatives require, specialized technical expertise and support (at least during startup), as well as independent data collection and evaluation. Yet the benefits to the P.E.I. agriculture industry and the Province in terms of: imported fossil fuel replacement, the environment, public perception, energy price stability and overall competitiveness far out weigh the initial learning curve and investment of public funds.

Recommendations:

(See pages 22-23 for rationale)

1-An Island wide farm initiative to **provide full and comprehensive energy audits** of all farms. This should be similar in scale to the environmental farm plan initiative.

2-**Energy efficiency training for farm operators as well as skills adaption training for home and industrial energy audit technicians** working in farm energy efficiency should be provided.

3-A **Farm Energy Policy Review Forum** should be organized to improve communication between the farm sector, energy efficiency technicians and government policy officials.

4-**A farm energy centre that specializes in farm energy efficiency and renewable energy should be established** and should seek to undertake partnerships with Holland College and the University of P.E.I.

5- There should be educational initiatives undertaken to keep farmers up to date on farm energy matters and **build farm sector capacity for the analysis of renewable and energy efficiency opportunities at farm sites.**

6-The farm sector should be given **access to grants, subsidies as well as interest free loans** in order to encourage the implementation of energy efficiency actions and renewable energy technologies.

Pilot Energy Audit Survey Methodology

A series of 11 energy audits(appx #1) were conducted on P.E.I. agricultural operations as part of the work of the Energy Conservation pilot project. The audit work consisted of an inventory of all energy using equipment and recommendations regarding energy efficiency undertakings . General data was collected regarding machinery but due to the limitations of analysis equipment and time of year, only general recommendations regarding tire pressure and maintenance, were included in the reports.

Participating farms included 3-potato, 4-dairy, 3-swine(includes Vet college pork testing site), 1 cattle operation and a feed grain cleaning operation.

The process for undertaking audit work was as follows:

1. Contact sponsoring body, i.e. P.E.I. Young Farmers Association to obtain a list of those farms interested in audit

2. Arrange time & date for site visit

3. Conduct audit: Gather data on energy consuming infrastructure and systems

4. Undertake research and comparative analysis of localized findings and research other data to complete bench marking. Also forward energy billings consent forms to Maritime Electric.

5. Research renewable energy technologies and formulate opportunities for implementation on audited farms. Do telephone survey of dairy producers to expand data for energy bench marking comparison.

6. Forward preliminary inventory report to producers suggesting both opportunities for conservation as well as examples and costing for renewable energy implementation.

7. Compile preliminary results and present in Power Point presentation to Young Farmers Association

8. Priorize best practices and opportunities for energy savings

9. Consult with a variety of experts and institutions working in the field of energy efficiency, farm services and renewable energy production. (See app#2)

Lessons Learned:

There has been little, if any, work undertaken in farm energy auditing within the Province, over the past number of years. As a result there were a number of interesting findings as well as challenges to the project undertaken. All of which will prove useful when further farm energy efficiency work is undertaken.

For example, scheduling audits for the fall and winter and obtaining modern tools and resources will allow for a more comprehensive survey. Furthermore additional training, from experts in the field such as Ron MacDonald P.Eng, will allow farmers to broaden their knowledge and understanding of energy efficiency techniques and equipment. In addition audit technicians, whose experienced is in industrial and home auditing, need specialized training for farm energy auditing as well as access to specialized computer software for analysis of the data gathered on site. These improvements will make audit results more comprehensive and therefore more useful to the farm operators.

One operator stated that an audit would be more useful if it was more specific to his operation. As stated above, this can only be accomplished with the necessary tools and time to undertake a comprehensive audit

As mentioned earlier, the main challenge to the completion of the audit work was the start of the project at the beginning of the planting season. As a result some audits were undertaken during a time which allowed for only limited participation by farmers. This resulted, at times, in an inadequate transfer of their knowledge about their on farm energy consumption to audit technicians. It is also clear that a comprehensive audit will require the technicians to be at the farm during a complete day of production and to have access to a variety of tools including infrared cameras, specialized software, liquid flow meters, energy use meters etc. One operator stated that an audit would be more useful if was more specific to his operation. As stated above, this can only be accomplished with the necessary tools and time to undertake a comprehensive audit.

The field of farm energy auditing has developed some impressive tools and resources that would make an Island wide program much more effective. The expertise and resources, similar to what has been provided to energy auditors in New Brunswick and Nova Scotia through the Agri-Nova company, would be quite useful for the P.E.I. farm sector. Also, access to comparative energy consumption studies in other Maritime and Canadian locations would be quite useful in bench marking the local farm energy audit results.

Audit Results:

It was determined that across all sectors electricity used for ventilation, processing heating and lighting was the main source of energy utilized and thus the focus for recommendations. It was also determined, through bench marking analysis, that there was a variation of approximately 70% between the most efficient and most consumptive farms surveyed. (See app #3 for bench marking results)

Cross Sector Opportunities for Energy Efficiency:

Lighting: Almost all farms will benefit from additional installation of more efficient light bulbs. While a significant number of producers were using at least some compact florescent bulbs(more common in dairy and pork operations than in potato operations) in their operation there was a need for dust coverings so as to remove the possibility of breakage and thus mercury spillage. Covers would also make it easier to clean fixtures and thus retain lighting efficiency in dusty operational areas.

Research was undertaken with regard to light emitting diode(LED) lights, as preliminary research showed considerable savings over even compact florescent bulbs. Further research and enquiries revealed, however, that LEDs are still prohibitively expensive for general usage, although their use is expanding in specific situations such as street and industrial lighting. It does appear that as LED technology develops, in terms of economies of scale, they will offer extremely high cost savings for farm operators.

The rated efficiency of CFLs over incandescent is 75% (e.g. 15 watts=60watts)and that represents a $8* savings per light per year. With the average bulb installation of 50 CFL units per farm this translates into $400 savings per year per operation. Again to retain savings, covers should be used for both environmental reasons and to facilitate easier and regular cleaning of the units.

With regard to dairy operations there were some operators using metal halide for extended lightening in order to gain additional milk production. We did determine, through research, that a 40% reduction in bulb wattage from 400 watts to 250 watts provided the same effect to enhanced milk production.

Although this information was forwarded to the operator in a followup report, due to cost constraints of a total retrofit to a lower wattage using metal halide, the farmer stated that he did not have the resources to replace the metal halide lighting system. As with many recommendations within this report an energy efficiency support program is needed to move this and other energy efficiency initiatives forward.

**Office of Energy Efficiency*

Hot-water Production in Dairy Operations:

Another key area where energy savings can occur is in the production of hot-water for the flushing of dairy milking systems. There are a number of ways to reduce hot-water flushing costs including on demand (propane gas) systems, additional tank insulation and pipe insulation as well as the installation solar hot-water heaters.

Electrical timers that activate the heater just before usage is required and closes down after the system is flushed may provide additional energy efficiency. Electrical hot-water heaters are rated at 60% efficiency due to the heat lost through the walls of the hot-water tank. As a result the installation of a timer in some operations could reduce energy loss inefficiency by approximately 15-20%, depending on the number of wash cycles completed.

On-demand Hot-water Heaters:

With regard to the energy savings resulting from on-demand or tankless systems fueled by propane, the determination of benefits was more problematic.

Propane, while being a much cleaner fuel than oil, is generally a higher cost than the electrical heating of hot water while the technology in terms of the the cost of installation and maintenance is higher.

The on- demand units do have the advantage of not having a tank and thus avoiding the heat loss of electric hot-water tanks. Our research does show however that one of the weaknesses of on-demand propane system is that, as a safety precaution, water pressure must be maintained within very tight parameters or the safety switch will shut the system down. This has been found to be a problem with ground water pumps in which the pressure can vary somewhat. As a result this type of system was not recommended in the audit reports.

Solar Hot-water Heaters:

Solar hot water heaters are a proven technology that have a record of low maintenance requirements. They are reasonable priced as well as having an existing technical services support system which is available on the Island. In addition the units have improved their efficiency over the past few years.

Using this technology it is now possible to reduce hot-water heating costs by at least 40% to 50%. Given the volume requirements and cost for hot-water we found that, even with the most optimistic assumptions of electric hot-water heaters efficiency, solar hot-water units could provide a reasonable payback to dairy producers.

Our calculations showed that average hot-water costs per year for the dairy operations surveyed is equal to $2130(app #4). This figure, we expect, is higher in actual operation because our calculations do NOT assume any hot-water usage other than for system flushing. Our calculations use ground water temperature at 50 degrees F and assume an average outside tank temperature of 60F. Assuming a cost of a four panel solar hot-water heater to be $8000 the yearly savings with solar hot-water supplying 50% of hot-water needs is $1065.43 and thus the average payback is equal to 7.5 years.

Clearly there is a need for additional on site research and demonstration of the various energy efficiency and renewable options to determine which system or combination of conservation and renewable energy approaches work best within the context of the Island farming sector.

Variable Frequency Drives(VFD):

VFDs can also play an important role in reducing energy use both in dairy and potato operations. VFDs control the speed of an electrical motor based on the load requirements rather than having motors run at full capacity even when the load requirements are much less. Discussion with local dairy suppliers indicated that they have the equipment available however the uptake by the dairy producers has been somewhat slow. From our experience, in talking with producers, this may have to do more with costs rather than scepticism about the positive attributes of the technology.

Within potato operations it has generally been found that as high as 70%-80% of the electrical consumption is utilized by the ventilation fan systems in potato warehouses. VFDs are effective in controlling the speed of plenum ventilation fans when warehouse environmental conditions prove less demanding through the initial storage period.

Although a producer had installed the Gorman Controls system, other producers usually run the ventilation system at 100 per cent capacity, usually in conjunction with a timing system or inspect potato warehouses to determine the environmental conditions and adjust as necessary.

A report, developed by the NB Agr-Alliance, Energy Audit program in 2006, indicated that tests of the Danfoss Frequency Drives, completed in P.E.I. potato storages have shown the potential for significant reduction in monthly electrical bills. According to the report, before the installation of the Danfoss Frequency Drives, "the average power consumption at one potato storage was measured to be 272 kW/day with the fans operating 12 hours per day at full speed. After the installation of the frequency drives, the power consumption was measured again and found to be 158 kW/day with the fans operating continually 24 hours per day at 50% of their normal operating speed, resulting in power savings of 42%."***** The report added that operational testing found that additional electrical efficiency could be realized by setting the Gorman Ventilation System to automatically control the speed of the fans to a minimum of 33% (20hz.) as the temperature of the potato stack permits.

*NB Agr-Alliance program report 06

VFD can also play a key role in reducing dairy production electrical costs. Our research, both secondary and onsite, shows that approximately 20% of the electrical costs for dairy operations are from milk processing, with the vacuum pump being the largest load within the system, outside the hot-water heating system. Vaccum milking pumps, on the sites visited, averaged between 5-10 horse power. Given a 10 HP vacuum pump there may be, depending on herd size, savings costs of $300-$450 per year through the utilization a VFD. (appx # 4).

Maintenance:

Maintenance is a key area in both lighting and ventilation systems. As mentioned previously, it was found that the efficiency of both lights and ventilation fans were degraded due to the lack of attention to cleaning. For example with regard to CFLs it was observed that most incandescent and CFL did not have dust covers thus providing less illumination per wattage output. None of the operations that were visited had installed protective covers. An additional benefit of covers was the ability to spray wash the units thus reducing the labor required for maintenance.

Ventilation fans in both potato and dairy operations could also benefit from a regular maintenance schedule. The build up of dust not only adds heat to motor housing thus reducing efficiency but will also affect fan velocity through the creation of turbulence and thus resistance to air movement. These observations suggest that additional training for operators on energy efficiency would be beneficial to the farm operation.

Three Phase Power:

Three phase motors provide 40 to 60% reduction in electrical use. Given the fact that the majority of electricity, certainly on potato farms and to a lesser extent on dairy farms, is utilized in motors the potential savings in the average operation is therefore significant.

Given our findings that the average base electrical usage for the surveyed farms is approximately 100000 kW per year and predominance of motor load (70% average electrical power) on overall electrical use. P.E.I. farm operation could save, based on a 40-60% reduction through the utilization of three phase motors, between $4200 to $6300 dollars per year. Unfortunately Maritime Electric does not provide three phase power in most rural area although this barrier can be overcome through the use of one phase to three phase convertors.

One operation was successful in operating a dirt eliminator with three phase motors through the use of a phase convertor and was quite happy with the energy reductions and overall operation of the equipment. We did visit another location involved with canola oil pressing that was having problems with the press operation and the problem was attributed to the low level and variation of amperage delivered from Maritime Electric.

The above examples indicate that all energy efficiency technologies must be viewed in an integrated way. That is, it is not only the technological energy efficiency delivered that must inform the decision to implement but there must also be an evaluation of the support infrastructure(e.g. access to replacement parts, trained staff) that can support the utilization of relatively new technology.

Farm Energy Self Sufficiency & Renewable Energy

Farming is a major user of energy mostly through the utilization of diesel and electricity. Given the unpredictability of the pricing of these farm inputs, it only makes sense that farm operations implement opportunities not only for energy efficiency but also examine the possibility for renewable energy production in order to attain at least some degree of energy self sufficiency. In addition there may be opportunities to sell excess energy supplies into the local energy market, thus providing an additional stream of revenue to augment farm income.

Farm Sector Advantages:

Against a background of uncertain fuel costs and, until recently, rising fuel costs, there has been an increased interest in renewable energy production on farms not only for onsite use but also to provide a new environmentally friendly income stream for agriculture. In our conversations with farmers it was found that the majority of farm operators were interested in exploring the possibilities of on farm energy production through biogas, wind turbines and biomass energy conversion.

Farmers generally have two significant advantages over commercial renewable energy companies; land ownership and technical proficiency. Significant land ownership and simply being “part of community” generally results in less requirements for environmental assessment and community consultation, with regard to infrastructure development and placement. This assumed “community” compliance and support place farmers in the enviable position of being able to move more quickly to undertake renewable energy projects.

Farming is a technically demanding sector requiring electro-mechanical proficiency by farm operators. As a result it is easier for farm operators to develop the skills sets required for on- farm renewable energy production. For example, in Europe*, it has been found that biogas generation units developed and operated by farmers are much more reliable than commercially installed units.

Given these implicit and natural advantages of farmers as opposed to others entrants in the renewable energy business as well as the low farm income that has been experienced in last number of years, it would seem to be an opportune time for the farming community, with government support, to move ahead with additional initiatives in support of on- farm renewable energy production.

** Professor Trivet, U.P.E.I. Biogas project presentation*

An Integrated Approach:

The recent Atlantic Farm Energy Conference in Moncton(Nov 18-19th/08) provided a host of ideas and reports on farm energy efficiency methods and renewable energy initiatives. The two day conference dealt with energy crops, production methods and market viability. A wide range of methods for producing renewable energy was examined including, biogas and biodiesel production as well as wind and solar energy production. One of the main messages that was delivered at the Moncton conference was that an integrated approach, that is an approach that takes into account all the factors needed for success in renewable energy production, is critical to the success of farm renewable energy development and production.

An integrated approach requires that all aspects of energy production be examined including but not limited to: feedstock adaptability or growth potential within the region, technological resources to maintain and harvest the feedstock, government policy support, the distance between the feedstock and processing plants, fossil fuel pricing and the market price available for energy production by products. The public perception of the alternative uses for the feedstock is also a factor. This has been evident in the “food to fuel”(corn used for ethanol) debate that was so evident during mid 2008.

It was interesting to note that the distance of feedstock to the processing centre was referenced as a key element for success, at the Atlantic Farm Energy Conference. For example, in reference to the US experience in bio-diesel production, it was found that 100 km distance was the maximum reach for bio fuel feedstock access and that beyond that distance renewable energy becomes less competitive.

Energy Crop Selection:

It was clear from the presentations, at the Atlantic Farm Energy Conference, that expert opinion differed on the most viable feedstock. For example, it was argued that the decision on whether to use canola or soybean as a bio fuel source should be based not simply on its attributes with regard to processing or the ease of extraction of the oil but also on a number of other factors including the marketability of by- products from the process.

With regard to bio-diesel production it was argued that soybean was a more suitable feedstock within the Maritime market because of the opportunity to replace imported feedstock with soy meal in the dairy industry. Contrary opinions were offered that suggested canola was the feedstock of choice because of it could be used as a bio-solid fuel. It was agreed, however, that the viability and thus profit margins created by renewable energies are directly linked to the marketability of production by-products as well as government farm energy policy.

Technological and Structural Viability

An example of feedstock viability that is significantly based on government policy is corn to produce ethanol. Four years ago, a Cornell University study stated that corn ethanol was actually a negative energy generator. Although this study has been heavily criticized by the US ethanol industry it is generally conceded that without the enormous government tax support system provide to corn producers in the US the economic viability of corn ethanol is in serious doubt.

Renewable Energy and Structural Considerations:

In order to examine and provide a frame of reference for structural elements that impact on the viability of renewable energy three fuel sources are examined below: hydrogen, biodiesel and ethanol. A rational is then given for hydrogen versus bio-diesel. These ratings are approximate and evaluated within the context of the Maritime region.

Fuel	access to feedstock / source	processing technology availability	transport /storage equip-ment	Ease of Utilization	compet-itiveness*	Gov policy Support
hydrogen	10	6	2	6	2	10
biodiesel	9	10	10	10	8	9
ethanol	8	8	7	10	6	7

Viability rating: 1 lowest, 10 highest

*factors/fuel sale, by- product sale, green credits

Rationale For Ratings(hydrogen and bio-diesel):

This rating system is not meant as a definitive statement on the viability of these fuels but meant rather as a framework to add to the discussion of the most effective renewable energy fuel within the local (P.E.I.) and regional (Maritime) context. In this particular example we have chosen transportation, although space heating could just as easily be utilized as a reference point.

Hydrogen is produced from the electrolysis of water. Within the context of source access it is rated quite high i.e. water is available most everywhere in the Maritimes. Technological availability is rated as low because electrolysis, while a proven technology, is not operational (that we are aware of) within this region and thus local technical availability is limited.

Transportation of the fuel is given a low rating because of the volatility of hydrogen. In addition the hydrogen molecule is quite small and thus the requirement for specialized infrastructure for storage and transport.

Hydrogen utilization requires relatively minimum retrofit for use in internal combustion engines, gas burners etc. Competitiveness is extrapolated through costs associated with all previous variables. With regard to the policy framework hydrogen scores reasonably well because of the priority given to wind energy within the region. And hydrogens' ability to act as storage medium when electric energy production from wind turbines is high and cannot be input into the electrical network because of network carrying capacity.

Bio-diesel:

Bio diesel has a wide range of sources. Basically oil can be extracted from a large variety of feedstock including canola, sunflower seeds, mustard and soybean, all of which can be grown within the Province. To date canola has been the feedstock of choice, due to its higher oil content and ease of extraction, although as mentioned above, there have been questions raised as to its viability because of the lower value of the by- product in comparison to soybean.

Technology availability is rated as high because of the region having bio diesel production equipment and the relatively low technical requirements to operate such units. Transportation is also given a high rating because of the existing infrastructure for conventional diesel, which also can utilized for bio-diesel transportation and storage. Utilization requires little or no retrofit for use in internal combustion diesel engines. Competitiveness is the result of an extrapolation of previous variables. Other factors such as social priorities are not included here but may be important as fuel access and security concerns increase as oil exploration activity decreases due to oil price decreases.

Government Farm Energy Policy and Programs:

As part of this project initiative, a brief review of government energy efficiency and renewable energy programs and policies was undertaken. It was concluded that while there is government support for specific initiatives, for example in canola oil production, there is little or no general policy, at present, regarding on- farm energy efficiency or renewable energy production.

There has been a variety of support programs across the country provided by provincial as well as Federal programs with regard to energy efficiency and renewables.

With reference to Federal programs, Natural Resources Canada's (NRCan's) ecoENERGY Retrofit program is designed to help industrial facilities overcome financial barriers to improving the energy efficiency of their operations. It is our understanding from discussions with NRCan officials that farms are eligible to receive financial support from this program.

NRCan will provide a financial incentive of up to 25 percent of project costs to a maximum of $50,000 per application and $250,000 per corporate entity to help small- and medium-sized industrial facilities implement energy-saving projects.

Another Federal program is the ecoABC - ecoAgriculture Biofuels Capital Initiative. The ecoABC Initiative is a federal $200 million four-year program ending on March 31, 2011 that provides repayable contributions for the construction or expansion of transportation biofuel production facilities. Funding is conditional upon agricultural producer investment in the biofuel projects, and the use of agricultural feedstock to produce the biofuel.

The Biofuels Opportunities for Producers Initiative (BOPI) has been setup to help farmers as well as rural communities hire specialists who can assist in developing business proposals and undertake feasibility and other studies necessary to create and expand biofuels production capacity.

PROVINCIAL PROGRAMS (sample)

ALBERTA

The Alberta government in 2006 committed $239 million over five years to strengthen and expand Alberta's bioenergy sector by encouraging manufacturers to bring more bioenergy products to the marketplace.

The investment has been used to administer the Renewable Energy Producer Credit program that has helped Alberta industry effectively compete with other jurisdictions that provide programs and tax exemptions to distributors who blend biofuels. At a total cost of $209 million, the four-year program was established to serve as a catalyst in enabling the introduction of renewable products into the traditional fuels and energy marketplace.

MANITOBA

After the recommendations of the Biodiesel Advisory Council to the Government of Manitoba in February 2005, the provincial government encouraged the development of a biodiesel industry in Manitoba, both production and consumption, using primarily Manitoba-grown and produced feedstocks. In November 2005, the province released a plan in response to these recommendations and the Manitoba Biodiesel Production Program was established to promote the development of facilities in the province of Manitoba.

ONTARIO

The Ontario Ethanol Growth Fund (OEGF) supports the production of ethanol fuel in the province by providing: capital assistance to help meet financial challenges, operating assistance to address changing market prices, support for independent retailers selling ethanol blends and a research and development fund to pursue opportunities for research and innovation.

Some energy programs, in other provinces, as a first step emphasis support for farm energy audits as a basic requirement before moving to support renewable energy initiatives. This makes sense because most farms can reduce energy use by 15-20% without a large investment and thus renewable energy initiative can be correctly sized for the operations' needs.

Role of Government Policy and Support:

With regard to the introduction of renewable energy production, it has been found that government policy and support mechanisms are one of the keys to success. Furthermore it has been shown that while support for R&D and the facilitating of capacity building through demonstration site technology development is important these actions need to be further supported through targeted policy instruments*.

The Danish experience in the development of wind turbine technology is one case in point. Today this small European country is at the forefront of wind turbine manufacturing and more Danes are employed in the manufacturing of wind turbines than Denmark's traditional primary industry, fishing.

Governmental policy and support has made Denmark an industrial center for wind turbine manufacture that can compete with fossil fuels in terms of costs. As a result Denmark is now manufacturing turbines at the rate of 1 gigawatt of wind capacity each year, this is approximately equivalent to two large coal-fired power stations while creating about 16,000 jobs in its economy.

One of the existing fallacies that may prevent government action is that government programs (with regard to renewable energy initiatives) distort market realities and thus create a reliance on subsidies and thus barriers to real world economic adaption. The Danish experience in supporting wind energy proves the opposite, that is, that properly developed and implemented government policy programs can nurture renewable energy production industries into commercial viability.

One form of market support which can be highly successful is support for local or on-farm renewable energy generation through government energy purchase mandates. For example a decision by government to mandate and support through subsidy the purchase of bio diesel or bio-solids to heat a variety of government buildings such as senior homes and schools, would prove useful in developing a stable long-term market for on-farm renewable energy producers.

The German government policy priority of providing a subsidy for renewable energy has also been quite successful. It has significantly increased German on- farm energy production through a variety of methods including bio-solid and photvoltatic energy production. This has provided a significant alternative income stream for farmers which has been most welcome during a time of declining food commodities prices in Europe.

**Innovation In Energy Technologies, D.Andersen & H. Olesen*

Capitalization Supported Through Secured Markets:

> One farmer, who utilizes canola oil in his diesel tractor, says that he believes that having a secure market for renewal energy (such as canola oil), through contract purchase agreements with farm users as well as institutional users such as schools, would make it much easier to finance renewal energy initiatives.

The bottom line is that unless farm renewable energy producers can show an ongoing market for their product secured through contracts, financial institutions, particularly in todays financial milieu, are unwilling to lend money. This is particularly true with renewable energy start up businesses where the technology, its application and the economic model is vastly different than conventional energy production. One farmer, who utilizing canola oil in his diesel tractor says that he believes that having a secure market for renewal energy (such as canola oil), through contract purchase agreements with farm users as well as institutional users such as schools, would make it much easier to finance renewal energy initiatives. It would also seem logical that if these enterprises had the financial security of contracted markets they would be better able to compete with private sector corporate energy distributors that imports the majority of its power from outside the Province.

The establishment of stable energy market cannot be understated. In fact the value chain model, now promoted as a useful model for actually returning stable and reasonable revenue to food producers, is quite similar in rationale.

In todays' economic climate governments, both federally and provincially, are assuming a larger role in supplying economic stimulus to the economy. Given the fact that energy will continue to be a significant and volatile cost input for farming, it would seem beneficial for both the farm sector and the Island community that government develop, in partnership with the farm sector, innovative energy policies that can support farm energy efficiency as well as a renewable energy generation.

Conclusions & Challenges:

Energy has become a significant input cost to farmers over the past few years and in order to remain and become more competitive farmers realize that they must use energy more efficiently. Part of the challenge of increasing competitiveness through energy use is dealing with the volatility of transport fuels and electrical costs and determining where the prices for fossil fuels will be, not just in the next 10-15 years, but rather within the next 2-3 years.

There are many opinions on the future pricing of conventional fuels yet few if any experts are predicting the decline of fuel to same level as the turn of the last century i.e. between $25-$35 barrel, at least NOT in the medium to long-term. Generally the considered opinion believes that oil prices will remain low (in the $40-50 range) throughout the economic recession. This will contribute to cutbacks by oil producers both in exploration as well as new production facilities. In addition the belief is that oil will rebound to the $95 per barrel range as soon as the recession begins to fade. Bank of Nova Scotia Commodities expert, Patricia Mohr states that the existing pricing and restrained investment climate will set the stage for a strong price rebound within 2-3 years (App 9).

Given the future predictions for oil increase pricing , the concerns over supply access as we reach peak oil and the demand by the EU for action on global climate change as well as the implementation of a cap and trade system it would be seem prudent for the agriculture sector, in partnership with government, to invest in energy efficiency now when the tools and resources are relatively cheap.

Attaining Energy Efficiency:

Given the benefits of farm energy efficiency in lowering carbon emissions and thus countering the effects of global warming, making energy supplies more secure, saving money and thus improving the competitiveness of the Island agriculture industry, the goal of energy efficiency makes abundant sense.

This is especially true given the fact that this project found that an investment in technological improvements can provide a payback to farm producers, without subsidy, within 6-7 years. In addition most farm audits revealed that operators could save 15%-20% without major investment in retrofit. It is generally agree that the cheapest form of energy is the energy you save through energy efficiency. It should be stated however that payback to operators is a key factor and that a 3-5 year payback period significantly increases the desire to retrofit.

Renewable Energy Potential:

As part of this project farmers were asked about their interest in developing renewable energy production on their farm. The great majority of participants expressed their desire to both know more about the possibility for renewable energy production as well as invest in on site production.

The most challenging part of an examination of renewable energy production on P.E.I. is to determine the most cost effective way for renewable energy production within the context of Island agriculture. Obviously there are a variety of possible energy renewable sources that can be adapted to produce energy; the key question is how profitable they might be in the medium to long-term?

Generally, renewable energy production is classified under: solar, wind, geoexchange, hydro and bio energy. All of the foregoing have been implemented within the Province. However, for the purposes of our discussion we have not dealt with hydro and geoexchange, although it should be stated that geo thermal or ground source pumps are becoming increasingly common in home energy use for space heating within P.E.I. It would therefore have the potential for competitive energy production especially, if the farm operation can produce the electricity on site for the compressor unit.

The output from the above sources can be used for a variety of energy outputs including electricity, hot-water, heating, ventilation, cooling, refrigeration and transportation fuels. As was mentioned earlier, the overall applicability and profitability of each source is dependent upon the local context.

For example geo thermal water system requires a considerable volume of water as well as a dispersement area that is generally satisfied with the drilling of two wells. This can substantially increases the cost of the system as well as the pay back period. Given a farm location, with sufficient water resources, at least one and possible two of the wells may be eliminated. As a result on farm installation of geo thermal may provide greater efficiencies to the agriculture sector than in a home use situation.

Solar renewable energy production has been used extensively in the mid seventies and is becoming more popular through the utilization of solar hot-water units. The technology has technical support advantages given the presence of three local companies that now sell and install the units. The technology has also been found to be very reliable with home energy audit inspectors reporting that homes units, even with little or no maintenance over 8 to 10 year period, still operate effectively.

Structural Inertia, Doing What We have Always Done:

Given the low operational costs, relatively inexpensive cost, payback time and the volume of hot-water utilized by the dairy industry it is curious why solar hot-water heaters have not been utilized more widely within the Island or indeed Maritime farm dairy sector.

There are perhaps a number of reasons for this situation. The most obvious being the relatively low cost of electricity for heating water up until the last 1-2 years. Secondly there have been no demonstration projects, within this province and indeed within the region, that have undertaken the required adaption of solar hot-water for on-farm use. There are indications that dairy operations in other regions and localities have utilized the technology successfully and gained substantial energy efficiencies.

Overall there a number of energy efficiency initiatives that make economic sense including: basic retrofit, pre-heating hot-water on dairy operations, technical improvements such as VFC and three phase power convertors. Yet it was found that given the present state of Island agriculture most operators are not in the financial position to implement these measures. Given the benefits to the local economy with regard to fossil fuel import substitution, security of fuel supply and a variety of environmental benefits related to global climate change it is important that government play a key role in supporting both on farm energy efficiency and renewable energy production.

Recommendations:

1-An Island wide initiative to provide comprehensive energy audits of all farms similar in scale of the environmental farm plan initiative. Each audit should determine specific savings for each production unit.

Rationale: From the small sample of energy inventories and analysis completed and given the data available for other regional audit initiatives it has been found that the vast majority of farms can reduce energy use by between 15 to 20%. In specific sectors such as dairy there is a larger saving potential available using renewable technologies such as solar hot-water heaters. In addition there are benefits in competitiveness, possible revenue streams through cap and trade systems as well as a connection with conscious consumers. A full-scale audit program should conduct the majority of audits in late fall and winter when producer availability is greatest.

2-energy efficiency training for farm operators sectors as well as skills adaption for home and industrial energy audit technicians who wish to transfer their skill sets to the farm sector as well as acquire access to software analysis tools, provided by companies like AGVIOR in Ontario.

Rationale: All those involved with energy efficiency agree that ultimately the best person to monitor and undertake energy efficiency is the operator and therefore producers should be empowered with knowledge of energy efficiency use. Resource personnel with the specific skills and resources, such as Agviro located in Ontario, which has been retained by the NB and NS departments of Agriculture, should be contracted to provide an energy training session for farmers and also provide intensive training for those who have been involved in industrial and home audits in order to adapt their expertise to the requirement of agriculture energy efficiency auditing.

3-The Convening of a Farm Energy Policy Review Forum

Rationale: Given the key role that government policy has in supporting farm energy efficiency and renewable energy production a formal process under the framework of a farm energy policy forum should be organized by the farm community so as to receive input from experts and farmers involved in farm energy efficiency retrofit and renewable energy production. This forum would also provide an opportunity for presentations and reviews of existing farm energy policies in various jurisdictions and provide recommendations .

4-The establishment of a Farm Energy Center

Rationale: The area of farm energy efficiency and renewable energy production can be confusing with the number of competing interests looking to move their technology forward. The early 2008 proposal for a sugar beet ethanol plant is one example.

The Farm Energy Center would serve as an information clearing house, informing the agriculture industry of the latest trends and technology in energy efficiency and renewable energy development through newsletters, enews, a website portal, conferences and symposiums. It would also provide the agriculture sector with energy conservation audits, onsite demonstrations and pilot projects as well as training seminars in the latest in technological innovations related to farm energy efficiency and renewable energy production.

5-Build capacity for the analysis of renewable energy assessment opportunities in various farm sites.

During the time of this project many questions arose as to the most viable renewable energy choice for various operators. This type of analysis require specialized tools and technical expertise as well as an extended visits to the onsite area. Although time consuming, this work is critical in determining the most cost effective conservation and renewable energy methods as well as capital expenditure and payback period. There are several tools now available such as the RETScreen software which should be more fully utilized in this analysis.

6-The farm sector should be given access to subsidies as well as interest free loans in order to encourage the implementation of energy efficiency actions and renewable energy technologies.

Rational: It appears that the margins in todays P.E.I. farming community do not allow for innovation even for technology(e.g. variable frequency controllers) with less than 5 year payback. There is therefore a need for the implementation of subsidy programs, at least initially, to demonstrate savings. A phase two should provide interest free loans in order to support farm producers who see the medium to long-term benefits of farm energy efficiency and/or energy self reliance.

Appendices:

App #1-Audited Farms and Institutions:

David Francis-potato farm
Kyle Jewell-dairy farm
Jeff & Janet Bystervelt-dairy farm
Eddie LeClair-hog farm
Nick McCardle-potato and grain cleaning & mixing operation
Craig McKenna-potato farm
Steven Reeves–dairy farm
Maria & Nelson Smith-hog farm
Atlantic Vet College-hog demo site
Ryan Weeks-dairy farm

App #2-Interviewees:

Mr. Scales, Island Dairy Services

Technicians, Tri-County Dairy

Mr. Cedric MacLeod, Macleod Agronomics

Mr. Mike Proud, Office of Energy Efficiency

Ms. Kate MacDonald, P.E.I. Energy Project

Tricia Lodge, Entegrity Wind Systems

Gerard Moll (tour of canola press operation)

Peter Boswell, P.E.I. Department of Agriculture

Professor Trivitt, UPEI (Biogas presentation)

App #3 Dairy Bench marking Results:

Benchmark comparative ratios:

Average electrical use on 6 dairy farms surveyed: =90420/kWh/year

Annual average expenditure (@ 15 cents per kWh): =$13563 per year

Per cow average electrical usage on farms surveyed: =1733.2 kWh/yr

Per cow per year, highest consumption: =2129.5 kWh/yr

Per cow per year, lowest consumption rate =778.34 kWh/yr

Percentage variation(lowest % of highest) = 36.5 %

App #4

Payback Period, Variable Frequency Control Unit for Vaccum Pump (Dairy)

The money saved by installing a VFD depends on many factors. These include size and type of vacuum pump, size and type of milking system and the amount of time required for milking and washing each day.

Payback period:

Assuming a 5-HP motor for the vacuum pump milking system the calculations for energy use are as follows:

5 HP is equivalent (1 HP =.746 kW of electricity) = 3.73 kW

Based on an eight 8 hr milking cycle = 29.84 kWh per day

Based on 365 days per year usage = 10891.6 kWh/year.

Cost for vacuum pump (based on .15 cents per kWh) = $1633.74

Yearly savings based on a 50% electrical energy reduction = $ 816.87

The payback period for a VFC unit costing $5000 =6.12 years

App #5

Payback Calculation for a solar hot-water heater in 50 herd dairy operation

The average amount of hot-water utilized on 50 herd operation is 120 gals per day*

Therefore, each flush is assumed to use 20 gallons or 60 gallons per milking. According to Dairy Board the required temperatures for three washes are 117F, 160F and 110F

Average amount of hot-water used twice a day based on three flushes per wash

Based on a ground water temperature of 50F (41 degrees is the general reference temperature for ground water)

1 BTU is defined as the energy required to raise 1 lb of water 1 degree Fahrenheit

1 gallon(imp) of water weighs 10 lbs therefore:

10 BTU required to raise the temperature of 1 gallon of water 1 degree

200 BTU s required to raise the temperature of 20 gallons of water 1 degree

13400 BTUs required to raise the temperature of 20 gallons of water 67 degrees

22000 BTUs required to raise the temperature of 20 gallons of water 110 degrees

12000 BTUs required to raise the temperature of 20 gallons of water 60 degrees

47400 BTUs required for one system wash(three flushes)

94800 BTUs required for two systems washes per day

3413 BTUs = 1 kWh

27.78 kWh electrical power required to produce hot-water to flush system twice a day

27.78 kWh @ .15 kWh =$4.17 per day @365 day=$1522.05

Therefore, hot-water costs per year for average dairy operation=$1522.05 with no tank loss. Based on Office of Energy efficiency rating the average efficiency of a hot-water tank (90% of dairies visited use electrical hot-water heaters) is 60% thus requiring an additional energy input of 40% results in the estimated electrical cost at $2130.87 electrical costs per year.

Payback Calculations:

Cost of 4 panel solar hot-water heater	=$8000
Yearly savings with solar hot-water supplying 50% of hot-water needs	=$1065.43
Average payback	**=7.5 years**

*Energy Facts Extension bulletin E-1273, Co-op Extension Services Michigan State University quoted 125 gallons per day based on 50 cow herd. The amounts quoted by local dairy suppliers were 120 gallons per day as a minimum and does NOT include hot-water for other cleaning requirements)

APP #6 Renewable Energy Technologies

Photvoltatic panels:

Photvoltatic panels were, until recently, too expensive to be competitive with conventional energy sources. This has changed considerably over the last few years with the increased efficiency of the units.

A photovoltaic cell converts solar energy into electricity by the photovoltaic effect. Until recently the commercial application of solar cells were limited, due to cost considerations, to powering small devices such as electronic calculators, although in remote locations where network electric access was prohibitively expensive, such as in cattle pasture areas, they have been used for water pumping and fence electrification.

With the increasing cost of electricity, especially in Europe, developers have succeeded in producing high efficiency solar cells that can generate electricity at higher efficiencies than conventional solar cells. The main challenge of the PV industry is in terms of producing the most cost efficient technologies (cost-per-watt or $/watt).

Today in Europe many farmers are installing PV panels on barn roof tops and feeding the generated electricity into the electrical grid. P.E.I. given its higher than average sunlight days, seems well placed to utilize this emerging technology. Again as mentioned previously farmers have the advantage in PV because of their ownership of thousands of square feet of rooftop.

Wind Energy:

During the course of our work we did have request from a farm operator for a costing of wind turbine units. As a result we spoke with Entegrity Energy Systems and completed some preliminary research on wind turbines. We received a quote from Integrity for a 40 kW unit costing approximately $200,000 for 40 kW unit(similar unit installed at Superior Sanitation site). Based on present day electrical costs with 7-10 year payback, depending on energy consumption. Site analysis for wind resources and load requirements would have to be assessed.

An additional challenge for Island farmers that must be kept in mind is that a large percentage of wind turbine units deliver three phase power and although phase convertor are readily available which also the conversion back to 1 phase electricity, the phase conversion does involve some loss of efficiency.

As mentioned previously in this report two significant advantages that farmers have over others interested in wind energy are their skills in dealing with electrical and mechanical devices as well as their land holdings which reduces consultations with land owners and possible complaints regarding degradation of view scapes and noise pollution.

Bio energy

Bio energy is perhaps one of the most active areas of exploration for renewables in P.E.I. Bio energy covers a large number of energy producing sources including: thermal conversion (e.g., wood burning)anaerobic digestion (biogas), biodiesel and ethanol.

Thermal conversion is generally related to the conversion by burning or gasification of bio-solids or biomass to energy. Generally a bio-solid is defined as a renewable source of fixed carbon in the short term, i.e., less than 10-20 years. This includes wood (Short rotation coppice willow, poplar), grasses and agricultural crops/residues. The activity around thermal conversion has grown over the pass few years with the introduction of a variety of burners such as pellet stove and a host of other bio-solids that can burn wood chips and a variety of grains.

Given that P.E.I. is an agriculture province there are a variety of sources that can provide bio-solids if the infrastructure, government policy and market can be rationalized to support the industry.

Anaerobic digestion (biogas)

Anaerobic digestion(biogas) production is one of the more interesting bio-energy technologies that uses the “everyday” waste that every livestock and dairy operation produces, that is, manure.

Anaerobic digestion is a natural process that has been used for centuries to produce what is essentially methane gas through the fermentation of waste in an oxygen free environment. One of the great benefits of anaerobic digestion is that through the process the quality of the waste product i.e. manure is improved as the organic nitrogen that was digested has been converted into inorganic forms, mostly ammonia. Inorganic nitrogen is more easily absorbed by plants and as a result the digested material is a higher quality fertilizer. In addition the odor and pathogen levels of the waste material are greatly reduced during the digestion process.

Bio-Diesel is essentially vegetable oil or at times animal fats that is treated to remove the gyclerins, which can under certain circumstances, harm a diesel engine.

Biodiesel was the original diesel, fossil-based diesel was developed after the invention of the diesel engine by Eric Von Diesel.

Biodiesel has properties quite similar to conventional diesel fuel, however the level of emission is less than conventional. Biodiesel in a standard diesel engine reduces emissions of carbon monoxide, unburned hydrocarbons, sulfates, nitrated polycyclic and particulate matter.

Diesel blends containing up to 20% biodiesel can be used in nearly all diesel-powered equipment while still maintaining fuel warranty standards and it has been generally found that higher-level blends and even pure biodiesel can be used in many engines with little or no modification.

One of the advantages of bio-diesel is that its production requires very little in the way of specialized production equipment and it can be used in standard diesel transport and storage equipment. One challenge of biodiesel use in a cold climate is that it can thicken and thus create difficulty with engine startup as temperatures drop.

App #7

P.E.I. Farm Energy Conservation Project

64 Lilly Dr. Charlottetown, P.E.I., C1A 7J8

626-4364, david@ecopei.ca

FAX TO: Attention Tracy Sinnott, Maritime Electric, 629-3630

Farm Producer Consent Form for Release of Electrical Usage Amounts 2007

to Young Farmer Association's Farm Energy Conservation Project

PLEASE PRINT CLEARLY

________________________________/______________________

Full Name /telephone

____

Address

Farm Consent for Release of Electrical Usage Information

I, ____, hereby authorize the Young Farmer Association's Farm Energy Conservation Project to request and retrieve my

electrical usage totals for 2007 and 2008 from Maritime Electric for determining methods and technologies that may enable my farm operation to reduce electrical usage.

I understand that the Young Farmer Association 's Farm Energy Conservation Project will not release my information to parties other than myself unless I request so in writing.

____/______________________

Signature /Date

For additional information contact: Project Co-ordinator, David MacKay 626-4364

P.E.I. Farm Energy Conservation Project

64 Lilly Dr. Charlottetown, P.E.I., C1A 7J8

626-4364, david@ecopei.ca

App #8

On Farm Energy Fuel Totals 2007

FAX TO: 902-892-9699

PLEASE PRINT

___________________________________/________________________

Full Name /Telephone

On Farm Energy Fuel Totals 2007

Fuel Type	Volume(s)
Diesel	
Furnace Oil	
Propane	
Electricity(kw) #	
Wood (cords)	
Other	-

This may be provide through Maritime Electric with the faxing of the consent form.

For additional information contact:

Project Co-ordinator, David MacKay 626-4364

App #9

Scotiabank Predicts Oil Rebound

The Globe and Mail, David Parkinson

November 28, 2008

“Oil prices have become so oversold that they will stifle investment in new production and eventually lead prices back up near $100 (U.S.)” a barrel, said Bank of Nova Scotia commodities expert Patricia Mohr. However, it may take a couple of years to get there.

In an interview yesterday, Ms. Mohr predicted the price of crude would hover in the current $50-a-barrel area "for the next six months"as the slowing global economy keeps a lid on demand. However, she said that with tight credit conditions and a lack of government funding likely to result in slowing production from cash-strapped Russia, and with the Organization of Petroleum Exporting Countries to consider output cuts as early as its meeting this weekend, a slowdown in supplies should support oil prices in the second half of next year.

More importantly, she said, prices in the $50 range make many investments for development of key new oil sources uneconomic - meaning the prospects for significant increases in oil production will be put on hold as long as prices remain relatively low. The resulting slowdown in capital spending on new production, she said, would leave the market looking under supplied once the global economy recovers, something she believes could begin in the second half of 2009.

"That's going to set the stage for a strong [price] rebound," she said - predicting that average prices could top $95 a barrel in the2011-13 period.

Ms. Mohr's outlook came as she released her monthly Scotiabank Commodity Price Index report for October - in which plunging oil was the leading factor in sending the index down 15.6 per cent in the month, its worst performance in its 36-year history. The index measures price performance across Canada's key exported commodities.

The oil and gas subindex tumbled 21.8 per cent from September, and Ms. Mohr noted that prices have continued to fall in November, which should further weigh down the overall index.

Ms. Mohr's views on oil investment prospects, which were highlighted in the report, got some timely support yesterday from Royal Dutch Shell PLC. The energy giant put its proposed Carmon Creek oil sands project in Alberta on hold, while it looks at ways to bring costs down to improve the project's economics.

But while the relative bargain oil prices may serve to constrain new supplies, analysts at Merrill Lynch argued this week that they should do little to spur demand - which they predicted would slump 0.5 percent globally next year.

Merrill commodity strategist Francisco Blanch estimated that each10-per-cent drop in the price of crude results in only a 0.1- to0.5-per-cent rise in demand, depending on the region of the world in question. He said the economic cycle has a bigger impact on demand than price, as consumers' reduced purchasing power largely offsets the benefits of lower oil prices.

"Oil demand growth almost always found a trough with the business cycle, in every recession since the 1970s."

However, Mr. Blanch said in a separate report that volatility in the energy futures market has eased in the past week, implying that the oil market might at least be stabilizing after its sharp declines - which were brought on by the "credit shock" that triggered a massive liquidation of energy futures by hedge funds.

Ms. Mohr noted that while hedge funds have exited many long positions in oil amid the credit crisis - in some cases permanently, as some hedge funds were wound down - other hedge funds have been piling into short positions in oil futures in record volumes, to profit on the downturn.

"Those positions can be unwound at some point when the market turns around," she noted - which implies that the hedge funds could still provide fuel for a rebound in oil prices.

Looking at the commodity market as a whole, Ms. Mohr predicted that the Scotiabank Commodity Index won't bottom until next spring, as existing long-term pricing contracts governing some commodities expire and are replaced by lower-priced new contracts. However, she predicted the index will have a "very strong rebound" in 2010, driven by a revival in the fast-growing emerging-market economies.

In particular, she said base metals could be poised for a speedy recovery, largely because major metal producers have slashed production much quicker than in most downturns, thanks to the unusually rapid price declines.

"Once emerging markets pick up again, the markets will tighten much quicker than they have normally," she said.

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