MUNICIPALITY OF THE DISTRICT OF CLARE

Clare Community Energy Master Plan
Milestone Two – Setting the Target
Final Report

December 2006

Lewis Engineering Inc.

CLARE COMMUNITY ENERGY MASTER PLAN
MILESTONE TWO – SETTING THE TARGET
FINAL REPORT

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1.0 INTRODUCTION

This report represents Milestone No. 2 of the Clare Community Energy Plan. This report details the measures and projects that will form the basis of the municipality's goal of promoting energy sustainability. The report described the process of determining the short list of renewable energy projects and then presents a detailed feasibility assessment of each short listed project.

A reasonable target for GHG emission reduction is then presented, which incorporates the measures and projects, previously described.

2.0 DEMAND SIDE MANAGEMENT (DSM) OPPORTUNITIES

2.1 GENERAL

The audits of residential, commercial, institutional, municipal, and industrial properties during Milestone 1 yielded important information about how energy is being used within each building or property. In total, well over 100 properties were audited. Our residential and small commercial auditing team focussed mainly on building envelopes, heating systems, major appliances, and lighting. Audits of other properties looked at the previous items but also included process equipment, controls, air conditioning systems, and cold storage systems.

The residential program indicated that the municipality has a disproportionate number of large older houses that have relatively inefficient building envelopes. Compared to other municipalities in the province, Clare probably has more older homes per capita than other areas and could benefit more from energy efficiency upgrades. Provincial assistance of up to $2,000 per household through the Energuide for Houses program may soon be augmented by a federal program similar to the previous Energuide program.

The other observation from the audits was a lot of system over capacity, particularly in the seafood processing industry. This is indicative of declining fish catches in recent years that have resulted in many plants operating at less than optimal capacity or system efficiency. Increased modularity of process systems would help to increase efficiency by allowing entire blocks of processing capacity to be turned off when raw material volume is insufficient to require its operation.

The measures described in the following sections are these that have been determined to have the best chance of resulting in significant energy savings within a reasonable period of time. Most measures can also be implemented directly by the property owners or using local contractors.

MEASURE	RATIONALE	ESTIMATED COST	SIMPLE PAYBACK
2.2 General Residential			
1. Where additional attic insulation can be installed, install insulation to provide a minimum measure of R40 in the attic.	The majority of heat loss in an uninsulated house is through the attic. Insulating an attic will have the greatest impact on heating costs in a house.	$700 per house	1 - 4 years depending upon current insulation levels and energy use
2. Install blown in cellular or fibreglass insulation in the exterior walls of the pre 1980's homes that have not yet had additional exterior insulation added.	Older homes either have little or no exterior wall insulation or the insulation installed has settled, leaving gaps of uninsulated wall that lead to increased heat loss.	$2,500 - $5,000 per house	5 - 20 years depending upon current insulation levels and energy use
3. Ensure all attic hatches are insulated to a minimum R40, and that they are tight fitting and provided with weather stripping to prevent warm air leakage into the attic.	Warm air will naturally rise. If it can get into a cold attic, moisture in the air will condense and can cause problems with moisture build-up leading to mould growth, reduced insulation efficiency, and wood rot.	$50 per attic hatch	2 - 5 years
4. Ensure all weather stripping on windows and doors is in good condition or have it replaced.	Weather-stripping is an effective barrier against air leakage into a conditioned space.	$5 per window $20 per door	0.5 - 2 years
5. Ensure all cracks around windows, doors, and other exterior wall penetrations are properly sealed with weatherproof caulking to prevent leakage of cold air into buildings.	Caulking is a cheap and effective means to reduce infiltration of unconditioned outdoor air into a conditioned space.	$400 including labour and supplies for an average house size	1 - 2 years
6. Install foam insulating pads behind the switch and receptacle covers in exterior walls.	These pads can reduce outdoor air infiltration, particularly in older homes.	$0.50 per receptacle or switch	1 - 2 years
7. Replace incandescent lamps with compact fluorescent lamps in all light fixtures that are illuminated for one (1) or more hours per day.	Compact fluorescent lamps use 75% less energy than incandescent lamps while providing similar light output. They also last 8 - 10 times as long while only costing 3 - 4 times as much.	$2 - $8 per fixture	0.5 - 2 years depending upon fixture use
8. Ensure thermostats are set back when the buildings or zones are unoccupied, or install programmable thermostats to automatically set back the temperature.	Programmable thermostats are more accurate than regular thermostats. When programmed correctly, they can prevent unnecessary energy use.	$70 per replacement thermostat	1 - 2 years
9. Adjust door hardware to ensure doors close tightly.	Tight fitting doors have lower levels of air leakage and wasted energy.	$10 - $50 per door	0.5 - 2 years

MEASURE	RATIONALE	ESTIMATED COST	SIMPLE PAYBACK
10. Add additional fibreglass blanket wrap insulation to the exterior of hot water heaters.	Reduce heat loss from tank to surrounding. Reduces energy consumption of the heater.	$20	0.5 - 2 years depending on usage
11 Add a minimum R20 insulation to uninsulated basement walls in heated basements. If basement is unheated, provide a minimum of R20 insulation at basement ceiling.	Reduce heat loss through basement walls to cold ground. Reduce heat loss through floors to cold basement. Up to 20% of heat loss can be through the floor.	$500 - $1,500 for an average house	2 - 5 years depending upon basement usage and heating system efficiency
12. Repair or replace damaged or missing backdraft dampers on dryer vents , ventilation system exhaust penetrations , or other external wall openings.	Reduced infiltration of unconditioned air into the house.	$20	1 - 2 years
13. Install low flow showerheads with a maximum flow of 6 L/min.	Reduces hot water use and energy required to produce it.	$20	0.5 - 1 year depending upon usage
14. When replacing major household appliances, purchase only energy star labelled appliances.	Energy star labelled appliances use 10 - 30% less energy than standard appliances without any significant price premium.	$100 - $300 premium per appliance	2 - 10 years depending upon type of appliance and frequency of use
2.3 General Commercial			
1. Upgrade building insulation and air sealing in heated buildings.	Reduced building heat losses and outdoor air infiltration will reduce the building heating load and heating fuel consumption	$1 - $3/sq.ft	3 - 10 years depending upon cost and energy savings
2. Upgrade building lighting from incandescent, HID or low efficiency fluorescent to high efficiency fluorescent..	Fluorescent lighting produces similar layout levels while using 30 - 75% less energy depending upon the original fixture type. Fluorescent lamps also last longer.	$3 - $300 per fixture depending upon size and type	1 - 5 years depending on cost and operating hours
3. Install programmable thermostats.	Electronic programmable thermostats are more accurate than manual analog thermostats and can prevent unnecessary energy use when programmed correctly. Energy savings of 5 - 10 % are common.	$100 per replacement thermostat	0.5 - 2 years depending on heating plant size and efficiency
2.4 General Industrial			
1. Upgrade building insulation and air sealing in heated buildings.	Reduced building heat losses and outdoor air infiltration will reduce the building heating load and heating fuel consumption	$1 - $3/sq.ft	3 - 10 years depending upon cost and energy savings
2. Upgrade building lighting from incandescent or HID to fluorescent.	Fluorescent lighting produces similar layout levels while using 30 - 75% less energy depending upon the original fixture type. Fluorescent lamps also last longer.	$3 - $300 per fixture depending upon size and type	1 - 5 years depending on cost and operating hours

MEASURE	RATIONALE	ESTIMATED COST	SIMPLE PAYBACK
2.5 General Institutional			
1. Upgrade building insulation and air sealing in conditioned buildings.	Reduced building heat losses and outdoor air infiltration will reduce the building heating load and heating fuel consumption	$1 - $3/sq.ft	3 - 10 years depending upon cost and energy savings
2. Upgrade to high efficiency lighting in buildings over 10 years old.	Fluorescent lighting produces similar layout levels while using 30 - 75% less energy depending upon the original fixture type. Fluorescent lamps also last longer.	$3 - $300 per fixture depending upon size and type	1 - 5 years depending on cost and operating hours
3. Install programmable thermostats.	Electronic programmable thermostats are more accurate than manual analog thermostats and can prevent unnecessary energy use when programmed correctly. Energy savings of 5 - 10 % are common.	$70 per replacement thermostat	0.5 - 2 years depending on heating plant size and efficiency
4. Install low flow showerheads and hot water tank blankets on dhw tanks.	Reduce dhw usage and storage losses. Standard showerheads use 2.5 - 4 gallons per minute. Low flow units use 1.5 gpm.	$25 per showerhead $20 per blanket	1 - 2 years depending upon usage
2.6 General Municipal			
1. Upgrade building insulation and air sealing in conditioned buildings.	Reduced building heat losses and outdoor air infiltration will reduce the building heating load and heating fuel consumption	$1 - $3/sq.ft	3 - 10 years depending upon cost and energy savings
2. Upgrade to high efficiency lighting in buildings over 10 years old.	Fluorescent lighting produces similar layout levels while using 30 - 75% less energy depending upon the original fixture type. Fluorescent lamps also last longer.	$3 - $300 per fixture depending upon size and type	1 - 5 years depending on cost and operating hours
3. Upgrade streetlights to high efficiency lamps. Utilize highly sensitive photocells or solar timers to reduce operating hours.	Streetlights operate for a large number of hours each year and consume large amounts of electrical energy. High efficiency lamps reduce energy consumption and wasted light and improve visibility.	$50 - $200 per fixture	7 - 15 years depending upon fixture size
2.7 Specific Municipal			
1. Conduct optimization study of sewage treatment plant operation.	Variations in the inflow to the sewage treatment plants suggest potential for similar variation in the level of treatment provided throughout the day. Shutting down or slowing down some process equipment during periods of low plant inflow may be possible without effecting the quality of the treatment process. If this is proven as part of the study, energy and operational savings will result. The use of effective micro organisms (EM) is one possible method of reducing energy input requirements to the treatment process.	$3,000 - $5,000	5 - 7 years

MEASURE	RATIONALE	ESTIMATED COST	SIMPLE PAYBACK
2.8 Specific Industrial			
1. Reduce ammonia quantities in refrigeration systems serving plate freezers.	Systems with insufficient refrigerant receiver capacity for the entire system charge must keep some plate freezers in service even if they are not needed in order to avoid excess system pressures. Excess ammonia could be stored or sold and the oldest most inefficiency plate freezers could be isolated from the system and removed from service.	$5,000 including new storage cylinder	1 - 2 years depending upon usage of equipment
2. Replace reciprocating compressor with mini screw compressor to hold refrigerant pressure in system down outside of production hours.	Screw compressors are more energy efficient, particularly at partial load, than reciprocating compressors. Maintaining the system when no production is required involves partial load operation the majority of the time.	$25,000	2 - 4 years depending upon equipment usage
3. Utilize seawater as a cooling system for coolers when seawater temperatures are sufficiently cold.	Operating a refrigerant based cooling unit to maintain a cooler at 4 - 5 deg. C requires continuous energy inputs. Cold seawater is already present in the plant to decontaminate clams. Seawater will be sufficiently cold to replace or supplement existing cooler for at least 2 months of each season.	$2,000 including new seawater piping in plant	3 - 5 years depending upon length of operating season
4. Install strip curtains on cooler doors.	During truck loading or unloading operations, doors can remain open for up to 2 hours continuously. Strip curtains can help to reduce the loss of cold air from the cooler without a significant disruption to operations.	$800	5 - 10 years depending upon frequency of loading operations.
2.9 Specific Commercial Institutional			
1. Install infra red temperature sensors to control the ice making plant.	Traditional ice making plants are controlled based upon temperature. The compressor plant starts and stops based upon maintaining a set brine temperature. This can lead to excessive plant run time when the ice is not being used. Infra red sensors detect ice surface temperature and provide much more accurate control and better ice quality. Energy savings of 10 - 15% can be expected based on operating schedules.	$25,000	3 - 5 years based on operating schedule

MEASURE	RATIONALE	ESTIMATED COST	SIMPLE PAYBACK
2. Install compressor waste heat recovery system to produce domestic hot water.	Ice arenas require a great deal of hot water for resurfacing. The heat in the resurfacing water must be removed by the ice making plant to sustain the ice surface. Recovering waste heat form the refrigeration cycle that us currently rejected outside to the condenser would reduce the cost of heating the water with either oil or electricity. Assuming 40 - 45 flood, per week during a 20 week operating year and 600 litres per flood with water at 40 deg. C will require approximately 18,000 kWh of energy input to heat the water. Sufficient waste heat is available to replace 90% of this load resulting in savings of 16,200 kWh per year.	$15,000	7 - 10 years
3. Install boiler water temperature reset control.	Boiler water temperatures are typically set at a temperature high enough to meet the building's heating requirements or the coldest winter day. Even on mils days, the boiler fires to maintain its water temperature at this high setting. A control set-up that adjusts boiler water temperature according to outdoor air temperature has been proven to save up to 5% of fuel costs.	$2,000	2 - 3 years
4. Install outdoor enthalpy economizer on central air conditioning unit.	Traditional air handling unit set-ups have a fixed amount of fresh air to maintain adequate ventilation but do not adjust to take advantage of free cooling potential of additional outdoor air or decreased cooling load through decreased outdoor air in summer. An enthalpy economizer will automatically adjust the outdoor air quantities to ensure maximum unit efficiency while maintaining adequate ventilation.	$1,000 for equipment less than 10 years old. $3,000 for older equipment	2 - 7 years depending upon age and operating schedule of unit
5. Install night covers on open top freezer display units.	Open top freezer display units in grocery stores are maintained at -18 deg. C or lower. Store is open approximately 72 hours per week which leaves 96 hours per week that the freezer units operate with no customers in the store. Styrofoam covers placed over the freezers during unoccupied hours will reduce energy losses by 50%.	$500 to cover 2 10' x 4' freezers.	09.5 - 1 year depending upon hours of operation

MEASURE	RATIONALE	ESTIMATED COST	SIMPLE PAYBACK
6. Reject compressor room heat into the building during the heating season.	Large grocery stores typically group their refrigeration compressors together in one room to make it easier for service access and noise control. Compressor operation produces heat that must be removed from the compressor room to prevent equipment overheating. This heat is usually rejected outside although it could be directed into the building during the heating season to reduce reliance on oil fired or electric heat.	$500 for damper, fan and ductwork	1 - 2 years
7. Install multispeed exhaust fans on kitchen exhausts.	Most commercial kitchen exhaust systems run continuously when the kitchen is open, even if the kitchen is not busy. Energy expended heating or cooling the air in the kitchen is lost when it is exhausted. Much less exhaust capacity is required when the kitchen is not busy so reducing the exhaust quantity by 50% or more will reduce fan power consumption and loss of conditioned air. If the kitchen is provided with other ventilation the exhaust hood could be shut off completely during periods of low kitchen activity using a time clock or other device.	$250 for multispeed motor and controls $100 for a time clock	1 - 2 years depending upon kitchen workload
8. Relocate freezer and cold room condensers outside.	refrigeration system condensers located inside have less capacity to reject heat, resulting in the compressor having to work harder to maintain system temperature. Relocating them outside or to a room with adequate outdoor air ventilation, will improve system efficiency by 5 - 10%.	$200 - $500 depending upon size of condenser and relocation distance	2 - 5 years depending on equipment operation

3.0 RENEWABLE ENERGY OPPORTUNITIES

3.1 OPPORTUNITY "LONG LIST"

3.1.1 Biomass

.1 Université Sainte-Anne: Wood chip, and potentially, wood waste fuelled conventional steam or hot water boiler heating plant to heat the buildings currently connected to their existing campus district heating system, either supplementing the existing oil fired boilers or relegating them to back-up mode. The feasibility of extending the DH system to include other nearby buildings will also be examined. The biomass fuel for this plant would have to be purchased.

.2 Université Sainte-Anne: Similar project to the above, but including a steam turbine/generator operating in a cogeneration mode. Under this concept, the DH system would receive its heat from an extraction from the steam turbine, rather than from the boiler directly. The electricity produced would be used, to the extent possible by the university, with excess electricity sold to Nova Scotia Power for now. Later, when regulations change to permit sale of electricity directly to outside consumers by wheeling over the NSP distribution system, this will be another option.

.3 Université Sainte-Anne: Wood chip fuelled cogeneration system but using gasification technology rather than combustion technology.

Each of the systems noted in .1 through .3 have several ownership and business options (as do most of the projects on this list), including 100% owned by the University; owned by a partnership of the Université and the Municipality; a PPP between the Université, and the private sector, or the University, private sector and Municipality; etc., and each option operated by one or more of the owners, or by an outside firm under contract to the owners.

.4 Municipality: A central wood fuelled heating or cogeneration plant, coupled to a district heating system for heating a small cluster of residences and buildings, e.g., in the area around Villa Acadienne in Meteghan.

.5 Comeau Lumber: Upgrade of existing wood waste fuelled turbine/generator to extract steam from the existing extraction port on the turbine, rather than from the boiler directly. This will increase the cycle efficiency of the plant by producing more useful energy from the steam.

.6 Spectacle Lake Hog Farm: Wood chip and wood waste fuelled heating or cogeneration plant, with a small district heating system to provide heat for existing buildings. The biomass would be obtained from the Spectacle Lake private wood lot.

.7 Spectacle Lake or 340 Coop: Gasification of mink carcases to produce heat, which would be extracted via an exchanger to produce useable heat or to produce power. Again, in the case of such a project at Spectacle Lake, a small district heating loop could be installed.

.8 Ecole Secondaire de Clare: Wood chip fuelled heating or cogeneration system using purchased wood chips.

.9 A.F. Theriault Sawmill: wood waste cogeneration to provide three phase power (they currently use a diesel generator for this).

3.1.2 Biogas

.1 Spectacle Lake Hog Farm or 340 Coop: Gasification of mink carcasses to generate a synfuel, i.e. a biogas fuel to be consumed in an internal combustion engine to generate electricity and heat.

.2 Spectacle Lake Hog Farm: An anaerobic digestion system for hog manure, and potentially mink carcasses, producing biogas for cogeneration, and an effluent stream which could be dewatered for production of compost.

.3 Spectacle Lake/Municipality: Extension of item 2.2 to include residential and ICI organic waste, sewage treatment plant waste, and septic tank waste.

3.1.3 Mini Hydro

This would be classified as a small run-of-river hydroelectric development, without any impoundment, typically with an output of less than 1 MW; there are three potential sites to be considered:

.1 Indian Falls on the Meteghan River (130 – 200 kW range).

.2 South Branch Meteghan River near St. Benoni (80 – 120 kW range).

.3 Bangor Sawmill, Meteghan River (less than 50 kW).

3.1.4 BioFuels

.1 Comeau Sea Foods: Herring oil from meal plant can be converted to a bio fuel oil using a commercially available transesterification process. The resulting bio fuel can then be blended with petroleum diesel in an 80/20 petroleum to bio oil blend for use in space heating, vehicles, or fishing vessel. The bio oil facility would have an initial capacity of approximately 400,000 litres per year based upon the current herring oil production.

.2 Spectacle Lake Hog Farm or 340 Coop: Rendering of mink carcasses to obtain oil for processing into a bio fuel oil. The remaining solid carcasses would have to be composted.

.3 Municipality/Others: Ethanol production using agricultural products, such as corn, that would be grown elsewhere in the province.

.4 Addition of waste restaurant oil as a supplement for any of the above bio-oil options.

3.1.5 Wind

.1 Private Developer: Site north of Cape St. Mary's within 1 – 2 km of the coast. This would comprise one or more large turbines, likely greater than 1 MW.

.2 Comeau Sea Foods: Site adjacent to plant in Saulnierville, comprising small turbines (in the 50 kW range).

.3 Université Sainte-Anne/Municipality/Others: Wind farm of small turbines adjacent to the university.

.4 Municipal/Private Developers: A small turbine wind farm at a site south of Meteghan.

.5 Spectacle Lake Hog Farm: Small turbine(s).

.6 Municipality: Single small turbine for the municipal building.

3.1.6 Tidal In-Stream Energy Conversion (TISEC) Systems

The technology that is currently being considered is relatively new, and not yet commercialized to the point where we would recommend it. Also, the local potential sites (except for the Meteghan River tidal estuary, which may have some potential for a small project), while in Digby County, are not actually in the Municipality of Clare.

We understand that the province, via the Department of Energy, may be considering a small demonstration project in the area, but we are not familiar with the details of this. For now, we recommend that TISEC systems not be included in the Clare Community Energy Plan.

3.1.7 Solar

Only solar thermal heating has been considered, as solar photovoltaic systems are completely non-viable financially, unless in a remote non-grid application which provides little opportunity for demonstration.

.1 Municipality/Private: Residential solar thermal units for provision of domestic hot water (homes and small buildings).

.2 Université Sainte-Anne: Solar thermal units for DHW at university buildings.

.3 Ecole Secondaire: DHW solar thermal units.

.4 Municipality/Private: Solar air heaters for homes and small buildings.

.5 Municipality/Private: Solar wall air heaters for larger industrial and/or institutional buildings.

.6 Comeau Sea Foods: Solar thermal units for process, washdown and domestic hot water.

.7 Université Sainte-Anne: Solar combined with earth storage to provide seasonal solar thermal in-ground storage at the university.

.8 Ecole Secondaire: Solar/Heat pump hybrid system utilizing the fire water reservoir as a heat sink.

3.1.8 Heat Pumps

.1 Université Sainte-Anne: Ground source heat pump for heating and dehumidification of the pool building.

.2 Comeau Sea Foods: Water source heat pumps for heating and cooling.

3.1.9 Combined Technologies

.1 Municipality – New Medical Centre: Demand side management, together with some combination of solar, ground source heat pumps, non-potable water utilization, and small wind turbine.

.2 Université Sainte-Anne: Demand side management, small wind turbine, biomass heating, and solar DHW.

3.2 EVALUATION CRITERIA AND MATRIX

The enclosed evaluation matrix was used to objectively rank the long list of proposed renewable energy projects using a set of criteria agreed upon with the project steering committee. Each criteria received a score between one (1) and five (5) which was then multiplied by its cumulative weighting to arrive at a total weighted score. Due to the fact that the evaluation criteria affected some categories differently than others, numerical comparisons of scores between categories were not made. We were attempting to demonstrate which project or projects within each category showed the greatest strength and thus the greatest chance of implementation and successful operation.

3.3 OPPORTUNITY "SHORT LIST"

The enclosed list shows ten (10) projects that were evaluated and selected as a "short list" for further evaluation. These projects were selected using the evaluation matrix and a number of other selection criteria such as the following:

- Ensure all technology sectors are represented.
- Ensure project has host support.
- Ensure each project sponsor receives at least one short list project.
- Ensure project is implementable.

This short list was presented to and approved by the project steering committee.

			1.1 - USA - Biomass Heating		1.2 - USA - Cogen Boiler		1.3 - USA - Cogen Gasifier		1.4 - Villa - Area Biomass/DH		1.5 - Comeau Lumber - Cogen Mods		1.6 - Spec. Lake Biomass		1.7 - Spec. Lake/340 Coop - Mink Gasification		1.8 - Ecole Secondaire - Biomass	
	Cmt. Wt.	Weighting Score	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.
Local Support - Go / No Go																		
Private Sector		Yes / No																
Government Sector		Yes / No	Yes		Yes		Yes		Yes		Yes				Yes		Yes	
Community		Yes / Nc																
Resource Availability																		
Fuel	4	Easily Available - 5	4	16	4	16	4	16	4	16					5	20		
Land	2	Difficult - 1	5	10	5	10	5	10	3	6					5	10		
Local Work Force	2																	
Technology																		
Proven	4	1 - 5	5	20	5	20	3	12	5	20					1	4		
Local Manufacturer	1	1 - 5 (N.S.)	2	2	2	2	1	1	2	2					1	1		
Local Tech Support	1	1 - 5 (N.S.)	4	4	4	4	2	2	4	4					2	2		
Local Service Suppor	1	1 - 5 (SW N.S.)	3	3	2	2	1	1	3	3					1	1		
Regulatory		1 - Problematic																
		5 - No Problems																
Environmental Permit Issues	2	1 - 5	4	8	4	8	4	8	3	6					2	4		
Municipal Zoning Issues	2	1 - 5	5	10	5	10	5	10	3	6					4	8		
Utility Connection Issues	2	1 - 5	5	10	3	6	3	6	4	8					4	8		
Social																		
Visibility	2	5 - High 1 - Low	4	8	4	8	4	8	5	10					1	2		
Local Benefits	2	5 - High 1 - Low	4	8	5	10	4	8	4	8					1	2		
Environmental																		
Emission Reduction	2	5 - High 1 - Low	2	4	3	6	5	10	2	4					2	4		
Local Pollution Reductior	2	5 - High 1 - Low	2	4	2	4	4	8	2	4					4	8		
TOTAL PROJECT SCORE			**49**	**107**	**48**	**106**	**45**	**100**	**44**	**97**	**120**	**0**	**0**	**0**	**33**	**74**	**0**	**99**

	1.9 - Theriault - Biomass		2.1 - Spec. Lake - Mink Gasification		2.2/2.3 - Spec. Lake - AD/Biogas		3.1 - Mini Hydro		4.1/4.3 - Comeau Sea Foods - Bio-diesel		4.2/4.3 - Spec. Lake/340 Coop - Mink Bio-diesel	
	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.
Local Support - Go / No Go												
Private Sector												
Government Sector	No		Yes		Yes		Yes					
Community												
Resource Availability												
Fuel			5	20	4	16	5					
Land			5	10	5	10	2					
Local Work Force					1	4						
Technology												
Proven			3	12	4	4	5					
Local Manufacturer			1	1	3	3	2					
Local Tech Support			1	1	5	5	4					
Local Service Suppor			1	1	5	10	4					
Regulatory												
Environmental Permit Issues			2	4	2	4						
Municipal Zoning Issues			4	8	5	10						
Utility Connection Issues			4	8	4	8						
Social												
Visibility			1	2	1	2						
Local Benefits			2	4	3	6						
Environmental												
Emission Reduction			3	6	2	4						
Local Pollution Reductior			4	8	3	6						
TOTAL PROJECT SCORE	**0**	**0**	**36**	**85**	**47**	**92**	**22**	**0**	**0**	**0**	**0**	**0**

			5.1 - Private - Large Wind Turbine(s)		5.2 - Comeau - Wind Turbine		5.3 - USA - Small Wind Turbine		5.4 - Private - Small Wind Farm		5.5 - Spec. Lake Small Wind Turbine		5.6 - Municipality - Small Wind Turbine		7.1 - Residential Solar DHW		7.2 - USA - Solar DHW		7.3 - Ecole Secondaire - Solar DHW		7.4 - Municipality/ Other - Solar Air Heaters		7.5 - Private - Industrial Solar Wall		7.6 - Comeau - Solar Hot Water		7.7 - USA - Solar Thermal/Earth Storage		7.8 - Ecole Secondaire - Solar/Fire Water Reservoir	
	Cmt. Wt.	Weighting Score	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.
Local Support - Go / No Go																														
Private Sector		Yes / No																												
Government Sector		Yes / No																												
Community		Yes / Nc																												
Resource Availability																														
Fuel	4	Easily Available - 5																												
Land	2	Difficult - 1																												
Local Work Force	2																													
Technology																														
Proven	4	1 - 5																												
Local Manufacturer	1	1 - 5 (N.S.)																												
Local Tech Support	1	1 - 5 (N.S.)																												
Local Service Suppor	1	1 - 5 (SW N.S.)																												
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Environmental Permit Issues	2	1 - 5																												
Municipal Zoning Issues	2	1 - 5																												
Utility Connection Issues	2	1 - 5																												
Social																														
Visibility	2	5 - High 1 - Low																												
Local Benefits	2	5 - High 1 - Low																												
Environmental																														
Emission Reduction	2	5 - High 1 - Low																												
Local Pollution Reductior	2	5 - High 1 - Low																												
TOTAL PROJECT SCORE			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

	Cmt. Wt.	Weighting Score	8.1 - USA - Ground Source Heat Pump		8.2 - Comeau - Water Source Heat Pump		9.1 - Municipality - Combined Technologies		9.2 - USA - Combined Technologies	
			Score	Total Wt.	Score	Total Wt.	Score	Total Wt.	Score	Total Wt.
Local Support - Go / No Go										
Private Sector		Yes / No								
Government Sector		Yes / No								
Community		Yes / Nc								
Resource Availability										
Fuel	4	Easily Available - 5								
Land	2	Difficult - 1								
Local Work Force	2									
Technology										
Proven	4	1 - 5								
Local Manufacturer	1	1 - 5 (N.S.)								
Local Tech Support	1	1 - 5 (N.S.)								
Local Service Suppor	1	1 - 5 (SW N.S.)								
Regulatory		1 - Problematic								
		5 - No Problems								
Environmental Permit Issues	2	1 - 5								
Municipal Zoning Issues	2	1 - 5								
Utility Connection Issues	2	1 - 5								
Social										
Visibility	2	5 - High 1 - Low								
Local Benefits	2	5 - High 1 - Low								
Environmental										
Emission Reduction	2	5 - High 1 - Low								
Local Pollution Reductior	2	5 - High 1 - Low								
TOTAL PROJECT SCORE			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

LONG LIST EVALUATION SUMMARY

Note: Shaded cells indicate projects recommended for the short list detailed evaluations

Measure	Weighted Score
1.1 - USA - Biomass Heating	126
1.2 - USA - Cogen Boiler	119
1.3 - USA - Cogen Gasifier	111
1.4 - Villa - Area Biomass/DH	111
1.5 - Comeau Lumber - Cogen Mods	111
1.6 - Spec. Lake - Biomass	97
1.7 - Spec. Lake/340 Coop - Mink Gasification	76
1.8 - Ecole Secondaire - Biomass	114
1.9 - Theriault - Biomass	0
2.1 - Spec. Lake - Mink Gasification	94
2.2/2.3 - Spec. Lake - AD/Biogas	108
3.1 - Mini Hydro	111
4.1/4.3 - Comeau Sea Foods - Bio-diesel	110
4.2/4.3 - Spec. Lake/340 Coop - Mink Bio-diesel	100
5.1 - Private - Large Wind Turbine(s)	111
5.2 - Comeau - Wind Turbine	115
5.3 - USA - Small Wind Turbine	113
5.4 - Private - Small Wind Farm	105
5.5 - Spec. Lake - Small Wind Turbine	108
5.6 - Municipality - Small Wind Turbine	111
7.1 - Residential Solar DHW	125
7.2 - USA - Solar DHW	125
7.3 - Ecole Secondaire - Solar DHW	123
7.4 - Municipality/ Other - Solar Air Heaters	119
7.5 - Private - Industrial Solar Wall	103
7.6 - Comeau - Solar Hot Water	125
7.7 - USA - Solar Thermal/Earth Storage	99
7.8 - Ecole Secondaire - Solar/Fire Water Reservoir	112
8.1 - USA - Ground Source Heat Pump	114
8.2 - Comeau - Water Source Heat Pump	112
9.1 - Municipality - Combined Technologies	116
9.2 - USA - Combined Technologies	115

4.0 RENEWABLE ENERGY OPPORTUNITY "SHORT LIST" FEASIBILITY ASSESSMENTS

4.1 UNIVERSITÉ SAINT ANNE, COMBINED TECHNOLOGIES PROJECT

4.1.1 Introduction

4.1.1.1 Project Overview and Host

The central heating plant at Université Sainte Anne was identified as a potential site for renewable energy opportunity, namely a wood chip fired district-heating system. The current heating plant consists of four (4) oil fired hot water boilers connected to a district heating system. The proposed new heating plant would see the installation of a wood chip fired district heating plant supplying the existing system as well as the expansion of the hot water distribution system to include additional buildings both on campus and off campus. The oil fired boiler plant would remain as a backup system to the new wood fired system. The wood fired heating plant would use very well proven technology to provide a reliable cost effective source of thermal energy for the campus using an underutilized local resource. The university student body is primarily in residence so there is a large on campus residential population relative to the overall size of the university. The domestic hot water demand is quite large this providing an opportunity for solar domestic hot water heating to reduce the load on the central plant, particularly in the summer. The seaside location of the campus makes it a good candidate for wind generation. A small wind turbine could reduce reliance on purchased energy from NSPI without requiring a power purchase agreement.

4.1.1.2 Summary of Financial Analysis

The new wood fired boiler would burn locally produced wood chips. The chips could be any blend of hardwood or softwood. After discussions with local business people and investigation of other local users of wood chips we have determined that a reasonable price for wood chips delivered to the plant would be in the order of $50/ton.

Current heating cost with oil (based on $0.62/L) is approximately $403,000.
Annual operating cost with a wood chip heating would be approximately $291,000.

So based on current fuel pricing the university could realize an annual operating cost savings of $112,000.

The approximate cost of installing a wood chip fired system is $1,650,000. This would result in a simple payback of fifteen (15) years.

Installing solar domestic hot water heating systems in the nine residential buildings on campus is expected to yield a positive return on investment of between 5% and 10%.

The small wind turbine has a relatively high cost per unit of energy capacity. Despite the good wind regime along the coast of St. Mary's Bay, this wind turbine is not considered a good investment on its own. When combined with the other two (2) technologies, however, a positive return on investment can be achieved.

As a financial test we always look at the viability of any project from the perspective of a private investor to see if it would be feasible. Using the assumptions listed above we have determined the Return on Equity for this combined technologies project over its twenty-five (25) year life would be in the range of 4%. This may not be high enough to interest a private developer, but to an institution like Université de Ste. Anne, may be considered attractive because it results in reduced operating costs.

4.1.2 Project Description

The conceptual design for this plant would see a new plant constructed behind the existing heating plant. The oil fired boiler plant would remain as a backup system to the new wood fired system. For a wood fired heating system, we would extend the existing hot water distribution system to include the Lapointe and Potevine systems. Solar domestic hot water systems would also be installed in each of the nine residence buildings. These systems would be integrated with the district heating system to ensure a continuous supply. The final requirement would be a 50 kW wind turbine located at the rear of the campus near the shoreline.

4.1.2.1 Project Components

The new central heating plant would consist of a single wood fired hot water boiler system capable of supplying the peak winter heating demand. The new equipment would consist of:

- Wood chip reclaim system from storage, sized for forty-eight (48) hour storage capacity
- Fuel conveying system from storage to boiler room
- Energy recovery boiler with trim components
- Structural Supports
- Automatic ash conveying system
- Flue gas vent system with ducting and supports
- Emission control of multi cyclone type
- Induced draft fan
- Control System for automatic operation.
- Computer Operator Interface
- Variable frequency drives for combustion air fans and ID fan
- Refractory installation.
- Mechanical Installation
- Electrical Installation
- Building
- Commissioning and start-up assistance
- Engineering
- Project Management

The solar dhw systems will consist of the following:

- Rooftop or support frame mounted solar panels
- Fluid piping
- Heat exchanger
- dhw storage tank
- Circulating pump

The wind turbine would consist of the following:

- wind turbine
- 30 m tower
- concrete tower base
- electrical system connection
- transformer
- control panel

4.1.2.2 Assumptions and Parameters

The following assumptions and parameters were used:

Current fuel oil pricing	-	$0.62/L
Current delivered wood chip pricing	-	$50/ton
Peak heating load for new plant	-	400 boiler horsepower
Extra staff required	-	one operator
Fuel high heating value	-	4,180 but/lb
Fuel moisture	-	50%
Average boiler load	-	2.34 million btu/hr
Plant availability	-	100%
Debt equity ratio	-	50 : 50
Debt interest rate	-	7.5%
Depreciation straight line	-	30 years
Average wind speed at site	-	7 m/s

4.1.2.3 Natural Resource Availability

The natural resource in this case is locally harvested hardwood and softwood. We have had some discussion with local business people involved in the forest industry: Denis Tufts, Hubert Leblanc and Arcade Comeau. Today hardwood firewood sells for $26.00 to $30.00 per ton roadside, freight and HST extra. Small hardwood that is not in demand for firewood sells for $24 per ton. It is possible to buy a mixture of pine/hemlock/larch for $17 per ton; presently it is really waste. Trucking rates are$8 for less than 40 km and $10 for more distance. La Foret Acadienne sells 3,000 cords of pulpwood to Bowater. Mr. Arcade Comeau estimates that that an acre of woodland around Clare grows one cord of wood fibre per year. He says also there is lots of aspen in Annapolis County, and that Irving has a good chipper presently in Weymouth. His view is that there is a sustainable harvest of presently unused fibre of somewhere between 3,000 and 10,000 cords per year depending on the mix required. An additional fuel resource available is construction and demolition waste. There is an estimated 1,000 – 1,500 tonnes of wood waste at the municipal construction and demolition waste site. Operators there have done a good job of removing metals, shingles, and drywall so the wood waste piles are reasonably free of contaminants. Some of the waste has been shipped previously, and is stored at the site as piled chips. Between 200 – 300 tonnes of construction and demolition waste if received at the waste site annually.

The solar resource in Clare is reported to be among the best in Nova Scotia. Persistent fog along the coast may reduce the effectiveness of solar panels at the University compared to sites further inland. The coastal wind regime in Clare is considered good with average wind speeds between 6.5 and 7.5 m/s.

4.1.2.4 Operations and Maintenance Requirements

The proposed heat system would involve more maintenance than the existing oil fired system. Solid fuel handling is more difficult and involves hoppers and conveyors with moving parts and the associated wear related components. For the purpose of the economic model we have allowed one additional operator for the heating plant for dayshift operation. We have also allowed an annual maintenance budget in the financial analysis model. Solar panels require periodic cleaning of the lenses and heat exchanger. The wind turbine requires regular bearing lubrication and inspection.

4.1.3 Regulatory Issues

4.1.3.1 Environmental Impact

The equipment will be located on a university campus in the vicinity of student residences. The majority of the impact will be done to the biomass plant. The following environmental impact is anticipated:

Air Emissions: The wood fired boiler will produce more particulate emissions than an oil-fired boiler. The current system is priced with a mechanical dust collector, which is inexpensive, simple and easy to maintain. At the design stage the particular technology for particulate removal can be addressed and modified as required. An electrostatic precipitator could also be considered which would offer higher removal efficiencies. As wood chips have no sulphur, there will be elimination of virtually all sulphur dioxide emissions. Greenhouse gas will be reduced as calculated in section 4.1.5.1.

Ash: The combustion of wood will involve production of ash. The ash will need to be collected and trucked off site for landfill. The ash content of the wood chips as fired is estimated at 1.2% by weight. This would mean our annual ash disposal volume would be in the order of 3,724 x 0.012 = 45 tonnes/year.

Fuel Supply: The fuel will be delivered to campus in specially designed trailers with a capacity of 30 tonnes. This will require approximately 124 truckloads per year passing through the campus. The trucks can be scheduled for the time of day that causes the least disruption to ongoing campus activities. The on site storage will allow forty-eight (48) hours total to accommodate for delivery disruptions. Also the oil-fired system can be maintained as a backup system.

Noise: The biomass plant can be designed so that there is no net increase in noise levels. There will be noise related issues from truck fuel delivery. The wind turbine can produce low frequency noise fur to the spinning blades. Locating the turbine at the back of the campus and greater than 100 m from the nearest residence should eliminate any potential noise problems.

4.1.3.2 Utility Connections

The utility connections, in this case the connection to the existing hot water distribution system, will be very easy. The new wood-fired heating plant would be build directly adjacent to the existing heating plant. The supply and return piping from the new plant would tie in directly to the existing header. The solar systems will be connected in series with existing domestic hot water systems in each building. The wind turbine will tie in to the campus distribution system downstream of the primary NSPI meter. Protection equipment will be required to prevent unauthorized grid energization. The wind turbine will be connected via a net metering arrangement.

4.1.3.3 Municipality Requirements/Issues

No issues are anticipated unless the district heating system at the campus is extended to surrounding properties. Coordination will be required at that time to avoid conflicts with existing municipal infrastructure.

4.1.4 Social and Economic Impact

Woodlot owners can benefit from the developing markets for wood chip fuel and that income streams generated would help owners deliver environmental and social benefits from their woods to society. Developing a market for low-grade hardwood and softwood timber through wood fuel projects could also make other woodland management operations more economically viable.

The money currently paid for oil would now stay in the community and create employment opportunities in the forest industry. Also from the plant operations aspect, extra jobs will be created to operate and maintain these new wood fired heating plants, while at the same time offering operational savings to the plant owner.

Use of timber from existing woodland could play an important role in sustaining rural communities, providing employment opportunities in timber harvesting and transport and supply chains. This would help to support the forestry sector and would offer valuable diversification opportunities for farmers.

This project will include solar domestic heating and a small wind turbine. Most of the benefits will accrue to the equipment manufacturers some of which are located outside the province.

However, the project will include construction of small structures to house the equipment, as well as electrical and mechanical work, both in installing equipment and modifying existing work. A quantity of concrete, for building foundations and for the wind turbine foundation will be required. The local manufacturer of ready mixed concrete should be well placed to meet this requirement.

In summary, this project would provide work for the local plumbing, electrical and general contractors. The local hardware and building supplies stores as well as the supplier of ready-mix concrete would also play an active role in the project.

4.1.5 Financial Assessment

4.1.5.1 Energy and GHG Emissions Reductions Estimates

Greenhouse gases are emitted when any fossil fuel such as oil is burned. When wood fuel is burned there is no net increase in greenhouse gas emissions, provided that a tree grows in place of the one that was cut down. There are some emissions that are created during the extraction, preparation and transport of the wood chips.

The estimated GHG reduction for this plant is 649,600 L/yr fuel oil saved at the heating plant.

Wood chip transportation related emissions:

Loads Fuel/year	-	124		
Assumed Round Trip Distance	-	60 km		
Truck Fuel Economy – (5 mpg)	-	56 L/100 km		
Annual Transportation Fuel Consumption	=	124 x 60 * 56/100	=	4,166 L

Net GHG Savings	=	(649,600 – 4,166) x 2.76 kg CO_2/L[1] fuel oil / 1000 kg/tonne
Net GHG Savings	=	1,780 tonne/year

A RETScreen analysis was performed for the 50 kW wind turbine to predict its GHG emission reduction potential based on local wind data and NSPI emission intensity factors2. The predicted annual reduction is 122 tonnes/year. The predicted annual GHG emission reduction for the solar dhw systems on nine (9) residences is 2.5 tonnes/year. The total for the project is therefore 1,780 + 122 + 25 = 1,927 tonnes/year.

1 2.76 kg CO_2/L is the emission factor used by Transport Canada for standard diesel fuel.
2 NSPI Emission Intensity Factor used is 0.93 tonnes CO_2e/MWh.

4.1.5.2 Cost Estimates

Capital Cost Estimate (+/-25%)

The following is the capital cost estimate for the combined technologies present. The breakdown of costs includes budget pricing on the boiler system and estimated costs for the remaining equipment and installation costs. All prices are in Canadian dollars, taxes not included.

Boiler System including hoppers and conveyors	$700,000
Water Treatment	$20,000
Feed Pumps	$20,000
Mechanical BOP + Installation	$200,000
Electrical System	$25,000
Instrumentation and Control	$25,000
Civil Works and Buildings	$200,000
Underground Piping Distribution System	$120,000
9 Solar dhw Systems Installed	$75,000
50 kW Wind Turbine Installed	$190,000
Subtotal	**$1,575,000**
Project and Construction Management 5%	$79,000
Engineering 12%	$190,000
Training	$50,000
Financing & IDC 5%	$79,000
TOTAL	**$1,973,000**

Operation and Maintenance Cost Estimate

The following is the cost estimate for the O&M requirements. The costs are based on a delivered fuel price as shown in Section 4.1.2.2. We have also included the cost of one additional staff member to operate and perform small routine maintenance at the biomass plant on the dayshift only.

Fuel	$186,500
Maintenance Contract	$25,000
Operator	$50,000
Wind Turbine Maintenance	$10,000
Solar dhw Systems Maintenance	$2,000
Insurance	$10,000
General Supplies	$10,000
Miscellaneous	$10,000
TOTAL	**$303,500**

4.1.5.3 Financial Feasibility Assessment

The fuel consumption figures for the two-year period from January 2004 to December 2005 were collected to determine energy usage.

The following fuel oil consumption data was collected:

Centre Sportif	-	1,199,910 L
Lapointe	-	58,664 L
Potevine	-	40,624 L
Total 2 Year		**1,299,198L**

Average Yearly Consumption - 649,600 L/yr

At current pricing of $0.62/L the university can expect a fuel oil bill of approximately $402,750 in the next fiscal year. The required cost of heating the campus with wood chips can be determined as follows:

Fuel Oil Heat Content	-	38,000 Btu/L
Assumed Boiler Efficiency	-	83 %

Total required annual heat output to system = 38,000Btu/L x 649,600 L/yr x 0.83%
= 20,488 x 106 Btu/yr

Wood fired boilers have significantly lower efficiency than oil-fired boilers because of the high moisture content of the wood. Typically wood chips contain 50% water by weight. Based on our combustion calculations we are assigning an efficiency of 65.8% for a wood fired boiler. The annual fuel consumption for a wood fired boiler would be as follows:

Heat Input = Heat Output/efficiency

= 20,488 x 106 Btu/yr/0.658 = 31,137 x 106 Btu/yr

Wood Chip Heating Value = 4180 Btu/lb

Annual Wood Chip Consumption = 31,137 x 106 Btu/yr / 4180 Btu/lb / 2,000 lb/ton
= 3,724 tonnes/yr

Savings Analysis

A University owned project would require a significant capital investment but there are significant annual fuel savings that can be realized. In order to determine the net savings for this scenario we examine all the credits and debits to the University associated with building and operating the new plant. Other expenditures associated with running the plant were not considered because there would be no net change to the University. Also debt servicing and plant depreciation costs are ignored.

The credits will be: Less fuel oil purchased, less electricity purchased
The debits will be: Wood fuel cost
Other O&M costs

Credits:	Current Fuel Oil Consumption (Litres)	649,600
	Current fuel oil price ($/Litre)	0.62
	Wind Turbine Production	$132,000 kWh/yr
	Current Average Cost ($/kWh)	0.08
	Current Annual Fuel Cost	$402,750
	Wind Turbine Production Value	$ 10,560
	Total	**$413,310**

Debits:	Wood Fuel	$186,500
	Non-Fuel O&M Cost	$105,000
	Total	**$291,500**

As can be seen from the above – there is significant annual savings to the university from this project of over $120,000 per year.

Investor Owned Plant

As a test for this project we analyzed the biomass plant to see if it would make sense from a private investment scenario. The assumption is that an investor owned plant would sell thermal energy (hot water) to the university at a price similar to what it costs today to produce that energy. In this case it is $20.39/million Btu based on current oil price of $0.62/L. The investor will factor in debt servicing costs as well as plant depreciation costs. The detailed financial model we use will look at all the various inputs to determine:

1. Return on Equity (ROE) which is Net Income divided by Shareholder Equity, where

    - Shareholder Equity = Assets – Liabilities
    - Assets = Original assets – depreciation + retained earnings
    - Liabilities = loan amount – principal payments

2. Return on Assets (ROA), which is earnings before interest and taxes (EBIT) divided by the value of the assets. This financial indicator could also be called Return on Investment

The model outputs for the investor owned plant are included in Appendix A. The output shows a poor Return on Equity of 6.5%. The Return on Assets for this project is 7.1%. This project would not attractive from an investor owned perspective at these rates of return.

Sensitivity Analysis

The following table shows the items within the financial model that were checked for project sensitivity to changes in these items.

Financial Sensitivity Analysis		
Item	**Change from Base Case**	**Return On Equity**
Base Case		6.5 %
Fuel Price	- $20/ton ($30/ton)	15.7 %
Fuel Price	- $10/ton ($40/ton)	11.3 %
Fuel Price	+$10/ton ($60/ton)	1.3 %
Capital Cost	-10%	8.4 %
Capital Cost	+10%	4.9 %
Capital Grant	50%	21 %

4.1.5.4 Conclusions

For a University owned project, there are potential operational cost savings. There are many positive economic benefits for this project including:

- Reduction of GHG
- Creation of local jobs in the forestry sector
- Making use of an under utilized resource.
- Additional employment opportunity at the university
- Keeping the money in Clare.
- Good visibility with wind turbine and solar panels.

4.1.6 Implementation Requirements

Implementation will require support and fundraising support from the university administration.

4.2 VILLA AREA, BIOMASS HEATING PLANT WITH DISTRICT HEATING

4.2.1 Introduction

4.2.1.1 Project Overview and Host

Villa Acadian was identified as a potential site for renewable energy opportunity, namely a wood chip fired district-heating system. The current heating plant consists of individual oil fired hot water boilers at each location. The proposed new heating plant would see the installation of a wood chip fired district heating plant supplying Villa Acadian, Au Logie Du Methagan, Foyer Evangeline, a local convenience store, funeral home as well as twenty-five (25) private residences. The oil fired boiler plants would remain as a backup system to the new wood fired system. The wood fired heating plant would use very well proven technology to provide a reliable cost effective source of thermal energy for the campus using an underutilized local resource.

4.2.1.2 Summary of Financial Analysis

The new wood fired boiler would burn locally produced wood chips. The chips could be any blend of hardwood or softwood. After discussions with local business people and investigation of other local users of wood chips we have determined that a reasonable price for wood chips delivered to the plant would be in the order of $50/ton.

Current heating cost with oil (based on $0.62/L) is approximately $70,000.
Annual operating cost with a wood chip heating would be approximately $59,000

So based on current fuel pricing an annual operating cost savings of $11,000 would be realized.

The approximate cost of installing a wood chip fired system is $659,000. This would result in a simple payback of sixty-six (66) years.

As a financial test we always look at the viability of any project from the perspective of a private investor to see if it would be feasible. Using the assumptions listed above we have determined the Return on Equity (ROE) would be negative for this project over its twenty-five (25) year life.

4.2.2 Project Description

The conceptual design for this plant would see a new plant constructed behind the Villa Acadien nursing home. The oil-fired boilers would remain as a backup system to the new wood fired system. For a wood fired heating system, we would extend the existing hot water distribution system to include Au Logie Du Methagan, Foyer Evangeline, a local convenience store, funeral home as well as twenty-five (25) private residences.

4.2.2.1 Project Components

The new central heating plant would consist of a single wood fired hot water boiler system capable of supplying the peak winter heating demand. The new equipment would consist of:

- Wood chip reclaim system from storage, sized for 48hr storage capacity
- Fuel conveying system from storage to boiler room
- Energy recovery boiler with trim components
- Structural Supports
- Automatic ash conveying system
- Flue gas vent system with ducting and supports
- Emission control of multi cyclone type
- Induced draft fan
- Control System for automatic operation
- Computer Operator Interface
- Mechanical Installation
- Electrical Installation
- Building
- Direct buried underground piping system
- Commissioning and start-up assistance
- Engineering
- Project Management

4.2.2.2 Assumptions and Parameters

The following assumptions and parameters were used:

Current Fuel Oil Pricing	-	$0.62/L
Current Delivered Wood Chip Pricing	-	$50/tonne
Peak Heating Load for New Plant	-	100 Boiler Horsepower
Extra Staff Required	-	One Operator Part time
Fuel High Heating Value	-	4,180 But/lb
Fuel Moisture	-	50%
Average Boiler Load	-	407,000 Btu/hr
Plant Availability	-	100%
Debt Equity Ratio	-	50 : 50
Debt Interest Rate	-	7.5%
Depreciation Straight Line	-	30 years

4.2.2.3 Natural Resource Availability

The natural resource in this case is locally harvested hardwood and softwood. We have had some discussion with local business people involved in the forest industry: Denis Tufts, Hubert Leblanc and Arcade Comeau. Today hardwood firewood sells for $26 to $30 per tonne roadside, freight and HST extra. Small hardwood that is not in demand for firewood sells for $24 per tonne. It is possible to buy a mixture of pine/hemlock/larch for $17 per tonne, presently it is really waste. Trucking rates are$8 for less than 40 km and $10 for more distance. La Foret Acadienne sells 3,000 cords of pulpwood to Bowater. Mr Arcade Comeau estimates that that an acre of woodland around Clare grows one cord of wood fibre per year. He says also there is lots of aspen in Annapolis County, and that Irving has a good chipper presently in Weymouth. His view is that there is a sustainable harvest of somewhere between 3,000 and 10,000 cords per year depending on the mix required.

4.2.2.4 Operations and Maintenance Requirements

The proposed heat system would involve more maintenance than the existing oil fired system. Solid fuel handling is more difficult and involves hoppers and conveyors with moving parts and the associated wear related components. For the purpose of the economic model we have allowed one additional operator for the heating plant on a part time basis. We have also allowed a small annual maintenance budget in the financial analysis model.

4.2.3 Regulatory Issues

4.2.3.1 Environmental Impact

The plant will be located on the site of a nursing home and in the vicinity of private residences. The following environmental impact is anticipated.

Air Emissions: The wood fired boiler will produce more particulate emissions than an oil-fired boiler. The current system is priced with a mechanical dust collector, which is inexpensive, simple and easy to maintain. At the design stage the particular technology for particulate removal can be addressed and modified as required. An electrostatic precipitator could also be considered which would offer higher removal efficiencies. As wood chips have no sulphur, there will be elimination of virtually all sulphur dioxide emissions. Greenhouse gas will be reduced as calculated in Section 4.1.5.1.

Ash: The combustion of wood will involve production of ash. The ash will need to be collected and trucked off site for landfill. The ash content of the wood chips as fired is estimated at 1.2% by weight. This would mean our annual ash disposal volume would be in the order of 649 x 0.012 = 8 tonnes/year.

Fuel Supply: The fuel will be delivered to campus in specially designed trailers with a capacity of thirty (30) tonnes. This will require approximately twenty-two (22) truckloads per year. The trucks can be scheduled for the time of day that causes the least disruption to ongoing neighbourhood activities. The on site storage will allow forty-eight (48) hours total to accommodate for delivery disruptions. Also the oil-fired system can be maintained as a backup system.

Noise: The plant can be designed so that there is no net increase in noise levels. There will be noise related issues from truck fuel delivery.

4.2.3.2 Utility Connections

The utility connections in this case will be the connection to the existing hot water distribution system in each individual building.

4.2.4 Social and Economic Impact

Woodlot owners can benefit from the developing markets for wood chip fuel and that income streams generated would help owners deliver environmental and social benefits from their woods to society. Developing a market for low-grade hardwood and softwood timber through wood fuel projects could also make other woodland management operations more economically viable.

The money currently paid for oil would now stay in the community and create employment opportunities in the forest industry. Also from the plant operations aspect, extra jobs will be created to operate and maintain these new wood fired heating plants, while at the same time offering operational savings to the plant owner.

Use of timber from existing woodland could play an important role in sustaining rural communities, providing employment opportunities in timber harvesting and transport and supply chains. This would help to support the forestry sector and would offer valuable diversification opportunities for farmers.

This project includes a small wood frame building as well as furnaces and heat distribution systems. There will be carpentry, mechanical and electrical work in the building and the equipment housed inside. Local excavation contractors will also benefit from the trenching required for the heat distribution lines.

This project will also require a continuing supply of fuel, which will be harvested locally, thereby providing employment for the wood harvesting sector. In full operation, this system will require several thousand tonnes of wood per year.

4.2.5 Financial Assessment

4.2.5.1 Energy and GHG Emission Reduction Estimates

Greenhouse gases are emitted when any fossil fuel such as oil is burned. When wood fuel is burned there is no net increase in greenhouse gas emissions, provided that a tree grows in place of the one that was cut down. There are some emissions that are created during the extraction, preparation and transport of the wood chips.

The estimated GHG reduction for this plant is 113,000 L/yr fuel oil saved at the heating plant.

Wood chip transportation related emissions

Loads Fuel/year	-	22		
Assumed Round Trip Distance	-	60 km		
Truck Fuel Economy – (5 mpg)	-	56 L/100 km		
Annual Transportation Fuel Consumption	=	22 x 60 * 56/100	=	740 L

Net GHG Savings	=	(113,000 – 740) x 2.76 kg CO_2/L* fuel oil / 1000 kg/tonne
Net GHG Savings	=	300 tonnes/year

* 2.76 kg CO_2/L is emission factor used by Transport Canada for standard diesel fuel.

4.2.5.2 Cost Estimates

Capital Cost Estimate (+/-25%)

The following is the capital cost estimate for a wood chip fired central heating plant. The breakdown of costs includes budget pricing on the boiler system and estimated costs for the remaining equipment and installation costs. All prices are in Canadian dollars, taxes not included.

Boiler System including hoppers and conveyors	$304,000
Water Treatment	$8,000
Feed Pumps	$8,000
Mechanical BOP + Installation	$80,000
Electrical System	$10,000
Instrumentation and Control	$10,000
Civil Works and Buildings	$85,000
Underground Piping Distribution System	$50,000
Subtotal	**$555,000**
Project and Construction Management 5%	$28,000
Engineering 12%	$66,000
Training	$10,000
TOTAL	**$659,000**

Operation and Maintenance Cost Estimate

The following is the cost estimate for the O&M requirements. The costs are based on a delivered fuel price as shown in Section 4.1.2.2. We have also included the cost of one additional staff member to operate and perform small routine maintenance at the plant on the dayshift only.

Fuel	$32,500
Maintenance Contract	$5,000
Operator (Part-Time)	$12,000
Insurance	$5,000
General Supplies	$2,000
Miscellaneous	$2,000
Total	**$58,500**

4.2.5.3 Financial Feasibility Assessment

The following fuel oil consumption data was estimated.

Villa Acadian	30,000 L/yr
Au Loge Du Meteghan	8,000 L/yr
Foyer Evangeline	10,000 L/yr
25 Private Residences	50,000 L/yr
1 Convenience Store	5,000 L/yr
1 Funeral Home	5,000 L/yr
Average Yearly Consumption	**113,000 L/yr**

At current pricing of $0.62/L the fuel oil bill will be approximately $70,000 in the next fiscal year. The required cost of heating the buildings with wood chips can be determined as follows:

Fuel Oil Heat Content – 38,000 Btu/L
Assumed boiler efficiency – 83 %

Total required annual heat output to system = 38,000Btu/L x 113,000 L/yr x 0.83%
= 3,564 x 106 Btu/yr

Wood fired boilers have significantly lower efficiency than oil fired boilers because of the high moisture content of the wood. Typically wood chips contain 50% water by weight. Based on our combustion calculations we are assigning an efficiency of 65.8% for a wood fired boiler. The annual fuel consumption for a wood fired boiler would be as follows:

Heat Input = Heat Output/efficiency

= 3,564 x 106 Btu/yr/0.658 = 5,416 x 106 Btu/yr

Wood Chip Heating Value = 4,180 Btu/lb

Annual Wood Chip Consumption = 5,416 x 106 Btu/yr / 4180 Btu/lb / 2000 lb/ton
= 647 tonnes/yr

Savings Analysis

A community owned plant would require a significant capital investment but there are minimal annual fuel savings that can be realized. In order to determine the net savings for this scenario we examine all the credits and debits to the community associated with building and operating the new plant. Also debt servicing and plant depreciation costs are ignored.

The credits will be:	Less fuel oil purchased
The debits will be:	Wood fuel cost
	Other O&M costs

Credits:	Current Fuel Oil Consumption (Litres)	113,000
	Current fuel oil price ($/Litre)	0.62
	Current Annual Fuel Cost	$70,000
Debits:	Wood Fuel	$32,500
	Non Fuel O&M Cost	$26,000
	Total	**$58,500**

As can be seen from the above – there is small annual savings compared to the capital investment required.

Investor Owned Plant

As a test for this type of plant we analyze the plant to see if it would make sense from a private investment scenario. The assumption is that an investor owned plant would sell thermal energy (hot water) to the community at a price similar to what it costs today to produce that energy. In this case it is $20.39/million Btu based on current oil price of $0.62/L. The investor will factor in debt servicing costs as well as plant depreciation costs. The detailed financial model we use will look at all the various inputs to determine:

1. Return on Equity (ROE) which is Net Income divided by Shareholder Equity, where

    - Shareholder Equity = Assets – Liabilities

- Assets = Original assets – depreciation + retained earnings
- Liabilities = loan amount – principal payments

2. Return on Assets (ROA), which is earnings before interest and taxes (EBIT) divided by the value of the assets. This financial indicator could also be called Return on Investment

The model outputs for the investor owned plant are included in Appendix C. The output shows negative return. This project would not attractive from an investor owned perspective at these rates of return.

4.2.5.4 Conclusions

For a community owned plant, the potential fuel savings will not be sufficient to justify the capital expenditure required.

There are many positive economic benefits for this project including:

- Reduction of GHG
- Creation of local jobs in the forestry sector
- Making use of an under utilized resource.
- Additional employment opportunity in the community (operator)
- Keeping the money in Clare.

4.3 COMEAU LUMBER, MODIFICATIONS TO EXISTING COGENERATION SYSTEM

4.3.1 Introduction

4.3.1.1 Project Overview and Host

The boiler plant at Comeau Lumber consists of a hog fuel fired boiler along with a 1 MW steam turbine. In the current mode of operation, hog fuel (bark, shavings and sawdust) is burned in a modern combustion system and steam is produced in a horizontal return type (HRT) boiler. The steam is produced at 125 psig in the boiler and a portion of the steam is sent to a steam turbine at full pressure. The remaining steam is sent to a pressure reducing station and reduced for use in the kiln and some for building heating. Creating high pressure steam and using a pressure reducing station to get lower pressure process steam is a waste of potential energy. The steam turbine has an extraction port that is not used. By using the extraction port, all the high pressure steam could be expanded across the first section of turbine blades to create electrical energy and reduce fuel consumption. The required low pressure steam would be extracted at the turbine extraction port. The increase in cycle efficiency from this method of operation is approximately 9%. This translates directly to a 9% reduction in fuel usage for the same thermal and electrical output.

4.3.1.2 Summary of Financial Analysis

The project is feasible from a private investor perspective. Using the assumptions listed in Section 4.1.2.2 we have determined the return on investment (ROI) would be approximately 40%. The project capital cost estimate will need to be further refined but a sensitivity analysis shows that even significant increase in capital cost of the project would still yield favourable a ROI.

4.3.2 Project Description

4.3.2.1 Project Components

The existing power plant at Comeau Lumber consists of the following major equipment.

- Bark reclaim system from storage.
- Fuel conveying system from storage to boiler room.
- Energy recovery boiler
- KMW Combustion System
- incl. Superior Boiler Works Model HRT-96-19-19.2-3906 Boiler rated at 31,245 lb/hr steam
- Automatic ash conveying system.
- Flue gas ducting and supports.
- Emission control of multi cyclone type.
- Control System for automatic operation.
- Forced Draft and Induced Draft Fan.

- Steam Turbine - General Electric 1000 KW 7988 RPM 5 Stage Steam Turbine Rated for 130 psig steam @ 356 F.
- Speed Reducing Gear - General Electric– Type S224 1000 kW 7988 / 1200 RPM
- AC Generator - General Electric Model BFL 2217 - 1250 kVA 480 Volts

4.3.2.2 Assumptions and Parameters

The following assumptions and parameters were used:

Current Wood Chip Pricing	-	$20/ton
Fuel High Heating Value	-	4,180 But/lb
Fuel Moisture	-	50%
Average Boiler Load	-	23,000 lb/hr
Annual Extra Staff Required	-	None
Turbine Generator Output	-	1,000 kW
Plant Availability	-	90%
Debt Equity Ratio	-	50 : 50
Debt Interest Rate	-	7.5%
Depreciation Straight Line	-	30 years

The actual turbine performance data with steam extraction will need to be confirmed with the manufacturer – General Electric.

4.3.2.3 Natural Resource Availability

This project will not involve additional resources, but simply use the existing resource more efficiently.

4.3.2.4 Operations and Maintenance Requirements

The proposed modifications to the steam piping system will not impose any additional operational or maintenance requirements on the plant.

4.3.3 Regulatory Issues

4.3.3.1 Environmental Impact

Fuel Supply: The fuel requirement will be reduced by approximately 9% for the same plant thermal and electrical output. This will directly result in 9% less emissions for the same electrical and thermal energy production.

4.3.3.2 Utility Connections

The utility connections, in this case are the steam piping and electrical connections at the plant. The electrical output of the turbine generator will remain the same so there will be no changes there. The steam piping system will need to be further evaluated, because with the new extraction system in service the steam pressure delivered to the distribution system will be lower. Lower steam pressure has a higher specific volume so the existing pipe size will need to be examined (i.e. a 6" pipe can carry more high pressure 125 psig steam than 50 psig steam for the same pressure drop.)

4.3.3.3 Municipality Requirements/Issues

No issues.

4.3.4 Social and Economic Impact

The plant will require 9% less fuel for the same thermal and electrical output. This will make the sawmill operation more viable as fuel savings should have a direct impact on bottom line.

The scope of this project is primarily mechanical and electrical. It consists of alterations to existing piping and electrical systems. The purpose of the work is to improve the efficiency of the existing co-generation system. The local benefits will be in the form of work for the local heating and electrical contractors as well as the hardware and building supply firms.

4.3.5 Financial Assessment

4.3.5.1 Energy and GHG Emission Reduction Estimates

Greenhouse gases are emitted when any fossil fuel is burned. When wood fuel is burned there is no net increase in greenhouse gas emissions, provided that a tree grows in place of the one that was cut down. There are some emissions that are created during the extraction, preparation and transport of the wood chips.

Based on our combustion calculations and the assumptions made in Section 4.1.2.2, the estimated GHG reduction for this plant is 9% or approximately 2,800 ton/yr.

4.3.5.2 Cost Estimates

Capital Cost Estimate (+/-30 %)

The following is an order-of-magnitude capital cost estimate for a turbine extraction system. The breakdown of costs includes equipment and installation costs. The capital cost can be refined further after a detailed inspection of the existing piping systems in the mill. All prices are in Canadian dollars, taxes not included.

Turbine Extraction Piping & Valves	$200,000
Electrical System	$15,000
Instrumentation and Control	$15,000
Subtotal	**$230,000**
Project and Construction Management 5%	$12,000
Engineering 12%	$28,000
Training	$5,000
Total	**$275,000**

4.3.5.3 Financial Feasibility Assessment

Savings Analysis

The plant would require a reasonably small capital upgrade to realize a nine (9) percent fuel savings. If the fuel being used in the plant is essentially free from the sawmill operations then there will be no payback for this upgrade. However if the fuel consumption of the plant exceeds the amount of hog fuel and sawdust generated, then additional fuel must be purchased.

For the purpose of the evaluation we will assume the mill will have all the hog fuel it requires from current operations and would be able to sell excess hog fuel for $20/ton at the mill gate.

The credits will be:	Less hog fuel purchased
The debits will be:	Debt Servicing Cost
	Depreciation

Credits:	Annual Fuel Savings	$59,300
Debits:	Debt Servicing Cost (100% debt, 7.5% of Capital Cost)	$5,000
	Depreciation 30 yr Straight Line	$9,000
	Total	**$45,300**

As can be seen from the above – there is a net savings to the sawmill.

Financial Returns

The assumption is that an owner would save 9% on his fuel supply. The detailed financial model we use will look at all the various inputs to determine:

1. Return on Equity (ROE) which is Net Income divided by Shareholder Equity, where

   - Shareholder Equity = Assets – Liabilities
   - Assets = Original assets – depreciation + retained earnings

- Liabilities = loan amount – principal payments

2. Return on Assets (ROA), which is earnings before interest and taxes (EBIT) divided by the value of the assets. This financial indicator could also be called Return on Investment

The model outputs for the investor owned plant are included in Appendix C. The output shows a very good Return on Equity of 40%. The Return on Assets for this project is 37%. This project is very feasible from an investor owned perspective.

4.3.5.4 Sensitivity Analysis

The following table shows the items within the financial model that were checked for project sensitivity to changes in these items.

Financial Sensitivity Analysis		
Item	**Change from Base Case**	**Return On Equity**
Base Case		40 %
Assigned Fuel Price	- 10$/ton (10$/ton)	18 %
Assigned Fuel Price	+10$/ton (30$/ton)	52 %
Capital Cost	+ 50 %	27 %
Capital Cost	- 20 %	48 %

4.3.5.5 Conclusions

The turbine steam extraction project is very feasible. The sensitivity analysis shows the return is of course very sensitive to fuel price. However with the assumed fuel price of $20/ton it will accept a 50% increase in capital cost and still remain feasible.

There are many positive economic benefits for this project including:

- Reduction of GHG
- Increased bottom line for sawmill

4.4 SPECTACLE LAKE GROUP, AD SYSTEM FOR HOG MANURE AND OTHER ORGANIC WASTES

4.4.1 Introduction

4.4.1.1 Project Overview and Host

Spectacle Lake Hog Farm is a large farrow to finish hog operation producing approximately 12,000 hogs per year for shipment to processors. All manure from the facility is collected in pits and flushed by gravity to a sump from where it is pumped to a stabilization lagoon that drains to an engineered wetland. Current hog manure production of 50 m^3 per day is expected to fall to 15 – 20 m^3 per day with the closure and relocation of the finishing operation out of the area in the spring of 2007. Sources of organic waste to replace the lost hog manure have been investigated that include mink carcasses from the fur industry and green cart waste collected by the municipality that is currently sent to a composting operation in Yarmouth County. The project plan would involve construction of an anaerobic digester to process the waste and produce a relatively inert, pathogenically safe organic product, which, upon dewatering, would be suitable for composting. Biogas generated within the digester would be used to generate electrical energy for use on the farm and thermal energy to maintain optimum temperatures within the process.

4.4.2 Project Description

The conceptual design for the plant would see an in ground plug flow style digester vessel constructed near the existing manure sump and belt press building. This location is to take advantage of existing infrastructure and reduce capital costs.

4.4.2.1 Project Components

The major components of the plant would consist of:

- Digester tank
- Mixing tank
- Effluent tank
- Manure pump

- Digester pump
- Water pump
- Shredder
- Gas cover
- Gas scrubber
- Combined heat and power unit
- Emergency flare
- Belt press

4.4.2.2 Assumptions and Parameters

The following assumptions and parameters were used in our analysis:

Current electricity purchase cost	-	$0.08/kWh
Current fuel oil cost	-	$0.62/L
Extra staff required	-	1 operator
Plant availability	-	98%
Debt to equity ratio	-	70 : 30
Debt interest rate	-	7.5%
Straight line depreciation	-	10 years
Debt term	-	20 years

4.4.2.3 Natural Resource Availability

The natural resource in this case is residual organic material form several sources. The hog manure volume estimate is based upon the breeding/gestation, farrowing, and weaning operations continuing after the finishing operation is relocated. The mink carcasses are residual of pelting operations that will continue as long as there is a mink industry in the area. Organic green cart waste is collected by the municipality and delivered to a composting operation in Yarmouth County. Depending upon the length of commitment of the current contract for delivery of this waste, this is another potential source of infeed stock for the digester. Another potential source is septage sludge. There are currently two lagoons in Clare that receive septage sludge from contractors that pump out septic tanks for residential, commercial, and industrial customers. The lagoons, once filled, must have the accumulated sludge removed in order for them to continue accepting wastes or new lagoons or other receiving facilities must be developed. The anaerobic digester could be a location to take excess accumulated sludge form the lagoons or to receive fresh septage sludge if the lagoons become filled and can no longer accept it. Fresh sludge would be desirable since it would have more organic material capable of sustaining the mesophilic bacteria necessary to achieve the waste treatment and methane gas production in the digester.

4.4.2.4 Operations and Maintenance Requirements

The proposed system would require more direct operator involvement and maintenance than the current manure handling system at Spectacle Lake. Maceration and infeeding of the carcasses and green cart waste, transfer and infeed of septage sludge, operation of the belt press, and maintenance of the combined heat and power unit are all requirements not currently part of the day-to-day operations at Spectacle Lake. We have allowed for one additional full time operator plus some contracted equipment maintenance to account for these requirements.

4.4.3 Regulatory Issues

4.4.3.1 Environmental Impact

The plant will be located within an existing industrial property. The following inputs are anticipated.

Air Emissions: The biogas produced will be primarily methane and water vapour. Emissions from the combined heat and power (CHP) unit will be primarily CO_2, H_20, and trace amounts of nitrous oxides similar to other gas fired engines. The flare will have a propane fired pilot but will be utilized solely to deal with equipment down time. Trace H_2S in the biogas will be scrubbed out prior to the CHP unit.

Odour: The digester is a sealed unit where only outputs will be biogas for combustion in the CHP unit and fully digested effluent, which tests have shown, has little or no objectionable odours.

Noise: The plant will be designed to enclose all noise producing equipment so there will be no increase over existing ambient noise levels at the site.

Liquid Emissions: The digester will have a double containment system to prevent leaks. Leak detection instruments will shut down any equipment if leaks are detected in any piping or vessels/ Daily visual inspections of the CHP unit will check for any leaks of the lube oil or cooling fluids.

Bio-security: Due to the proximity of the hog barns and a mink ranch to the site, bio-security measures will be important to prevent disease transmission. A minimum amount of material will be stored on site in an unprocessed state and for a maximum of twenty-four (24) hours and only in enclosed containers. All loose residual material will be cleaned up daily from the site.

4.4.3.2 Utility Connections

Power from the CHP unit will tie in downstream of the farms meter. Under a net metering arrangement with NSPI, surplus power can be fed back to the grid to offset the cost of purchased power. Some connection safety equipment required by NSPI will be included in the plant equipment.

4.4.3.3 Municipality Requirements/Issues

No municipal energy issues are of concern. Issues of noise, odours, and bio-security were addressed earlier.

4.4.4 Social and Economic Impacts

This project includes the construction of two simple wood framed buildings and a rectangular, in ground, concrete digester tank, and related mechanical and electrical work.

The main beneficiaries will be the general contractors and the mechanical and electrical contractors as well as the concrete supplier, which is located right on site. Local building supply businesses will also benefit from the activity.

4.4.5 Financial Assessment

4.4.5.1 Energy and GHG Emission Reduction Estimates

The biogas produced in the digester will have an energy content of roughly 60% that of natural gas per unit volume. Electricity produced from this biogas will produce CO_2 at a rate of 0.452 tonnes/MWh. Electricity in Nova Scotia using current NSPI emission intensity factors shows a rate of 0.9 tonnes/MWh. Therefore a GHG emission savings of 0.448 tonnes/MWh is expected. The plant is expected to produce approximately 50 kW of electricity of which roughly 20 kW will be utilized in the plant process equipment leaving 30 kW as net output. Plant availability is expected to be 98% or annual operating hours of (8760 – 175) = 8,585 hours.

Net total electrical output is 8,585 * 30 = 257.5 MWh/year

∴ Net GHG savings = 257.5 * .448 = 115 tonnes/year

4.4.5.2 Cost Estimates

Capital Cost Estimate

Description	Hog Manure CSTR System
Galvanized Chain Link Fence (1.8 m high w/barbed top)	$4,000
Double Swing Gates (x2)	$3,500
Piping System Cost	$30,000
Manure Pump	$15,000
Manure Valves	$20,000
Solid/Liquid Separator/Pump Enclosure	$20,000
Effluent Tank (concrete)	$30,000
Effluent Return Pump from Jacket to Pond (Sump Pump)	$10,000
Anaerobic Digester	$250,000
AD Tank Insul. Cover and Internal Support for Membrane	$20,000
Digester Heat Piping System	$20,000
Digester Flexible Membrane	$10,000
Cover Seal (Compressor & Air Tubing)	$3,000
Air Injection System	$2,000
Biogas Scrubber	$17,000
Biogas Scrubber Blower	$5,000

Description	Hog Manure CSTR System
Macerator	$40,000
Solids Infeed Hopper	$15,000
Unprocessed Storage Bins	$10,000
Water Trap	$5,000
Flare	$15,000
Control Valves	$15,000
Power Generation Island Exchanger	$10,000
Heat Medium Pumps (x4)	$3,000
Power Generation Island	$75,000
Boiler	$15,000
Enclosure for Engine and Boiler	$30,000
Composting Cost (1 month composting)	
Windrow Composting Slab	$33,875
Engineering	$75,000
Project Management	$50,000
System Total before Contingency	**$873,375**
Contingency (15%)	$131,006
TOTAL	**$1,004,381**

Operation and Maintenance Capital Costs

Operator	$25,000
Maintenance Contracts	$5,000
Spare Parts	$1,000
Fuels/Lubricants	$5,000
Insurance	$3,000
Taxes	$2,000
TOTAL	**$41,000**

4.4.5.3 Financial Feasibility Assessment

Electricity generation from the CHP unit will not produce revenue directly since, in a net metering arrangement with NSPI, there is no power purchase agreement. The net output, however, will displace energy that would otherwise have been purchased.

Green cart waste sent to the composting facility in Yarmouth County is charged a tipping fee of approximately $75 per tonne. Assuming the current contract can be voided and a similar tipping fee negotiated, this would provide some revenue to the plant.

Disposal of septage sludge currently costs clients approximately $0.50 per gallon ($100/tonne) for removal. Lagoon disposal is currently costing little or nothing to the sludge haulers. If the haulers must incur a cost to develop new lagoons when the current ones are filled, paying a nominal fee to dispose of the sludge at this facility may be acceptable. We have assumed a modest tipping fee for septage sludge of $20/tonne.

Revenue credits would therefore be:

Electricity displacement	-	257.5 MWh @ $80/MWh	=	$20,600/year
Green Cart Waste	-	626 tonnes/year @ $75/tonne	=	$46,950/year
Septage Sludge	-	1,600 tonnes/year @ $20/tonne	=	$32,000/year
Compost Sales	-	880 tonnes/year @ $15/tonne	=	$13,200/year
TOTAL REVENUE			**=**	**$112,750/year**

Annual costs will be:

Operator	$25,000
Maintenance Contracts	$ 5,000
Spare Parts	$ 1,000
Fuels/Lubricants	$ 5,000
Insurance	$ 3,000
Taxes	$ 2,000
TOTAL COSTS	**$41,000**

Based on a capital cost of approximately $1,000,000, 70% debt, and an interest rate of 7.5% over the project service life of twenty (20) years, annual loan repayment and debt servicing costs will be roughly $67,000 per year leaving a profit of approximately $5,000 per year to apply against an equity investment of $300,000. This yields a very low return on equity of less than 2%.

Additional revenue streams are unlikely and costs should remain stable. Reducing the capital cost by 20% to 800,000 results in a return on equity of 7.5%. This indicates that a careful design and reduced capital cost could produce a project with an acceptable rate of return. Loss of revenue, however, associated with leak of septage sludge or green cart waste would cause the project to revert to a net annual loss.

4.4.5.4 Conclusion

The project can help deal with some potentially difficult environmental issues surrounding septage wastes and mink carcasses while producing small amounts of green energy and a useable organic compost. The project can keep more money in Clare and create positive attitudes toward organics disposal.

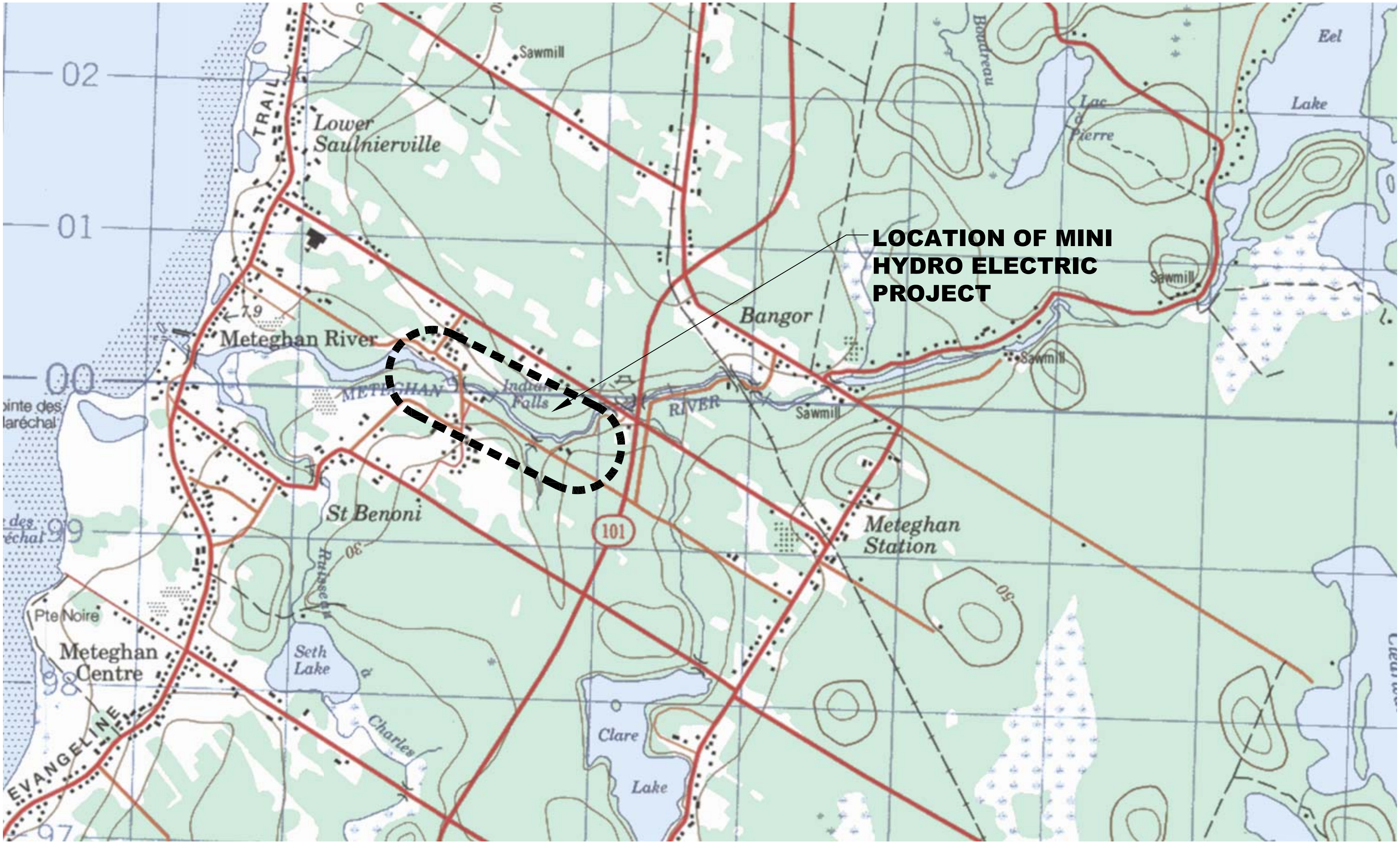
4.5 METEGHAN RIVER MINI HYDRO

4.5.1 Introduction

4.5.1.1 Project Overview and Host

Hydroelectricity provides more than 19% of the world's electricity consumption from both large and small power plants. Many regions of the world have a significant number of small hydroelectricity plants in operation. In China, for example, more than 19,000 MW of electricity is produced from 43,000 small hydro-facilities (Reference: RETScreen International Clean Energy Decision Support Centre, Clean Energy Project Analysis, Small Hydro Projects). Small hydro projects can range up to 50 MW with projects in the 100 kW to 1 MW range sometimes referred to as "mini" hydro, and projects under 100 kW sometimes referred to as "micro" hydro.

A review of potential mini hydroelectric sites / opportunities within the Municipality has led to the selection of the Meteghan River in the vicinity of Indian Falls as a possible hydroelectric site. The location identified is approximately 2 kms inland (east) from the community of Meteghan River as shown on Figure Hydro 1. The project host would be the Municipality of the District of Clare and/or Nova Scotia Power Corporation (NSPC).



HORNER ASSOCIATES LIMITED Consulting and design engineers	Lewis Engineering Inc.	CLARE ENERGY MANAGEMENT PLAN METEGHAN RIVER MINI HYDRO-ELECTRIC PROJECT	FIGURE No. HYDRO 1 SCALE: NTS

4.5.1.2 Summary of Financial Analysis

Preliminary cost estimates identified in Section 4.5.5.2 indicate capital costs in the order of $5.0 M. Amortization of that cost at 6% over twenty years would require annual payments in the amount of $436,000 per year Revenues from a 300 kW hydro-electric facility, assuming eight (8) months per year operation at twenty-four (24) hours per day and sale of electricity at $0.08/kWh, would result in revenues in the order of $110,000 per year. This project would therefore not pay for itself unless; a) financial grants were available to off-set capital costs, b) the present cost of electric power were to increase dramatically, or c) the dollar value were to be attributed to recognize carbon credits associated with greenhouse gas emission reduction. In fact, all three of the above factors would be required to demonstrate cost effectiveness. This scenario is highly unlikely so the project is not recommended for implementation.

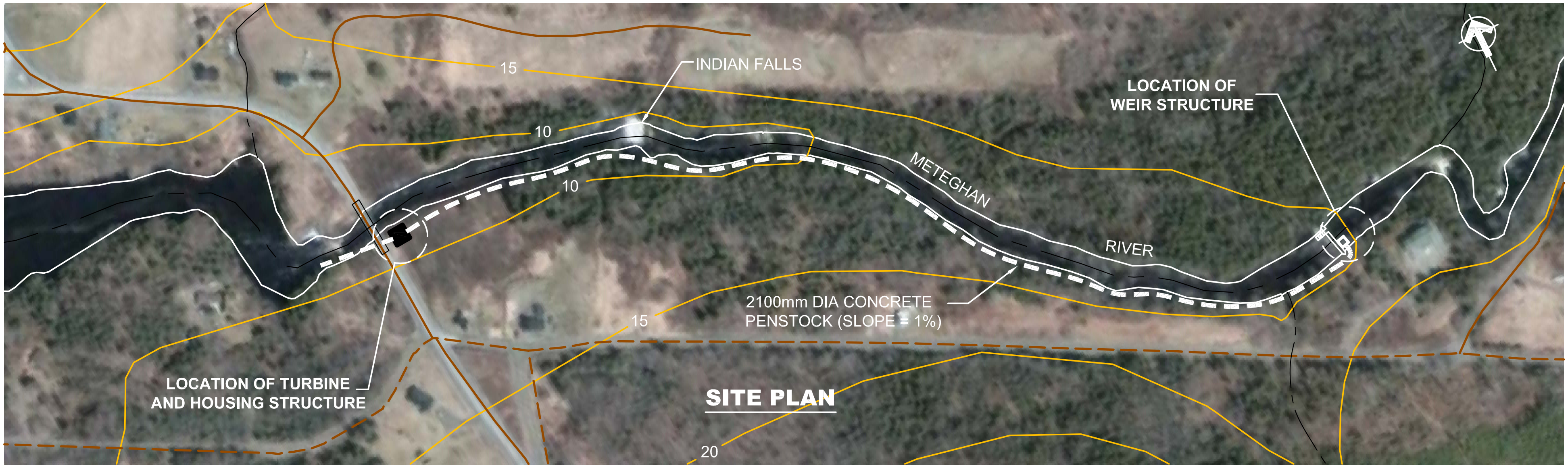
4.5.2 Project Description

4.5.2.1 Project Components

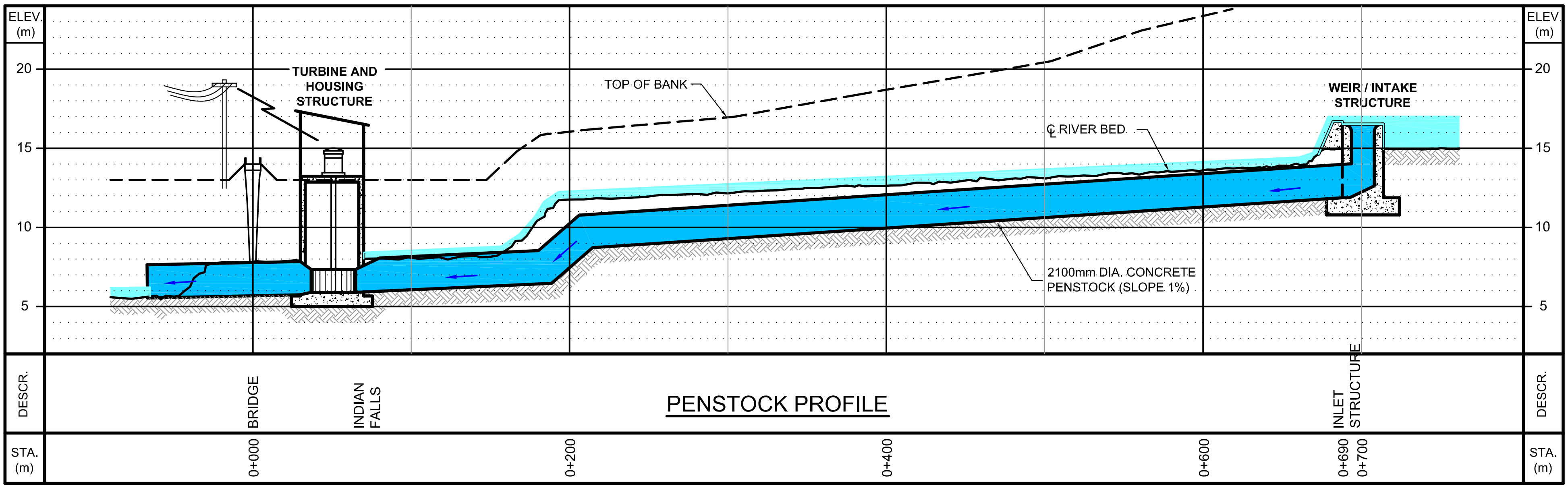
A small hydroelectric generating station usually consists of two (2) main components, i.e., civil works and powerhouse electrical/mechanical equipment. Civil works normally incorporate a diversion dam or weir and intake structure through which water is directed via a canal, tunnel, or penstock, through to a powerhouse. The powerhouse will include a turbine through which the water flows with enough force to create electricity via a generator. The water then flows back into the river via a tailrace. This (Meteghan River) application is shown in plan and section on Figure Hydro 2, indicating the potential for approximately 10 m of vertical head available from the proposed location of the weir intake structure through to the powerhouse turbine and housing structure. The penstock for this application would be a pre-cast concrete structure following the riverbank a distance of some 760 lin m from the intake to the powerhouse.

4.5.2.2 Assumptions and Parameters

This project is based on a number of assumptions including; public acceptance, land and water resource availability, environmental sustainability in terms of being able to prevent or mitigate damage to the river and habitat, regulatory approvals, and guaranteed sale of electrical power to NSPC.



SITE PLAN



PENSTOCK PROFILE

HORNER ASSOCIATES LIMITED
Consulting and design engineers

Lewis Engineering Inc.

CLARE ENERGY MANAGEMENT PLAN		FIGURE No.
		HYDRO 2
METEGHAN RIVER MINI HYDRO-ELECTRIC PROJECT		SCALE: NTS

4.5.2.3 Natural Resource Availability

The Meteghan River drains approximately 167 sq. kms, with Eel Lake providing the immediate headwaters at a location approximately 7 kms east of the river mouth, which is located in the community of Meteghan River. Environment Canada maintained a stream discharge gauging station from 1964 to 1999 at a location near the community of Meteghan River (Sta 01DA001). Monthly data from 1964 to 1999 including monthly and annual means, maximum and minimum flows are provided on the following page. It can be seen from the Environment Canada data that a monthly mean discharge of 3 Cu m/s is available from November through to June, i.e., eight months of the year. This therefore is considered the natural resource available. Minimum fish passage flow requirements may reduce available flows in the month of June to somewhat less than 3 cms, however, it is expected that adequate flows for hydroelectric generation would be available for all months except July, August, September and October. Assuming an available head of 10 m vertical and minimum 3 m3 / sec, it is determined that a mini-hydroelectric power generating station in the order of 300 kW would be possible, based on natural resource availability.

4.5.2.4 Operations and Maintenance Requirements

Operation and maintenance requirements would include, but not necessarily be limited to; normal intake cleaning/maintenance, powerhouse operation and maintenance, and environmental monitoring as may be identified by regulatory agencies.

4.5.3 Regulatory Issues

4.5.3.1 Environmental Impact

An environmental impact assessment will be required for this project.

4.5.3.2 Utility Connection

Liaison/coordination with NSPC will be required to; confirm project suitability, identify potential funding, establish infrastructure requirements, establish electric power purchase understanding/ agreements, term and operational responsibilities.

Environment Canada Environnement Canada Canada

METEGHAN RIVER NEAR METEGHAN RIVER (01DA001)
Monthly Mean Discharge (m^3/s)

Archived hydrometric data from Canada's HYDAT database.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1964	-	-	-	-	-	-	-	-	1.63	1.64	2.57	11.6	-
1965	9.47	4.02	6.12	4.34	2.44	1.83	1.30	1.01	0.890	0.875	1.12	4.01	3.12
1966	4.62	4.17	7.63	3.08	2.55	4.10	2.06	1.35	1.35	2.72	5.24	3.78	3.55
1967	6.35	4.70	4.46	8.69	7.18	1.84	1.67	1.59	1.94	8.07	6.61	17.6	5.91
1968	7.13	6.18	10.5	4.51	2.58	10.2	2.84	1.71	0.856	0.918	2.30	8.08	4.81
1969	8.08	5.16	2.97	11.4	4.59	2.55	1.88	1.56	1.44	1.26	2.70	9.35	4.40
1970	4.94	7.76	2.61	7.68	3.37	2.50	1.74	1.36	1.43	2.07	5.63	6.09	3.90
1971	4.51	11.6	7.33	7.52	4.11	2.80	1.68	1.46	1.61	1.40	1.66	6.99	4.34
1972	8.91	4.08	9.04	7.71	10.4	4.45	2.07	1.49	1.32	2.24	8.41	9.41	5.80
1973	6.87	8.99	9.07	4.38	5.30	5.82	10.9	6.23	2.76	1.51	2.04	10.3	6.18
1974	7.02	8.71	8.79	7.03	3.31	4.71	2.59	1.79	2.07	2.47	4.48	7.56	5.02
1975	7.68	4.24	7.76	7.40	3.13	2.37	1.45	1.23	1.12	1.26	6.69	10.2	4.55
1976	11.9	9.01	5.97	3.76	8.37	1.93	2.55	1.39	1.31	3.96	5.72	9.55	5.46
1977	8.13	4.06	10.4	9.06	2.96	4.21	6.83	3.21	3.73	10.7	5.68	10.6	6.65
1978	15.2	5.56	3.02	7.78	3.56	1.85	1.44	0.690	0.274	0.448	0.861	3.52	3.68
1979	12.6	9.12	13.6	6.01	4.88	4.19	0.854	3.38	1.75	3.07	7.66	5.94	6.07
1980	3.80	1.66	8.67	5.09	2.30	1.28	1.12	0.668	0.570	0.714	4.22	8.36	3.22
1981	6.40	11.5	4.84	12.4	1.86	2.12	2.98	1.72	1.33	5.07	7.97	11.6	5.76
1982	8.91	9.64	5.82	6.36	4.19	1.04	2.27	2.87	1.21	0.951	1.37	6.14	4.21
1983	4.86	4.69	8.23	7.93	6.54	5.35	1.74	1.89	2.36	1.38	3.50	6.38	4.57
1984	6.10	11.1	7.49	6.80	6.08	3.27	3.01	1.16	1.19	1.01	0.904	3.05	4.24
1985	1.86	2.83	8.14	4.18	4.86	5.45	1.38	0.730	0.715	0.525	1.92	2.42	2.92
1986	6.73	4.36	10.2	5.26	3.23	3.03	1.17	2.17	1.86	2.58	4.20	6.32	4.27
1987	3.98	2.38	2.87	9.60	2.75	1.28	0.916	0.448	0.404	1.36	4.36	8.66	3.25
1988	3.81	11.1	3.22	4.49	2.63	1.09	2.00	3.47	1.01	1.45	7.02	6.15	3.92
1989	5.04	6.40	7.59	8.55	3.30	2.86	1.08	0.647	0.993	2.51	8.71	4.90	4.36
1990	5.40	9.13	4.52	9.70	5.47	6.51	1.17	0.854	0.393	0.566	5.08	10.7	4.92
1991	5.37	4.92	7.81	6.24	3.09	0.860	0.408	1.96	2.83	5.13	8.19	6.42	4.43
1992	5.16	4.37	8.17	5.86	4.04	1.03	0.556	0.475	0.426	0.587	4.97	6.30	3.50
1993	5.29	3.91	5.66	9.79	4.25	1.84	1.06	0.434	0.411	0.699	7.43	10.8	4.30
1994	6.06	5.14	14.4	12.6	10.7	4.73	0.922	0.637	0.594	0.492	2.83	9.29	5.71
1995	10.8	4.77	5.25	4.64	2.43	3.11	2.44	2.03	0.732	1.65	8.52	5.79	4.34
1996	6.97	9.84	9.33	7.94	6.99	2.23	3.91	2.50	5.60	5.24	4.02	8.92	6.12
1997	7.33	9.05	9.29	10.8	9.06	2.20	0.661	0.340	0.325	0.311	0.460	2.34	4.31
1998	12.3	6.69	9.43	5.52	1.68	0.572	0.551	0.512	0.514	4.37	6.22	3.47	4.31
1999	8.48	5.10	10.3	4.00	1.07	0.607	0.425	0.355	2.10	4.26	-	-	-
Mean	7.09	6.46	7.44	7.09	4.44	3.02	2.05	1.58	1.42	2.37	4.61	7.50	4.59
Max	15.2	11.6	14.4	12.6	10.7	10.2	10.9	6.23	5.60	10.7	8.71	17.6	6.65
Min	1.86	1.66	2.61	3.08	1.07	0.572	0.408	0.340	0.274	0.311	0.460	2.34	2.92

4.5.3.3 Municipality Requirements/Issues

The Municipality of the District of Clare would; host the project, coordinate public input/hearings, assemble land package and right-of-ways, coordinate approvals, design/construction, and issue building permits.

4.5.4 Social and Economic Impact

Social impact would be beneficial as the supply and use of energy is a significant factor in the community's future. Planning for energy and resource use will help the community advance and reach a sustainable high quality of life. Economic impact will be positive during construction of the project and will be determined on a long-term basis, in large measure, by the degree of "buy-in" demonstrated by provincial and federal funding agencies.

This project includes the construction of a small building, excavation and construction of a large pipeline and repairs and upgrading of an existing river dam. Also included will be the supply and installation of hydro turbines and hooking up to the existing electrical distribution grid.

It is possible that local excavation contractors will be able to carry out the excavation and pipeline installation, or as a minimum, supply the equipment needed to carry out the work.

The area general contractors and electrical and mechanical contractors are well placed to construct the building and do the necessary mechanical and electrical work, except for the turbine.

4.5.5 Financial Assessment

4.5.5.1 Energy and GHG Emissions Reductions Estimates

Run-of-river hydroelectric projects, that is projects not requiring damming and flooding of forested or agricultural lands, are considered to be highly sustainable in terms of reducing greenhouse gas emissions. Such energy offsets electricity generated using fossil fuels. This project, at 300 kW power, if utilized eight months per year on a continuous basis, would reduce greenhouse gas emissions by approximately 1,500 tonnes (CO_2 equivalent) per year.

4.5.5.2 Cost Estimates

Preliminary capital cost estimates are comprised of three (3) main components as follows:

- Weir / intake structure; including a mass concrete weir structure approximately 1.2 m in height, extending across the full width of the river and including spillway/fish ladder at $400,000.
- Penstock; incorporating approximately 760 lin m of 2100 mm diameter pre-cast concrete pipe extending from the weir/intake structure along a south bank of the Meteghan River to the turbine/ powerhouse structure and tailrace pipe crossing the adjacent roadway and discharging downstream below the small falls at $1,200,000 M.
- Turbine/powerhouse consisting of turbine selected for low head applications to drive an induction generator including; speed adjustment, in-line and bypass valves and gates, hydraulic controls, electric protection and switchgear, station servicing including cooling/lubricating system, ventilation telecommunications fire and security and housing structure at $1,600,000.

Total estimated capital cost including 25% contingency allowance is $4.0 M. Engineering including; reconnaissance survey, feasibility studies, environmental assessments and detailed design at 20% bring this project to an estimated capital cost of $4.8 M. Use $5.0 M.

4.5.5.3 Financial Feasibility Assessment

The amortization cost of $ 5.0 M at 6% interest over twenty (20) years is $436,000 / year. Assuming the project generates 300 kW continuously over eight months of the year at 80% efficiency and is able to sell that power at $ 0.08 / kW hour, revenues would be in the order of $110,000 / year.

4.5.5.4 Conclusions

While the sustainable water resource (head and flow) appears to be available on the Meteghan River at Indian Falls to generate 300 kW of electrical power over eight months of the year, preliminary costing of the project indicates that it is not cost effective or viable based on current; funding availability and potential sale of power revenues.

4.5.6 Implementation Requirements

This project is not recommended for implementation.

4.6 COMEAU SEAFOODS, BIODIESEL SYSTEM

4.6.1 Introduction

4.6.1.1 Project Overview and Host

Comeau Seafoods produces fish oil as a by-product of its meal plant process. The company also consumes large quantities of petroleum diesel each year in its vessels and vehicles as well as plant heating systems. This study was intended to determine the technical and financial feasibility of converting the fish oil by-product into a biodiesel that could be blended with petroleum diesel and used in the company's vehicles, vessels, or heating plants.

4.6.1.2 Summary of Financial Analysis

The project is not feasible at current fuel pricing levels but could be feasible with only a modest 10 – 15% increase in current prices for petroleum diesel.

4.6.2 Project Description

The concept design would see a skid mounted packaged biodiesel processing plant located within the existing fishmeal plant at Comeau Seafoods. New storage tanks for refined biodiesel, raw fish oil, and methanol will also be required along with piping and electrical upgrades.

4.6.2.1 Project Components

The major components of the plant would consist of:

- Skid mounted biodiesel processing plant – 10,000 L/day capacity
- Raw fish oil storage tank
- Refined biodiesel storage tank

- Methanol storage tank
- Glycerin storage tank
- Transfer pumps, fuel blending pump
- Control system
- Computer/operator interface
- Commissioning and start-up assistance
- Engineering
- Project management
- Operator training

4.6.2.2 Assumptions and Parameters

The following assumptions and parameters were used in our analysis:

Current diesel fuel pricing	-	$0.95/L
Current heating oil pricing	-	$0.62/L
Current fish oil price	-	$900/tonne
Annual fish oil production	-	200,000 L/year
Debt to equity ratio	-	50 : 50
Debt interest rate	-	7.5%
Depreciation straight line	-	10 years
Debt term	-	10 years

4.6.2.3 Natural Resource Availability

The raw material is a by-product of the processing of fishmeal using herring caught by the corporate fishing fleet. This material will continue to be available as long as the fishmeal plant continues to operate. Quantities will depend on the amount of herring or other species processed at the plant.

4.6.2.4 Operations and Maintenance Requirements

The proposed system will require some ongoing operator involvement once the batch is loaded and started. Typically, one batch per day can be processed, with operator involvement to set up and monitor each batch. This is anticipated to require one person half time during processing meaning they would be available for other duties in the meal plant the remainder of the time. Regular maintenance will involve cleaning and replacing filters and strainers, instrument adjustments, and tank cleaning.

4.6.3 Regulatory Issues

4.6.3.1 Environmental Impact

This process is a modification to an existing industrial process to increase the value of an industrial by-product. No environmental issues are anticipated.

4.6.3.2 Utility Connections

No issues are anticipated.

4.6.3.3 Municipality Requirements/Issues

No requirements or issues are anticipated.

4.6.4 Social and Economic Impacts

The work required is primarily mechanical, including installation of a holding tank. Local mechanical contractors will be able to carry out this work.

4.6.5 Financial Assessment

4.6.5.1 Energy and GHG Emission Reduction Estimates

Greenhouse gases are emitted when any fossil fuel is combusted. Research studies conducted for Natural Resources Canada show that biodiesel, produced from fish oil produce approximately 36% fewer greenhouse gases per unit volume than petroleum diesel. All production from this plant is intended to displace petroleum diesel in diesel engines in either vehicles or vessels. The estimated GHG reduction for this plant is 200,000 L of biodiesel per year.

Petroleum diesel produces 2.76 kg of GHG emissions per litre consumed.

Biodiesel produces 2.76 (0.64) = 1.77 kg per litre
∴ (2.76 – 1.77) – 200,000 = 198,000 kg = 198 tonnes/year of GHG reductions

4.6.5.2 Cost Estimates

Capital Cost Estimate

10,000 L/day skid mounted biodiesel processing unit	$37,000
Storage tanks	$5,000
Mechanical and electrical installation	$10,000
Transfer pumps	$3,000
Biodiesel blending pump	$5,000
Engineering	$3,000
Project Management	$2,000
Operator Training	$3,000
TOTAL	**$68,000**

Operating Cost Estimate

Operator (1/2 time)	$15,000
Chemicals	$15,000
Insurance	$2,000
TOTAL	**$32,000/year**

4.6.5.3 Financial Feasibility Assessment

The project will displace 200,000 L of purchased petroleum diesel. Since all product is assumed to be produced for consumption by Comeau Seafoods, we have assumed no additional fuel tax liability associated with use of this product in company equipment.

Savings Analysis

Credits: 200,000 L of petroleum diesel @ $0.95/L = $190,000 per year

Debits: Loss of fish oil sales revenue 182 tonnes @ $900/tonne = $163,800
Annual operating costs = $32,000

Assuming a 50:50 debt to equity ratio on the capital expenditure, annual debt servicing costs of approximately $4,800 are expected. No return on equity is available until the price of diesel fuel reaches $1.03 per L and a return on equity of 10% is not available until the price reaches $1.07 per litre. Given the volatility in world energy markets, this is not considered to be excessive. The enclosed sensitivity analysis table shows that slight reductions in capital cost coupled with slight increases in diesel prices can produce quite attractive returns.

Sensitivity Analysis

	Diesel Price	Capital Cost	Return on Equity
Base Case	0.95	68,000	-
	1.03	68,000	0%
	10.7	68,000	10%
	0.95	60,000	-
	1.03	60,000	20%
	1.07	60,000	46%
	1.00	60,000	0%

4.6.5.4 Conclusion

At current pricing for fuels this project does not appear commercially feasible. Feasibility, however, is achieved with a 10% increase in petroleum diesel prices. Slight reductions in project capital cost produce even better returns with only a 10% increase in current diesel prices. It may be best to consider operating the plant and storing more of the finished product when petroleum diesel prices are low and using it up when the prices rise.

4.7 COMEAU SEA FOODS, LARGE WIND TURBINE

4.7.1 Introduction

The wind data derived from the Helimax wind speed analysis mapping indicates that there are a number of areas along the southern coast of St. Mary's Bay, which have the potential for wind generation. A feasibility study of a potential wind project at Comeau Sea Foods in Saulnierville was undertaken as this location is representative of the wind regime along this coast. The general results of this feasibility study can also be applied to other sites having similar wind characteristics.

4.7.1.1 Overview

A site was selected on property owned by and immediately adjacent to the Comeau Sea Foods processing plant for the purposes of the study. The site is accessible by road and is relatively close to existing Utility distribution lines. The property is owned by Comeau Sea Foods, reducing the complications of acquiring land for the project.

The physical site is large enough to install one large wind turbine unit. It is envisioned that the unit would generate directly to the Utility distribution system through a power purchase agreement with the Utility.

4.7.1.2 Summary of Financial Analysis

The financial analysis looks at the revenue stream expected from a 2 MW Vestas V80 Unit based on a RETScreen energy model of the units, using weather data from Yarmouth and Helimax wind speed analysis mapping data. The analysis includes capital cost estimates, operating and maintenance estimates and sensitivity analysis. The model outputs are included with the appendix to this report.

4.7.2 Project Description

The project involves procurement and installation of a 2 MW wind turbine generating unit on the Comeau Sea Foods property in Saulnierville. The wind generator would be connected directly to the Utility distribution system and sell energy to the grid based on a power purchase agreement with the Utility. The project would include wind speed data collection, environmental and Utility permitting requirements, preparation of the site, procurement of the wind generator and balance of plant components and erection of the equipment. Interconnection to the Utility distribution system would be made via an appropriately sized transformer and disconnect.

A Vestas V80 wind generating unit was chosen for the cost estimate as Vestas already have a presence in Nova Scotia, which would likely reduce maintenance costs.

4.7.2.1 Project Component

Prior to commencement of detailed engineering, a feasibility study is required in order to assess the actual wind conditions at the proposed site. As noted later, profitability of the project is very sensitive to wind speed. A meteorological tower would be required at the site to collect sufficient data to prove the feasibility of the project and decide to proceed with project implementation. At this stage, environmental assessment, contract discussions with the Utility, scheduling and project costing can be started.

Once the project gets the green light, the detailed engineering phase of the project would commence including a utility connection study, finalization of permit documentation, finalization of power purchase agreement, detailed design, equipment procurement, erection contracts and project management. Once the wind turbine has been constructed the unit will be fully commissioned and put into service.

4.7.2.2 Natural Resource Availability

The Helimax wind speed analysis map of Digby County indicates that the average wind speeds along the southern shore of St. Mary's Bay range from 6.0 m/s to 7.0 m/s at 60 M to 6.51 m/s to 7.5 m/s at 100 M. Generally speaking, current wind generation technology becomes profitable in Nova Scotia at wind speeds in excess of 7 m/s under the current power purchase agreement with the Utility.

4.7.2.3 Assumptions and Parameters

The average cost to construct utility size (> 500 kW)wind generation in Nova Scotia ranges between \$1,800/kW to \$2,200/kW. Wind generation projects at lower average wind speeds are very sensitive to capital cost, average wind speed, maintenance costs and the price received for generated energy.

A capital cost of $1,500/kW was used in the analysis for comparison purposes since it is anticipated that the capital cost of the Comeau Sea Foods site would be lower due to its accessibility.

4.7.2.4 Operating and Maintenance Requirements

Once a wind turbine is installed, the day-to-day operating costs are minimal. The main concern with wind generation equipment is associated with premature component failures such as gearboxes, hydraulics etc. which are expensive to replace. Service agreements and warranties are therefore important to consider when installing a wind generator. Selection of wind generation vendor equipment is also important as the industry is not yet mature enough to provide long-term maintenance numbers.

4.7.3 Regulatory Issues

4.7.3.1 Environmental Impact

Prior to erection of the Wind Turbine, an environmental assessment of the proposed site will be required. The assessment will establish the environmental character of the proposed site and surrounding area. The assessment will include public consultation, predict the environmental impact of the wind farm, describe measures to mitigate any adverse impact and provide information for the permitting process. Typically, this assessment would cost between $15,000 and $40,000 for a single turbine project.

The main concerns associated with a foreshore site such as at Comeau Sea Foods are the impacts on sea birds, mitigation of risk associated with environmental damage such as hydraulic oil and transformer oil leaks, noise and visual impact on the local area.

4.7.3.2 Utility Connection

Currently Nova Scotia Power is not offering power purchase contracts to wind generation facilities; however it is expected that the utility will be issuing another solicitation for wind generation in the near future. The existing rate structure for wind generation is in the $0.075/kWhr range, including government incentives. It is generally recognized that the current rate structure is too low to make wind projects viable unless the site is located within a very good wind regime capable of delivering capacity factors in excess of 40%.

Prior to interconnection to the Utility distribution system, a study will be required to assess impacts on the utility's grid due to interconnection of the wind generator. Project engineering must address any issues identified during the study in the detailed engineering phase of the project. Typical issues include distribution system reliability, fault clearing philosophy, generator protection requirements, voltage regulation, load level matching and equipment isolation. A $1,000 deposit is required to make application and the study will typically cost between $5,000 and $10,000.

The actual cost to interconnect is a function of the complexity of the specific site but ranges between $100,000 and $150,000. The work includes a line extension, an electronic re-closer, which provides backup protection, primary metering and interconnection infrastructure.

4.7.4 Social and Economic Benefits

The social and economic benefit of wind generation is associated with offsetting environmental impacts of fossil fuel generation. At the local level; however, view plane obstruction and noise, are of concern. Site specific impact assessment is recommended when planning a wind generation project.

The turbine will be manufactured outside the area. The work to be done locally, includes the excavation of the area for the concrete base, formwork and concrete, readily available locally as well as civil works such as roads and grading. There will also be some electrical work to connect the turbine to the existing system.

4.7.5 Financial Assessment

Three different sized Vestas units were compared using RETScreen analysis software based on capital costs of $1,500/kW, $1,800/kW and $2,200/kW and wind speeds of 6, 6.5 and 7 m/sec. In addition, a sensitivity analysis was carried out based on the energy purchase price.

A more detailed financial analysis was then performed on the most promising Vestas unit from the initial analysis to verify project feasibility.

4.7.5.1 Energy Estimate and GHG Reduction Estimate

As detailed above, the Helimax wind speed analysis map of Digby County indicates that the wind speeds along the southern shore of St. Mary's Bay range from 6.0 m/s to 7.0 m/s at 60 M to 6.5 m/s to 7.5 m/s at 100 M. RETScreen energy analysis of a VESTAS V80 was carried out for wind speeds between 6.0 m/s and 7.5 m/s. Estimated annual energy production and GHG reduction is detailed in the table below.

Wind Speed (M/sec)	Capacity Factor	Estimated Annual Energy Produced	GHG Reduction
6	21%	3,635 MWh	3,271 tonnes
6.5	25%	4,358 MWh	3,922 tonnes
7	29%	5,080 MWh	4,572 tonnes
7.5	33%	5,720 MWh	5,148 tonnes

4.7.5.2 Financial Feasibility Assessment

The tables below show a comparative analysis carried out on RETScreen for several VESTAS wind generating units in the 850 kW to 2,000 kW range based on average wind speeds of 6 m/sec to 7m/sec. Actual site specific wind data would be required before any project is undertaken. Assumptions included O&M at $75,000/year, gearbox replacement after ten (10) years and blade replacement after fifteen (15) years, and an energy purchase price of $0.075/kWh.

$ per kW	Return on Investment		
VESTAS V80 2 MW			
$1,500	2.9%	9.4%	15.9%
$1,800	0.1%	5.6%	10.8%
$2,200	-	2.2%	6.5%
VESTAS V66 1.65 MW			
$1,500	-	-	5.5%
$1,800	-	-	2.3%
$2,200	-	-	-

$ per kW	Return on Investment		
VESTAS V52 0.85 MW			
$1,500	-	-	-
$1,800	-	-	-
$2,200	-	-	-

The comparative analysis showed clearly that the V80 2 MW unit will yield the best return on investment. A more detailed cost analysis was ten carried out on the Vestas V80 unit using LEI's financial model. In this base case, capital costs were set at around $3,600,000 or $1,800/kW and a sensitivity analysis was performed for capital cost, energy purchase rate, and average wind speed. The results are as follows:

Average Return on Equity After Taxes

Wind Speed	6 m/sec	6.5 m/sec	7 m/sec	7.5 m/sec
Capital Cost M$				
3.6	-8.6	-3.2	0.2	3.2
3.0	2.2	5.0	8.7	12.1
4.4	-15.4	-7.5	-3.2	-0.3

A sensitivity analysis based on energy purchase price with a capital cost of $3,000,000 is detailed below:

Average Return on Equity After Taxes

Wind Speed	6 m/sec	6.5 m/sec	7 m/sec	7.5 m/sec
$/kWh				
0.75	-8.6	-3.2	0.2	3.2
0.08	-6.3	-1.6	1.8	4.9
0.09	-2.9	1	4.6	7.9
0.07	-11.4	-5	-1.2	1.7
0.065	-16.1	-7.4	-3	0

The analysis indicates that with expected capital costs of $1,800/kW and a sales price for energy of $0.075/kWh, the potential return on equity is weak, even at average winds above 20 m/s. A capital subsidy to reduce capital costs to $1,500/kW or less or an operating subsidy to increase the energy rates price to $0.0/kWh would produce a return on equity that is potentially attractive to investors.

4.7.5.3 Conclusions

Average wind speed is critical in the success of any wind generating unit, especially these located in a wind regime below 7 m/sec. On site wind monitoring is strongly recommended to properly assess site specific wind conditions prior to investing in any projects in this wind regime.

The analysis indicates that at current capital costs of $1,800/kW, current energy purchase pricing and 6 to 7 m/s wind regimes, this wind project would not likely be feasible. If the capital costs can be substantially lowered to less than $1,500/kW, energy purchase pricing is offered in the $0.09 kWh range and site specific wind speeds are close to the estimated high of 7.5 m/s, a project is worth looking at; cost overruns or unexpected maintenance costs still being a concern. If future power purchase agreement offerings by the Utility are more generous and capital cost can be reduced below the norm in Nova Scotia, wind projects of this nature will become attractive.

Capital subsidies can also be effective in reducing capital cost for such projects. An order of magnitude capital subsidy of $600,000 for a 2 MW site would make projects attractive.

4.7.6 Employment Requirements

The Project is essentially a revenue producer. Employment opportunities exist during the construction phase of the project however there are minimal direct employment opportunities on the operation side.

4.8 RESIDENTIAL SOLAR DOMESTIC HOT WATER PROJECT(S)

4.8.1 Introduction

4.8.1.1 Project Overview and Host

The vast majority of private homes in Clare utilize oil or electricity to provide domestic hot water. While wood is a common fuel for space heating, it is not commonly used in heating boilers that also provide domestic hot water. The amount of solar energy available in Clare is sufficient to provide a significant portion of the domestic hot water needs of a typical household throughout most of the year. The hosts in this case would be private homeowners who are interested in renewable energy and in reducing greenhouse gas emissions. We foresee a successful project involving 3 – 5% of the private residences in Clare, which is roughly 100 – 180 homes.

4.8.2 Project Description

The project involves the installation of solar domestic hot water heating systems in several homes in the municipality. Although flat plate collectors are manufactured in Nova Scotia, we are proposing evacuated tube collectors that are reported to have greater efficiency at similar costs.

4.8.2.1 Project Components

Typical components required for system installation in each residence are as follows:

- Roof mounted solar collector
- Hot water storage tank
- Heat exchanger
- Insulated piping
- Circulating pump
- Electrical components
- Controls

4.8.2.2 Assumptions and Parameters

The following assumptions and parameters were used in our analysis:

Current fuel oil pricing to homeowners	-	$0.75/L
Current electricity rate to homeowners	-	$0.10/kWh
Debt to equity ratio	-	75 : 25
Provincial Rebate	-	$500
Debt interest rate	-	7.5%
Debt term	-	10 years
Depreciation straight line	-	30 years

4.8.2.3 Natural Resource Availability

The enclosed map of Nova Scotia indicates that most of Clare has among the best solar fraction in the province. Some local experience has indicated that the solar fraction is much better with increased distance from the coastline. The best candidate for solar panels may therefore be house situated more inland.

4.8.2.4 Operations and Maintenance Requirements

Circulating pumps generally require replacement every 5 – 10 years. Heat exchanger cleaning frequency depends on domestic water quality and hardness. Solar collectors require periodic inspection and surface cleaning. Less than $100 per year should be sufficient to cover maintenance.

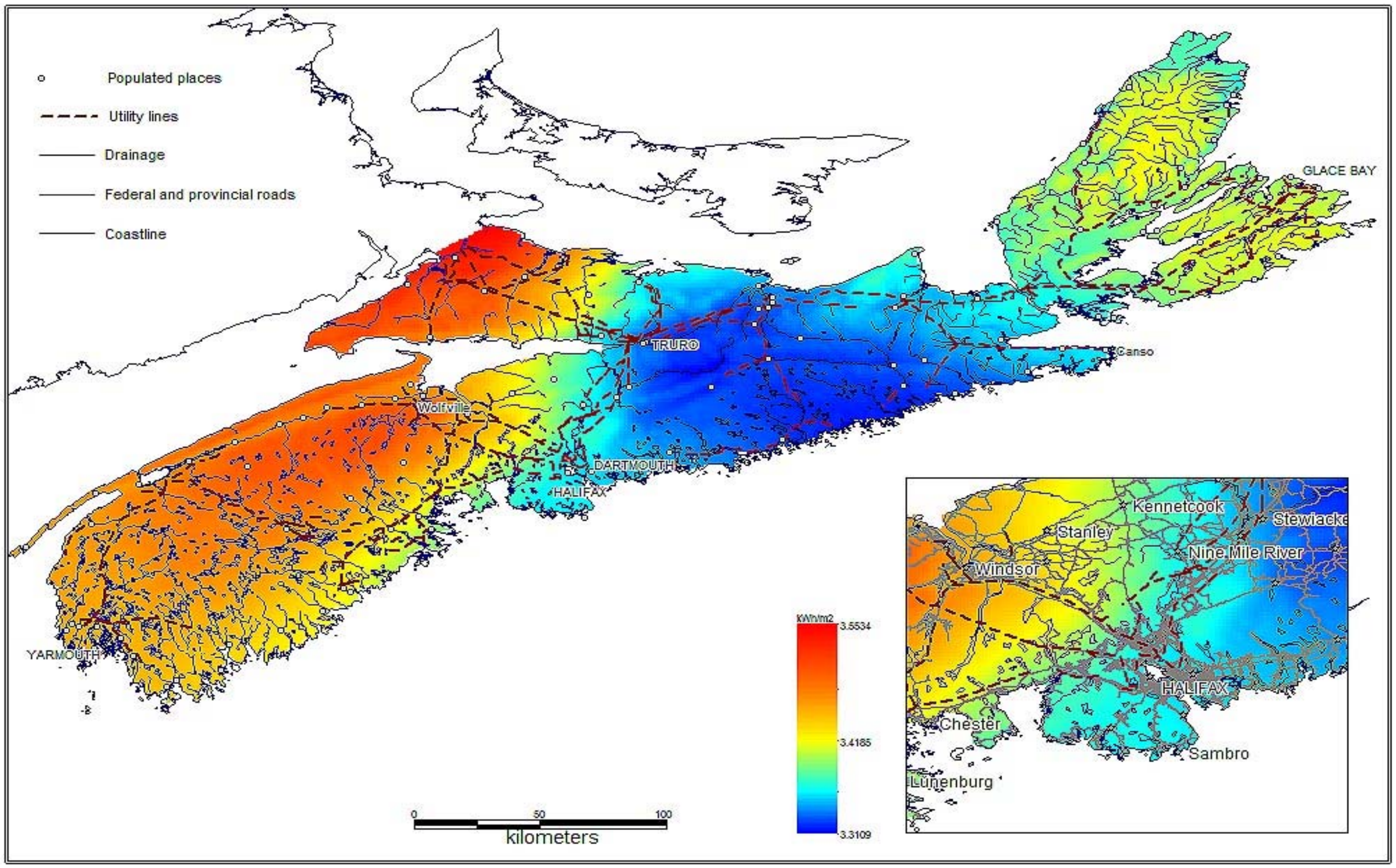
4.8.3 Regulatory Issues

There are no regulatory issues anticipated.

4.8.4 Socio and Economic Impacts

These small projects will provide work for local general contractors as well as mechanical contractors, since a large number of small installations are possible.

Solar Map of Nova Scotia



Distribution of solar energy (kWh/m2) is based on model predictions spatially adjusted by empirical observations

4.8.5 Financial Assessment

The attached analysis performed using RETScreen includes GHG emission reduction calculations, cost estimates, and financial analysis. It indicates a per residence GHG reduction of 1.2 tonnes, a per residence installed capital cost of approximately $7,500, and a return on investment of 5.3%. Simple payback is estimated to take over thirty (30) years.

Some economies of scale could be gained through multiple installations under one contract which could reduce the per residence capital cost by up to 20%. A reduction of this magnitude would increase the ROI to 9% and reduce the simple payback to twenty-three (23) years.

RETScreen® Cost Analysis - Solar Water Heating Project

Type of project: Standard | Currency: $ | Cost references: None

Initial Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
Feasibility Study							
Other	Cost	0	$ 200	$ -		-	-
Sub-total :				**$ -**	0.0%		
Development							
Other	Cost	0	$ -	$ -		-	-
Sub-total :				**$ -**	0.0%		
Engineering							
Other	Cost	0	$ 200	$ -		-	-
Sub-total :				**$ -**	0.0%		
Renewable Energy (RE) Equipment							
Solar collector	m²	4.0	$ 500	$ 2,000		-	-
Solar storage tank	L	184	$ 4.00	$ 734		-	-
Solar loop piping materials	m	27	$ 24.00	$ 639		-	-
Circulating pump(s)	W	0	$ -	$ -		-	-
Heat exchanger	kW	2.4	$ 650	$ 1,560		-	-
Transportation	project	1	$ 250	$ 250		-	-
Other	Cost	0	$ -	$ -		-	-
Sub-total :				**$ 5,184**	69.4%		
Balance of System							
Collector support structure	m²	4.0	$ 50	$ 200		-	-
Plumbing and control	project	1	$ 1,000	$ 1,000		-	-
Collector installation	m²	4.0	$ 10	$ 40		-	-
Solar loop installation	m	27	$ 2.00	$ 53		-	-
Auxiliary equipment installation	project	1	$ 50	$ 50		-	-
Transportation	project	1	$ 50	$ 50		-	-
Other	Cost	0	$ -	$ -		-	-
Sub-total :				**$ 1,393**	18.6%		
Miscellaneous							
Training	p-h	4	$ 60	$ 240		-	-
Contingencies	%	10%	$ 6,577	$ 658		-	-
Sub-total :				**$ 898**	12.0%		
Initial Costs - Total				**$ 7,475**	100.0%		

Annual Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
O&M							
Property taxes/Insurance	project	1	$ 100	$ 100		-	-
O&M labour	project	1	$ -	$ -		-	-
Other	Cost	0	$ -	$ -		-	-
Contingencies	%	0%	$ 100	$ -		-	-
Sub-total :				**$ 100**	100.0%		
Fuel/Electricity	kWh	0	**$ -**	**$ -**	0.0%	-	-
Annual Costs - Total				$ 100	100.0%		

Periodic Costs (Credits)		Period	Unit Cost	Amount		Interval Range	Unit Cost Range
Valves and fittings	Cost	10 yr	$ 250	**$ 250**		-	-
pump	Cost	10 yr	$ 400	**$ 400**		-	-
rebate	Credit	2 yr	$ 500	**$ (500)**		-	-
End of project life		-		**$ -**			*Go to GHG Analysis sheet*

RETScreen® Greenhouse Gas (GHG) Emission Reduction Analysis - Solar Water Heating Project

Use GHG analysis sheet? Yes

Type of analysis Standard

Background Information

Project Information

Project name	Residence
Project location	Clare NS

Global Warming Potential of GHG

1 ton CH_4 =	21 tons CO_2	(IPCC 1996)
1 ton N_2O =	310 tons CO_2	(IPCC 1996)

Base Case Electricity System (Reference)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (t_{CO2}/MWh)
Natural gas	100.0%	56.1	0.0030	0.0010	45.0%	8.0%	0.491
Electricity mix	100%	135.5	0.0072	0.0024		8.0%	0.491

Base Case Heating System (Reference)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	GHG emission factor (t_{CO2}/MWh)
Heating system						
Diesel (#2 oil)	100.0%	74.1	0.0020	0.0020	65.0%	0.414

Proposed Case Heating System (Mitigation)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	GHG emission factor (t_{CO2}/MWh)
Heating system						
Electricity	0.0%	135.5	0.0072	0.0024	100.0%	0.000
Solar	100.0%	0.0	0.0000	0.0000	100.0%	0.000
Heating energy mix	100.0%	0.0	0.0000	0.0000		0.000

GHG Emission Reduction Summary

	Base case GHG emission factor (t_{CO2}/MWh)	Proposed case GHG emission factor (t_{CO2}/MWh)	End-use annual energy delivered (MWh)		Annual GHG emission reduction (t_{CO2})
Heating system	0.414	0.000	2.90		1.20
			Net GHG emission reduction	t_{CO2}/yr	**1.20**

Complete Financial Summary sheet

RETScreen® Financial Summary - Solar Water Heating Project

Annual Energy Balance

Project name		Residence	Electricity required	MWh	-
Project location		Clare NS			
Renewable energy delivered	MWh	2.90	GHG analysis sheet used?	yes/no	Yes
			Net GHG emission reduction	t_{CO2}/yr	1.20
			Net GHG emission reduction - 25 yrs	t_{CO2}	30.03
Heating fuel displaced	-	Diesel (#2 oil)			

Financial Parameters

Avoided cost of heating energy	$/L	0.750	Debt ratio	%	75.0%
			Debt interest rate	%	9.0%
			Debt term	yr	5
GHG emission reduction credit	$/$t_{CO2}$	10.0	Income tax analysis?	yes/no	No
GHG reduction credit duration	yr	10			
GHG credit escalation rate	%	2.0%			
Retail price of electricity	$/kWh	-			
Energy cost escalation rate	%	3.0%			
Inflation	%	2.0%			
Discount rate	%	10.0%			
Project life	yr	25			

Project Costs and Savings

Initial Costs				**Annual Costs and Debt**		
Feasibility study	0.0%	$	-	O&M	$	100
Development	0.0%	$	-	Fuel/Electricity	$	-
Engineering	0.0%	$	-	Debt payments - 05 yrs	$	1,441
RE equipment	69.4%	$	5,184	**Annual Costs - Total**	**$**	**1,541**
Balance of system	18.6%	$	1,393			
Miscellaneous	12.0%	$	898	**Annual Savings or Income**		
Initial Costs - Total	100.0%	**$**	**7,475**	Heating energy savings/income	$	312
Incentives/Grants		$	500			
				GHG reduction income - 10 yrs	$	12
				Annual Savings - Total	**$**	**324**
Periodic Costs (Credits)						
Valves and fittings		$	250	Schedule yr # 10,20		
pump		$	400	Schedule yr # 10,20		
rebate		$	(500)	Schedule yr # 2,4,6,8,10,12,14,16,18,20,22,24		
End of project life -		$	-			

Financial Feasibility

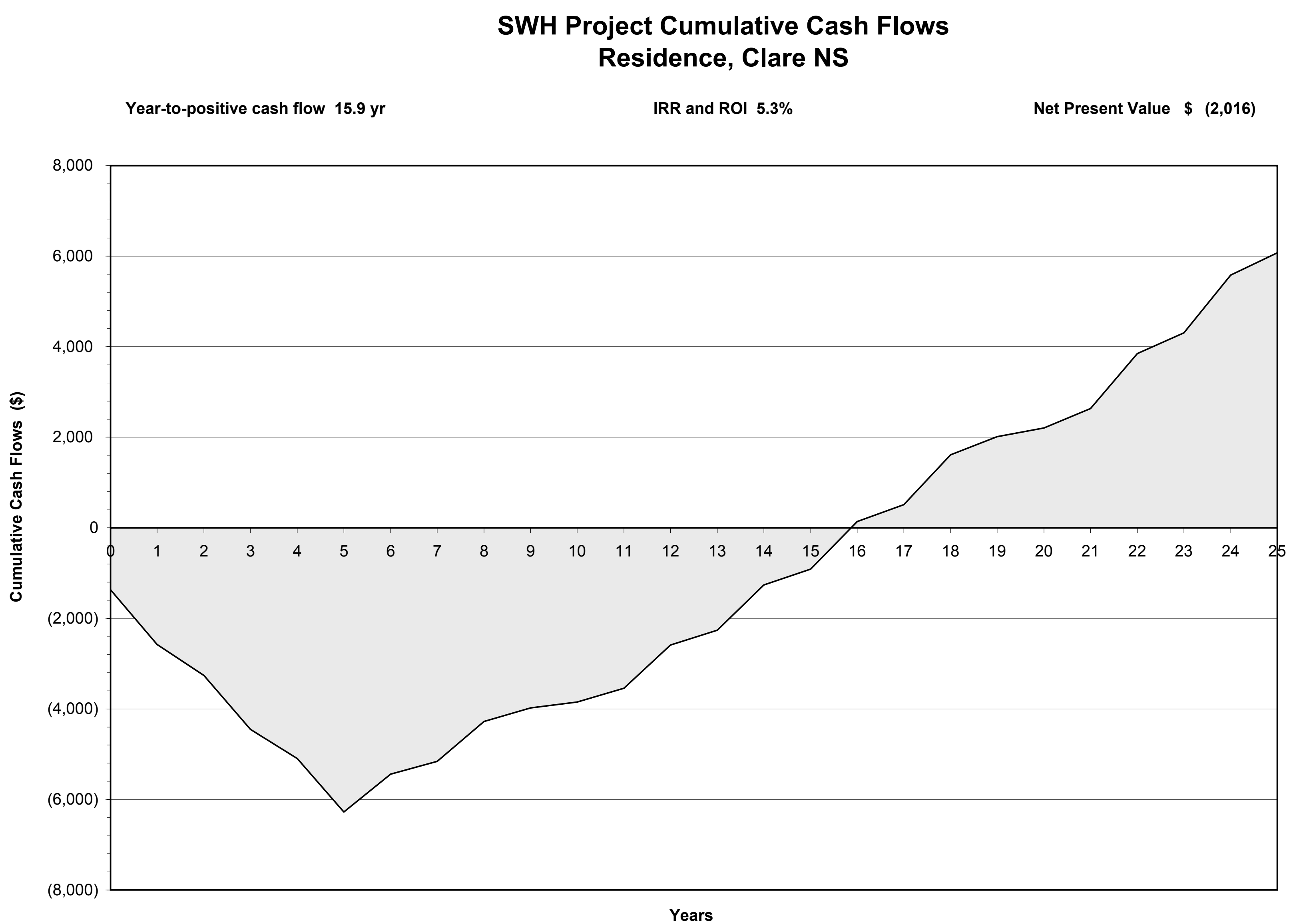
Pre-tax IRR and ROI	%	5.3%	Calculate GHG reduction cost?	yes/no	Yes
After-tax IRR and ROI	%	5.3%	GHG emission reduction cost	$/$t_{CO2}$	185
Simple Payback	yr	31.2	Project equity	$	1,869
Year-to-positive cash flow	yr	15.9	Project debt	$	5,606
Net Present Value - NPV	$	(2,016)	Debt payments	$/yr	1,441
Annual Life Cycle Savings	$	(222)	Debt service coverage	-	0.16
Profitability Index - PI	-	(1.08)			

Yearly Cash Flows

Year #	Pre-tax $	After-tax $	Cumulative $
0	(1,369)	(1,369)	(1,369)
1	(1,210)	(1,210)	(2,579)
2	(682)	(682)	(3,261)
3	(1,194)	(1,194)	(4,455)
4	(645)	(645)	(5,099)
5	(1,177)	(1,177)	(6,276)
6	836	836	(5,440)
7	282	282	(5,158)
8	878	878	(4,280)
9	302	302	(3,979)
10	129	129	(3,850)
11	307	307	(3,543)
12	952	952	(2,591)
13	328	328	(2,263)
14	999	999	(1,264)
15	351	351	(913)
16	1,049	1,049	137
17	375	375	512
18	1,102	1,102	1,614
19	401	401	2,015
20	191	191	2,206
21	428	428	2,634
22	1,216	1,216	3,850
23	457	457	4,307
24	1,277	1,277	5,584
25	489	489	6,073

RETScreen® Financial Summary - Solar Water Heating Project

Cumulative Cash Flows Graph



4.9 A.F. THERIAULT SHIPYARD – SOLAR AIR HEATING

4.9.1 Introduction

4.9.1.1 Project Overview and Host

The A.F. Theriault shipyard conducts vessel repair and construction at its facility in Meteghan River. A series of building house machine shops, component fabrication shops, and vessel assembly halls that allow the bulk of the fabrication work indoors under controlled conditions. Building heating is provided by a combination of oil fired radiant heaters and wood fired forced air heating systems. The main large vessel fabrication hall has one long side of the building facing south southeast. Potential exists for installation of a solar air heating system on the upper section of this side of the building and possibly on the low sloping roof above. The solar air heating system will supplement the existing oil fired heating system and reduce oil consumption.

4.9.2 Project Description

The conceptual design involved installation of a solar wall air preheating system on the southern exposure of the main fabrication hall.

4.9.2.1 Project Components

Typical components required for system installation in each residence are as follows:

- Solar wall panels
- Circulating fan
- Temperature controller

4.9.2.2 Assumptions and Parameters

The following assumptions and parameters were used in our analysis:

Current fuel oil pricing	-	$0.62/L
Current electricity rate	-	$0.10/kWh

Debt to equity ratio	-	75 : 25
Debt interest rate	-	7.5%
Debt term	-	10 years

4.9.2.3 Natural Resource Availability

The solar resource in Clare is among the best in Nova Scotia according to the Solar Nova Scotia atlas.

4.9.2.4 Operations and Maintenance Requirements

The proposed system will require minimal, if any, maintenance. Fan replacement is required approximately every ten (10) years. Some cleaning of the external panels may be required.

4.9.3 Regulatory Issues

No regulatory issues are anticipated.

4.9.4 Socio and Economic Impacts

These small projects will provide work for local general contractors as well as mechanical contractors, since a large number of small installations are possible.

4.9.5 Financial Assessment

The attached RETScreen analysis indicates annual GHG emission reductions of 11.7 tonnes of CO2e and a return on investment of 11%. Total capital cost is estimated at $35,000 with annual operational costs of $1,000. Fourteen (14) years are required to achieve a positive cash flow but this could be reduced if fossil fuel costs continue to rise. The building proposed as the best for this installation recently has row motel siding installed so the owner may be anxious to remove a section of new siding to install the solar wall. Solar wall installations are more common on new construction or included in replacement siding as part of a building upgrade.

RETScreen® Cost Analysis - Solar Air Heating Project

Type of project: Standard | Currency: $ | Cost references: None

Initial Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
Feasibility Study							
Other	Cost	0	$ -	$ -		-	-
Sub-total :				$ -	0.0%		
Development							
Other	Cost	0	$ -	$ -		-	-
Sub-total :				$ -	0.0%		
Engineering							
Other	Cost	1	$ 500	$ 500		-	-
Sub-total :				**$ 500**	1.4%		
Renewable Energy (RE) Equipment							
Solar collector materials	m²	125	$ 63	$ 7,875		-	-
Equipment installation	m²	125	$ 50	$ 6,250		-	-
Cladding material credit	m²	-125	$ -	$ -		-	-
Cladding labour credit	m²	-125	$ -	$ -		-	-
Incremental transportation	project	0	$ -	$ -		-	-
Other	Cost	0	$ -	$ -		-	-
Sub-total :				**$ 14,125**	40.4%		
Balance of Equipment							
Fans and ducting materials	L/s	4,167	$ 2.00	$ 8,333		-	-
Fans and ducting labour	L/s	4,167	$ 1.50	$ 6,250		-	-
Fan and duct mat'l credit	L/s	-4,167	$ -	$ -		-	-
Fan and duct labour credit	L/s	-4,167	$ -	$ -		-	-
Incremental transportation	project	0	$ -	$ -		-	-
Other	Cost	0	$ -	$ -		-	-
Sub-total :				**$ 14,583**	41.7%		
Miscellaneous							
Overhead	%	10%	$ 28,708	$ 2,871		-	-
Training	p-h	0	$ -	$ -		-	-
Contingencies	%	10%	$ 29,208	$ 2,921		-	-
Sub-total :				**$ 5,792**	16.5%		
Initial Costs - Total				**$ 35,000**	100.0%		

Annual Costs (Credits)	Unit	Quantity	Unit Cost	Amount	Relative Costs	Quantity Range	Unit Cost Range
O&M							
Property taxes/Insurance	project	1	$ 1,000	$ 1,000		-	-
O&M labour	project	1	$ 500	$ 500		-	-
Travel and accommodation	p-trip	1	$ -	$ -		-	-
solar credit	Credit	1	$ 500	$ (500)		-	-
Contingencies	%	0%	$ 28,708	$ -		-	-
Sub-total :				**$ 1,000**	93.3%		
Fuel/Electricity	kWh	**716**	**$ 0.1000**	**$ 72**	6.7%	-	-
Annual Costs - Total				$ 1,072	100.0%		

Periodic Costs (Credits)		Period	Unit Cost	Amount	Interval Range	Unit Cost Range
replace fan	Cost	10 yr	$ 1,000	**$ 1,000**	-	-
			$ -	**$ -**	-	-
			$ -	**$ -**	-	-
End of project life		-	$ -	**$ -**		*Go to GHG Analysis sheet*

RETScreen® Greenhouse Gas (GHG) Emission Reduction Analysis - Solar Air Heating Project

Use GHG analysis sheet? Yes

Type of analysis: Standard

Background Information

Project Information

Project name: AF Theriault Shipyard

Project location: Clare NS

Global Warming Potential of GHG

1 ton CH_4 = 21 tons CO_2 (IPCC 1996)

1 ton N_2O = 310 tons CO_2 (IPCC 1996)

Base Case Electricity System (Reference)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	T & D losses (%)	GHG emission factor (t_{CO2}/MWh)
Coal	75.0%	94.6	0.0020	0.0030	35.0%	8.0%	1.069
Natural gas	12.0%	56.1	0.0030	0.0010	45.0%	5.0%	0.476
Large hydro	5.0%	0.0	0.0000	0.0000	100.0%	8.0%	0.000
Small hydro	5.0%	0.0	0.0000	0.0000	100.0%	8.0%	0.000
Biomass	2.0%	0.0	0.0320	0.0040	25.0%	8.0%	0.030
Wind	1.0%	0.0	0.0000	0.0000	100.0%	8.0%	0.000
Electricity mix	100%	236.1	0.0083	0.0076		7.6%	0.859

Base Case Heating System (Reference)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	GHG emission factor (t_{CO2}/MWh)
Heating system						
Diesel (#2 oil)	100.0%	74.1	0.0020	0.0020	75.0%	0.359

Proposed Case Heating System (Mitigation)

Fuel type	Fuel mix (%)	CO_2 emission factor (kg/GJ)	CH_4 emission factor (kg/GJ)	N_2O emission factor (kg/GJ)	Fuel conversion efficiency (%)	GHG emission factor (t_{CO2}/MWh)
Heating system						
Electricity	1.5%	236.1	0.0083	0.0076	100.0%	0.859
Solar	98.5%	0.0	0.0000	0.0000	100.0%	0.000
Heating energy mix	100.0%	3.5	0.0001	0.0001		0.013

GHG Emission Reduction Summary

	Base case GHG emission factor (t_{CO2}/MWh)	Proposed case GHG emission factor (t_{CO2}/MWh)	End-use annual energy delivered (MWh)		Annual GHG emission reduction (t_{CO2})
Heating system	0.359	0.013	48.2		16.70
			Net GHG emission reduction	t_{CO2}/yr	**16.70**

Complete Financial Summary sheet

RETScreen® Financial Summary - Solar Air Heating Project

Annual Energy Balance

Project name		AF Theriault Shipyard	Electricity required	MWh	0.7
Project location		Clare NS			
Renewable energy delivered	MWh	48.2	GHG analysis sheet used?	yes/no	Yes
			Net GHG emission reduction	t_{CO2}/yr	17
			Net GHG emission reduction - 30 yrs	t_{CO2}	501
Heating fuel displaced	-	Diesel (#2 oil)			

Financial Parameters

Avoided cost of heating energy	$/L	0.620	Debt ratio	%	75.0%
			Debt interest rate	%	7.5%
			Debt term	yr	10
GHG emission reduction credit	$/$t_{CO2}$	-	Income tax analysis?	yes/no	No
Retail price of electricity	$/kWh	0.100			
Energy cost escalation rate	%	3.0%			
Inflation	%	2.0%			
Discount rate	%	7.0%			
Project life	yr	30			

Project Costs and Savings

Initial Costs				**Annual Costs and Debt**		
Feasibility study	0.0%	$	-	O&M	$	1,000
Development	0.0%	$	-	Fuel/Electricity	$	72
Engineering	1.4%	$	500	Debt payments - 10 yrs	$	3,824
RE equipment	40.4%	$	14,125	**Annual Costs - Total**	**$**	**4,896**
Balance of equipment	41.7%	$	14,583			
Miscellaneous	16.5%	$	5,792	**Annual Savings or Income**		
Initial Costs - Total	100.0%	**$**	**35,000**	Heating energy savings/income	$	3,713
Incentives/Grants		$	500			
				Annual Savings - Total	**$**	**3,713**
Periodic Costs (Credits)						
replace fan		$	1,000	Schedule yr # 10,20,30		
		$	-			
		$	-			
End of project life -		$	-			

Financial Feasibility

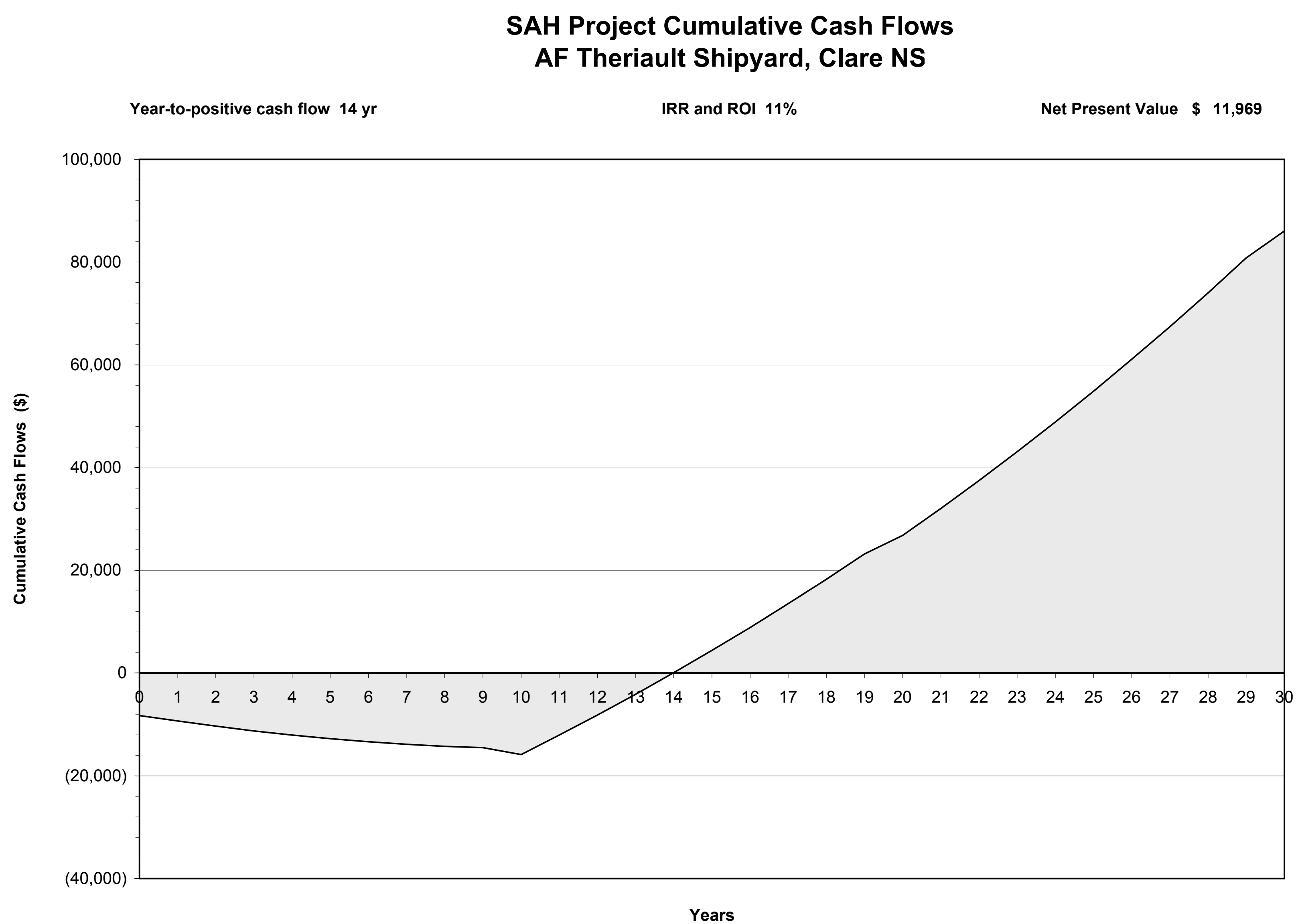
Pre-tax IRR and ROI	%	11.0%	Calculate GHG reduction cost?	yes/no	Yes
After-tax IRR and ROI	%	11.0%	GHG emission reduction cost	$/$t_{CO2}$	(58)
Simple Payback	yr	13.1	Project equity	$	8,750
Year-to-positive cash flow	yr	14.0	Project debt	$	26,250
Net Present Value - NPV	$	11,969	Debt payments	$/yr	3,824
Annual Life Cycle Savings	$	965	Debt service coverage	-	0.64
Profitability Index - PI	-	1.37			

Yearly Cash Flows

Year #	Pre-tax $	After-tax $	Cumulative $
0	(8,250)	(8,250)	(8,250)
1	(1,094)	(1,094)	(9,344)
2	(1,002)	(1,002)	(10,345)
3	(906)	(906)	(11,252)
4	(808)	(808)	(12,060)
5	(707)	(707)	(12,767)
6	(602)	(602)	(13,370)
7	(495)	(495)	(13,864)
8	(383)	(383)	(14,247)
9	(268)	(268)	(14,515)
10	(1,369)	(1,369)	(15,884)
11	3,797	3,797	(12,087)
12	3,923	3,923	(8,164)
13	4,054	4,054	(4,110)
14	4,188	4,188	79
15	4,327	4,327	4,406
16	4,470	4,470	8,876
17	4,618	4,618	13,495
18	4,771	4,771	18,266
19	4,928	4,928	23,194
20	3,605	3,605	26,799
21	5,258	5,258	32,057
22	5,431	5,431	37,488
23	5,610	5,610	43,098
24	5,794	5,794	48,891
25	5,984	5,984	54,875
26	6,179	6,179	61,055
27	6,382	6,382	67,436
28	6,590	6,590	74,026
29	6,805	6,805	80,831
30	5,216	5,216	86,047

RETScreen® Financial Summary - Solar Air Heating Project

Cumulative Cash Flows Graph



4.10 NEW MEDICAL CENTRE, COMBINED TECHNOLOGIES

4.10.1 Introduction

4.10.1.1 Project Overview and Host

The new medical centre is to be constructed to a high energy efficiency standard in keeping with the municipality's commitment to become more energy efficient and reduce greenhouse gas emissions. Including renewable energy and best in class energy efficient technologies in the building. The building is not yet designed so any analysis of energy efficient technologies to be included in the building will be conceptual at best.

4.10.1.2 Summary of Financial Analysis

Solar and ground source heat pumps will most likely be cost effective for this building since it is new construction. An onsite wind turbine may be difficult to justify without accurate wind data to determine potential availability. The building is not yet designed and without building loads, no equipment sizing or pricing can occur.

4.10.2 Project Description

New technologies being considered for the building include ground source heat pumps for heating and cooling, solar domestic hot water heating, and a small wind turbine to reduce reliance on purchased electricity from the grid.

4.10.2.1 Project Components

The general components to be included will be:

- Ground loop tubing
- Circulating pumps
- Heat pumps, one per zone
- Storage tanks
- Solar panels

- 50 kW wind turbine including a 30 m tubular tower
- Grid interconnection
- Computer operation interface
- Engineering
- Project Management

4.10.2.2 Assumptions and Parameters

The following assumptions and parameters were used in our analysis:

Current fuel oil pricing	-	\$0.62/L
Current electricity rate	-	\$0.10/kWh

4.10.2.3 Natural Resource Availability

Solar and wind resource is a previously described. Earth energy resource is dependant upon soil conditions. Desirable soils are free of rocks and stones with a high residual moisture content and a high water table. Wet soils conduct heat much more effectively than dry soils. If soil conditions are not good, heat pumps can also work with groundwater pumped from one well and ingested back into another. Water requirements of 6 – 7 litres/minutes per tonne of cooling capacity are usually required. We would expect a building of this size too have a cooling requirements of 5 – 10 tonnes.

4.10.2.4 Operations and Maintenance Requirements

Heat pumps require little annual maintenance beyond filter changes, bearing lubrication, and belt adjustments. Solar panels, as described previously, require only cleaning on a regular basis. Wind turbines require regular bearing lubrication and inspection as well as fluid changes. Due to the height of the equipment, this work tends to be quite specialized and will require maintenance personnel from outside the municipality.

4.10.3 Regulatory Issues

4.10.3.1 Environmental Impact

No environmental impact is associated with the solar panels, the heat pump ground loops contain an antifreeze solution, which could contaminate groundwater if it leaked into the ground. All ground loops are pressure tested to double the operating pressure prior to filling and with a zero leakage tolerance, no system passing this test is liable to leak. Wind turbines produce some noise and are visible due to their height. The turbine must be located to minimize visible and audible interference with neighbouring properties.

4.10.3.2 Utility Connections

Utility connection of the wind turbine to the NSP grid will be via a net metered arrangement. No power purchase equipment is required. Protection devices are required to prevent grid energization during a power outage.

4.10.3.3 Municipal Requirements/Issues

This building will be owned by the municipality so zoning and permits for the building itself are not an issue. The municipality should consult neighbouring owners regarding location of the wind turbine.

4.10.4 Socio and Economic Impacts

The benefits will be similar to the Université Sainte Anne project. The exception being that it involves the construction of a large new building as well as the demolition of the existing Medical Centre. It includes grading, landscaping and paving. Local contractors have the capability to do all but the paving.

The larger General contractors, such as Delmar and Garian Construction are based in Yarmouth, but employ a number of local workers resident in Clare. These two contractors have engineering staff as well as safety programs and purchasing agents, which the smaller local contractors do not have.

The same can be said for electrical and mechanical contractors, the larger ones such as Germain, Graves, and Tri-Lite are based in Yarmouth, but employ Clare trades-persons.

4.10.5 Financial Assessment

Without benefit of a building design or functional program, it is not yet possible to properly size systems within the building.

Previous analysis of the solar hot water collectors is helpful in determining the relative benefit of this technology over traditional methods of providing domestic hot water. The advantage of this project is that this is a new building so no costs need to be incurred for mobilization, cutting, or demolition.

The largest portion of the cost of installing ground source heat pumps is the ground loop installation. The best projects for ground source heat pumps are those where a prepared building site must be infilled. Ground loops can be installed prior to infilling and eliminate the cost of trenching and backfilling. If this can be done, the premium for a ground source heat pump system compared to a standard oil fired heating system and electric compressor based air conditioning is only 10 – 20%. If the additional excavation is required, the premium can jump to 40 – 50% depending upon ground conditions. With a gain in efficiency of 200 – 400% over traditional heating and cooling systems, however, paybacks are generally good.

The 50 kW wind turbine was selected due to the fact it is a size that is currently in service in Nova Scotia and is manufactured and has service personnel in this province. Installed cost of the turbine and related equipment and systems will be between $150,000 and $200,000. Based upon the previous wind analysis conducted for the site in Saulnierville, a capital cost this high will not yield a positive return on investment unless the wind regime on the site allows for a very high unit availability. Accurate wind data apparently exists for the proposed site of the new medical centre but is currently not publicly available. Without this data and an accurate assessment of potential availability, we cannot recommend the wind turbine as part of this project.

5.0 RECOMMENDATIONS FOR DEVELOPMENT

Following feasibility analysis of the short listed renewable energy projects and development of the demand side management measures (DSM), a meeting was held with the project steering committee to discuss our findings and determine a direction to proceed.

It was determined that all demand side management projects have merit and can be supported. Direct municipal support for any projects will require supplemental funding. The most likely scenario will involve public funding support for DSM demonstration projects in some residential properties and in one or more public buildings. Information and logistical support would be provided to other building and business owners interested in applying for funding programs to assist with the cost of DSM measures.

The ten short listed projects analysed in Section 4 of this report were discussed by the steering committee. The committee is interested in projects that have visibility, good local benefits, environmental benefits, high levels of local support, and can produce positive cash flow. Following discussion centered on the preceding criteria, it was decided to recommend eight projects for development provided that project funding and permitting approvals can be obtained. The eight recommended projects are:

1. Université de Ste. Anne Combined Technologies Project
2. Comeau Seafoods Wind Turbine
3. Comeau Seafoods Biodiesel
4. Comeau Lumber Cogeneration Enhancements
5. New Medical Centre Combined Technologies Project
6. AF Theriault Solar Wall Air Heating Project
7. Spectacle Lake Anaerobic Digester Project
8. Residential Solar Domestic Hot Water Heating Program

The Milestone No. 3 implementation plan will be structured to determine the best strategies to ensure successful development of these recommendations.

6.0 SETTING THE GHG EMISSIONS REDUCTION TARGET

During the Milestone 1 GHG Emission Inventory process, a forecast of future GHG emissions was made based on three potential scenarios; business as usual, optimistic, and realistic. All scenarios showed a reduction in overall emissions from 2006 levels and the optimistic and realistic scenarios showed an overall reduction over 1990 levels. The primary reason for the reduction is a gradual decrease in methane emissions from the closed municipal landfill from its peak emission year of 2006.

The eight renewable energy projects recommended for implementation represent a total annual GHG emission reduction potential of 10,320 tonnes per year broken down as follows:

USA Combined Technologies	1,927
Comeau Seafoods Wind Turbine	5,148
Comeau Seafoods Biodiesel	198
Comeau Lumber Cogeneration Enhancement	2,800
Spectacle Lake AD Project	115
Residential Solar dhw Project	120
New Medical Centre Combined Technologies	
A.F. Theriault Solar Air Heating	12

The residential DSM measures represent the greatest potential for GHG reduction of any sector due to the predominantly residential nature of the municipality. The fact that over 60% of the total GHG emissions from the residential sector are attributable to pre 1970's homes suggests that there is significant potential for residential DSM to have a large impact on GHG emissions. Public awareness programs regarding the cost saving and enhanced comfort benefits as well as information and assistance with government incentive programs will help attract homeowners to invest in DSM. Implementation of most DSM measures in the residential hungry stock is expected to have the following impact on GHG emissions.

Mini Residential	Pre 1970	10%
Small Residential	Pre 1970	15%
Large Residential	Pre 1970	20%
Mini Residential	1970 - 1985	10%

Small Residential	1970 - 1985	12%
Large Residential	1970 - 1985	15%
Mini Residential	1985 - 2006	3%
Small Residential	1985 - 2006	5%
Large Residential	1985 - 2006	5%

A reasonable expectation of take-up by homeowners for DSM is 20% which represents approximately 740 occupied homes. If the 20% figure is applied equally across all residential sectors, the expected GHG reduction would be 1,072 tonnes per year.

A 20% take-up rate is also considered reasonable for the commercial and small industrial sector. This would result in an expected annual reduction in GHG emissions of 10% for participating businesses that follow the general recommended measures. This represents a GHG emission reduction of 198 tonnes per year.

Large industrial businesses are fewer but many have been active participants in the project to date. We expect a 50% participation rate as reasonable and that general measures could save 5% of overall emissions. This represents a total GHG reduction of 500 tonnes per year.

Institutional and municipal loads are small. It is reasonable to expect 100% participation from the municipality as project sponsor and 75% of the institutional load since the university represents a large portion of this and they are on the project steering committee. We expect general members could save 10% of overall emissions. This represents a total GHG reduction of 1,100 tonnes per year. Declining methane output from the municipal landfill will also lead to reduced GHG emissions of 1,500 tonnes per year compared to 2006.

Specific DSM measures will require implementation by each individual business or institution. Assuming a reasonable take-up rate of 20%, these measures could remain in GHG emission savings of a further 5% beyond the general measures of approximately 400 tonnes per year.

This yields a total estimated reduction of 15,100 tonnes per year or 10% of current 2006 emissions. Excluding the landfill emission reduction which is happening anyway, the remaining reduction is 9% of current emissions.

6.1 ESTABLISHMENT OF BASELINE YEAR

The best and most accurate data sets of energy information were usually those available for the previous twelve (12) months ending at our data collection period in July and August of 2006. We therefore recommend 2005 or 2006 as the baseline year.

6.2 SCHEDULE FOR TARGET ACHIEVEMENT

DSM measures implementation could begin quickly. Renewable energy projects will require longer time periods to secure funding and complete detailed feasibility analysis. A reasonable schedule for implementation is two (2) years from completion of the implementation plan in early 2007. We would therefore expect by early 2009 to have reduced GHG emission by 9% below 2006 levels, excluding emissions, or by 11% including landfill emissions.

APPENDIX A
Université Ste. Anne Biomass Heating Plant
Financial Analysis

Earnings Statement

1	Revenue				
	Gross Electrical Output		0	kw	
	Net Electrical Power output kw		0	kw	
	Gross Plant Heat Rate			btu/kwhr	
	Electrical energy production @8760 hrs/yr		0	kWh	
	Rate			$/KWHR	
	Annual escalation		2.00%		
	Secondary electrical energy production				
	Rate				
	Annual escalation				
	Thermal energy production		20,498	MMBTU/yr	
	Rate		20.3900		
	Annual escalation		2.00%		
	Initial availability of plant on an annual basis		100.0%		
	Annual degradation of power available		0.000%		

6.1.3 **Annual O&M Cost Estimate**

Operating Variable - as a % of production				
Fuel				
Water				
Total % variable		0.00%		
(All costs in 2005 CAN$)				
Operating and Maintenance - Fixed				
Manager		0		
Admin. Personnel		0		
Maintenance Contract		25,000		
Operators 1		50,000		
Insurance		10,000		
General Supplies		10,000		
Miscellaneous		10,000		1.11%
Fuel		0		
	0			
PRICE $/TONNE	50			
Fuel Heating Value btu/lb	4,180			
Ton/year	3,730			

3 Accounts receivable

Collection of revenue as follows:	
Current	0.0%
30 days	100.0%
60 days	0.0%
Provision for Bad debts	0.0%
	100.0%
Total annual revenue - amount in A/R at end of yea	8.3%

4 Capital Costs

Non depreciable	0
Depreciable	1,650,700
Total	1,650,700
Depreciation Rates - Straight line - years	30.0

Capital Additions	Year	Amount
-Depreciation on capital additions	7	0
line	14	0

4 Financing of Capital Costs

Debt	50.0%	825,350
Equity / Internal	50.0%	825,350

Financing of Capital Additions		Loan #2
Debt	100.0%	0
Equity	0.0%	0

Terms of Debt

		Loan #1	Loan #2
Interest Rate		7.50%	7.50%
Term - years debt to be paid		30	0
Paid in # of periods per year		4	4
	Pv		
Future value of debt at end of term	Fv	0	0
Payments at beginning (1) or end	Type	0	0

5 Bank Operating Loan

	Current	0.0%
	30 days	100.0%
	60 days	0.0%
		100.0%
	Total annual expenses, amount in A/P at end of ye	8.3%
7	Corporate tax rate	0.0%
	Capital Cost Allowance Rate	40.0%
	Payable in	180
8	Dividends	
	Net minimum retained earnings:	0
	- balance paid out as dividends in following year	

Projected Statement of Earnings

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Revenue																			
Thermal energy production	20,498	20,498	20,498	20,498	20,498	20,498	20,498	20,498	20,498	20,498	20,498	20,498	20,498	20,498	20,498	20,498	20,498	20,498	20,498
Rate	20	21	21	22	22	23	23	23	24	24	25	25	26	26	27	27	28	29	29
Total	417,962	426,322	434,848	443,545	452,416	461,464	470,694	480,107	489,710	499,504	509,494	519,684	530,077	540,679	551,492	562,522	573,773	585,248	596,953
Carbon Credits	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capacity Payment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total potential revenue	417,962	426,322	434,848	443,545	452,416	461,464	470,694	480,107	489,710	499,504	509,494	519,684	530,077	540,679	551,492	562,522	573,773	585,248	596,953
% available	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Gross revenue	417,962	426,322	434,848	443,545	452,416	461,464	470,694	480,107	489,710	499,504	509,494	519,684	530,077	540,679	551,492	562,522	573,773	585,248	596,953
Expenses																			
Fuel Cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating and maintenance	292,000	297,840	303,797	309,873	316,070	322,392	328,839	335,416	342,125	348,967	355,946	363,065	370,327	377,733	385,288	392,994	400,853	408,870	417,048
Bad debts	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Interest on operating loan																			
Interest on debt	61,689	61,096	60,459	59,771	59,031	58,234	57,375	56,450	55,454	54,381	53,225	51,980	50,639	49,194	47,639	45,963	44,157	42,213	40,118
Depreciation and amortization	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023
Amortization capital additions		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total expenses	408,712	413,960	419,279	424,667	430,125	435,649	441,238	446,890	452,602	458,371	464,195	470,069	475,989	481,951	487,950	493,979	500,034	506,107	512,189
Net Income before corporate taxes	9,250	12,362	15,569	18,878	22,291	25,815	29,455	33,217	37,107	41,132	45,299	49,615	54,088	58,728	63,543	68,543	73,739	79,142	84,764
Corporate taxes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net income	9,250	12,362	15,569	18,878	22,291	25,815	29,455	33,217	37,107	41,132	45,299	49,615	54,088	58,728	63,543	68,543	73,739	79,142	84,764
Retained earnings - beginning		9,250	12,362	15,569	18,878	22,291	25,815	29,455	33,217	37,107	41,132	45,299	49,615	54,088	58,728	63,543	68,543	73,739	79,142
Dividends		9,250	12,362	15,569	18,878	22,291	25,815	29,455	33,217	37,107	41,132	45,299	49,615	54,088	58,728	63,543	68,543	73,739	79,142
Retained earnings - end	9,250	12,362	15,569	18,878	22,291	25,815	29,455	33,217	37,107	41,132	45,299	49,615	54,088	58,728	63,543	68,543	73,739	79,142	84,764

Projected Balance Sheet

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
ASSETS																			
Cash	46,099	95,754	144,863	193,381	241,260	288,448	334,889	380,522	425,282	469,099	511,897	553,594	594,103	633,328	671,167	707,509	742,237	775,221	806,325
Accounts receivable	34,830	35,527	36,237	36,962	37,701	38,455	39,224	40,009	40,809	41,625	42,458	43,307	44,173	45,057	45,958	46,877	47,814	48,771	49,746
	80,929	131,281	181,100	230,343	278,962	326,904	374,114	420,531	466,091	510,725	554,355	596,901	638,276	678,384	717,124	754,386	790,051	823,992	856,071
Capital Assets																			
Non depreciable	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Depreciable	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700
	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700	1,650,700
Accumulated depreciation	55,023	110,047	165,070	220,093	275,117	330,140	385,163	440,187	495,210	550,233	605,257	660,280	715,303	770,327	825,350	880,373	935,397	990,420	1,045,443
Net	1,595,677	1,540,653	1,485,630	1,430,607	1,375,583	1,320,560	1,265,537	1,210,513	1,155,490	1,100,467	1,045,443	990,420	935,397	880,373	825,350	770,327	715,303	660,280	605,257
Total assets	1,676,606	1,671,934	1,666,730	1,660,950	1,654,545	1,647,464	1,639,650	1,631,044	1,621,581	1,611,191	1,599,798	1,587,321	1,573,673	1,558,758	1,542,474	1,524,713	1,505,354	1,484,272	1,461,327
LIABILITIES																			
Accounts payable	24,333	24,820	25,316	25,823	26,339	26,866	27,403	27,951	28,510	29,081	29,662	30,255	30,861	31,478	32,107	32,749	33,404	34,073	34,754
Corporate taxes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	24,333	24,820	25,316	25,823	26,339	26,866	27,403	27,951	28,510	29,081	29,662	30,255	30,861	31,478	32,107	32,749	33,404	34,073	34,754
Long term debt	817,672	809,402	800,495	790,900	780,565	769,433	757,442	744,526	730,614	715,628	699,487	682,101	663,374	643,202	621,474	598,070	572,861	545,708	516,460
Total liabilities	842,006	834,222	825,811	816,722	806,904	796,298	784,845	772,477	759,124	744,709	729,149	712,357	694,234	674,680	653,581	630,820	606,266	579,780	551,214
EQUITY																			
Capital	825,350	825,350	825,350	825,350	825,350	825,350	825,350	825,350	825,350	825,350	825,350	825,350	825,350	825,350	825,350	825,350	825,350	825,350	825,350
Retained earnings	9,250	12,362	15,569	18,878	22,291	25,815	29,455	33,217	37,107	41,132	45,299	49,615	54,088	58,728	63,543	68,543	73,739	79,142	84,764
Total equity	834,600	837,712	840,919	844,228	847,641	851,165	854,805	858,567	862,457	866,482	870,649	874,965	879,438	884,078	888,893	893,893	899,089	904,492	910,114
Total Liabilities and Equity	1,676,606	1,671,934	1,666,730	1,660,950	1,654,545	1,647,464	1,639,650	1,631,044	1,621,581	1,611,191	1,599,798	1,587,321	1,573,673	1,558,758	1,542,474	1,524,713	1,505,354	1,484,272	1,461,327
Return on Investment																			
Earnings before tax	9,250	12,362	15,569	18,878	22,291	25,815	29,455	33,217	37,107	41,132	45,299	49,615	54,088	58,728	63,543	68,543	73,739	79,142	84,764
Interest on long term debt	61,689	61,096	60,459	59,771	59,031	58,234	57,375	56,450	55,454	54,381	53,225	51,980	50,639	49,194	47,639	45,963	44,157	42,213	40,118
Earnings before interest and tax	70,939	73,458	76,028	78,649	81,322	84,049	86,831	89,668	92,562	95,513	98,524	101,595	104,727	107,922	111,181	114,505	117,896	121,354	124,882
Investment - Net debt & equity	1,650,700	1,652,273	1,647,114	1,641,414	1,635,127	1,628,206	1,620,598	1,612,247	1,603,093	1,593,071	1,582,111	1,570,136	1,557,066	1,542,812	1,527,280	1,510,367	1,491,963	1,471,950	1,450,199
Return on Investment (ROI) before tax	4.30%	4.45%	4.62%	4.79%	4.97%	5.16%	5.36%	5.56%	5.77%	6.00%	6.23%	6.47%	6.73%	7.00%	7.28%	7.58%	7.90%	8.24%	8.61%
	7.13%																		
Return on Investment (ROI) after tax	4.30%	4.45%	4.62%	4.79%	4.97%	5.16%	5.36%	5.56%	5.77%	6.00%	6.23%	6.47%	6.73%	7.00%	7.28%	7.58%	7.90%	8.24%	8.61%
Return on equity (ROE) after tax	1.11%	1.48%	1.86%	2.24%	2.64%	3.05%	3.46%	3.89%	4.32%	4.77%	5.23%	5.70%	6.18%	6.68%	7.19%	7.71%	8.25%	8.80%	9.37%
	6.52%																		
Total dividends paid during operation	913,156	822,538	737,774	658,633	584,894	516,351	452,808	394,080	339,992										

Projected Statement of Cash Flow

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Cash From Operations																			
Net Income	9,250	12,362	15,569	18,878	22,291	25,815	29,455	33,217	37,107	41,132	45,299	49,615	54,088	58,728	63,543	68,543	73,739	79,142	84,764
Depreciation and amortization	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023
	64,274	67,385	70,593	73,901	77,314	80,839	84,479	88,241	92,131	96,156	100,322	104,638	109,112	113,751	118,566	123,566	128,762	134,165	139,787
Cash From Financing																			
Bank loan																			
Accounts payable	24,333	487	496	506	516	527	537	548	559	570	582	593	605	617	630	642	655	668	681
Corporate taxes payable	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Debt	825,350																		
Capital addition debt		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Capital	825,350																		
Total cash provided	1,675,033	487	496	506	516	527	537	548	559	570	582	593	605	617	630	642	655	668	681
Cash Used																			
Accounts receivable	34,830	697	711	725	739	754	769	784	800	816	833	849	866	883	901	919	938	956	975
Land	0																		
Buildings and equipment	1,650,700	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Debt repayment	7,678	8,270	8,908	9,595	10,335	11,132	11,991	12,916	13,912	14,985	16,141	17,386	18,727	20,172	21,728	23,404	25,209	27,154	29,248
Dividends	0	9,250	12,362	15,569	18,878	22,291	25,815	29,455	33,217	37,107	41,132	45,299	49,615	54,088	58,728	63,543	68,543	73,739	79,142
Total cash used	1,693,208	18,217	21,980	25,889	29,952	34,177	38,575	43,156	47,930	52,909	58,106	63,534	69,208	75,144	81,357	87,866	94,690	101,849	109,365
Net cash provided (used)	46,099	49,655	49,109	48,518	47,879	47,188	46,441	45,633	44,760	43,817	42,798	41,697	40,508	39,225	37,839	36,343	34,728	32,984	31,103
Cash - beginning		46,099	95,754	144,863	193,381	241,260	288,448	334,889	380,522	425,282	469,099	511,897	553,594	594,103	633,328	671,167	707,509	742,237	775,221
Cash - end	46,099	95,754	144,863	193,381	241,260	288,448	334,889	380,522	425,282	469,099	511,897	553,594	594,103	633,328	671,167	707,509	742,237	775,221	806,325

Projected Debt Repayment Schedule

	Loan #1	Loan #2	Loan #3
Interest rate on debt	7.50%	7.50%	0.00%
Terms of repayment - years	30	0	0
- no of payments in year	4	4	0
No. of periods for payment of debt (Nper)	120	0	0
Amount of debt	825,350	0	0
Future balance of debt at end of term	0	0	0
Payments due beginning (1) or end of period	0	0	0
Period payment	17,342	#DIV/0!	#DIV/0!
Start Period	1	0	0

Period	Opening Balance	Additions	Balance	Payment	Interest	Principal	End Balance	Paid in Year Interest	Paid in Year Principal
1	825,350	0	825,350	17,342	15,475	1,866	823,484		
2	823,484	0	823,484	17,342	15,440	1,901	821,582		
3	821,582	0	821,582	17,342	15,405	1,937	819,646		
4	819,646	0	819,646	17,342	15,368	1,973	817,672	61,689	7,678
5	817,672	0	817,672	17,342	15,331	2,010	815,662		
6	815,662	0	815,662	17,342	15,294	2,048	813,614		
7	813,614	0	813,614	17,342	15,255	2,086	811,528		
8	811,528	0	811,528	17,342	15,216	2,125	809,402	61,096	8,270
9	809,402	0	809,402	17,342	15,176	2,165	807,237		
10	807,237	0	807,237	17,342	15,136	2,206	805,031		
11	805,031	0	805,031	17,342	15,094	2,247	802,784		
12	802,784	0	802,784	17,342	15,052	2,289	800,495	60,459	8,908
13	800,495	0	800,495	17,342	15,009	2,332	798,162		
14	798,162	0	798,162	17,342	14,966	2,376	795,786		
15	795,786	0	795,786	17,342	14,921	2,421	793,366		
16	793,366	0	793,366	17,342	14,876	2,466	790,900	59,771	9,595
17	790,900	0	790,900	17,342	14,829	2,512	788,388		
18	788,388	0	788,388	17,342	14,782	2,559	785,828		
19	785,828	0	785,828	17,342	14,734	2,607	783,221		
20	783,221	0	783,221	17,342	14,685	2,656	780,565	59,031	10,335
21	780,565	0	780,565	17,342	14,636	2,706	777,859		
22	777,859	0	777,859	17,342	14,585	2,757	775,102		
23	775,102	0	775,102	17,342	14,533	2,808	772,294		
24	772,294	0	772,294	17,342	14,481	2,861	769,433	58,234	11,132
25	769,433	0	769,433	17,342	14,427	2,915	766,518		
26	766,518	0	766,518	17,342	14,372	2,969	763,548		
27	763,548	0	763,548	17,342	14,317	3,025	760,523		
28	760,523	0	760,523	17,342	14,260	3,082	757,442	57,375	11,991
29	757,442	0	757,442	17,342	14,202	3,140	754,302		
30	754,302	0	754,302	17,342	14,143	3,198	751,104		
31	751,104	0	751,104	17,342	14,083	3,258	747,845		
32	747,845	0	747,845	17,342	14,022	3,319	744,526	56,450	12,916
33	744,526	0	744,526	17,342	13,960	3,382	741,144		
34	741,144	0	741,144	17,342	13,896	3,445	737,699		
35	737,699	0	737,699	17,342	13,832	3,510	734,189		
36	734,189	0	734,189	17,342	13,766	3,576	730,614	55,454	13,912
37	730,614	0	730,614	17,342	13,699	3,643	726,971		
38	726,971	0	726,971	17,342	13,631	3,711	723,260		
39	723,260	0	723,260	17,342	13,561	3,780	719,480		
40	719,480	0	719,480	17,342	13,490	3,851	715,628	54,381	14,985
41	715,628	0	715,628	17,342	13,418	3,924	711,705		
42	711,705	0	711,705	17,342	13,344	3,997	707,708		
43	707,708	0	707,708	17,342	13,270	4,072	703,636		

44	703,636	0	703,636	17,342	13,193	4,148	699,487	53,225	16,141
45	699,487	0	699,487	17,342	13,115	4,226	695,261		
46	695,261	0	695,261	17,342	13,036	4,305	690,956		
47	690,956	0	690,956	17,342	12,955	4,386	686,570		
48	686,570	0	686,570	17,342	12,873	4,468	682,101	51,980	17,386
49	682,101	0	682,101	17,342	12,789	4,552	677,549		
50	677,549	0	677,549	17,342	12,704	4,638	672,911		
51	672,911	0	672,911	17,342	12,617	4,724	668,187		
52	668,187	0	668,187	17,342	12,529	4,813	663,374	50,639	18,727
53	663,374	0	663,374	17,342	12,438	4,903	658,470		
54	658,470	0	658,470	17,342	12,346	4,995	653,475		
55	653,475	0	653,475	17,342	12,253	5,089	648,386		
56	648,386	0	648,386	17,342	12,157	5,184	643,202	49,194	20,172
57	643,202	0	643,202	17,342	12,060	5,282	637,920		
58	637,920	0	637,920	17,342	11,961	5,381	632,540		
59	632,540	0	632,540	17,342	11,860	5,481	627,058		
60	627,058	0	627,058	17,342	11,757	5,584	621,474	47,639	21,728
61	621,474	0	621,474	17,342	11,653	5,689	615,785		
62	615,785	0	615,785	17,342	11,546	5,796	609,990		
63	609,990	0	609,990	17,342	11,437	5,904	604,085		
64	604,085	0	604,085	17,342	11,327	6,015	598,070	45,963	23,404
65	598,070	0	598,070	17,342	11,214	6,128	591,943		
66	591,943	0	591,943	17,342	11,099	6,243	585,700		
67	585,700	0	585,700	17,342	10,982	6,360	579,340		
68	579,340	0	579,340	17,342	10,863	6,479	572,861	44,157	25,209
69	572,861	0	572,861	17,342	10,741	6,600	566,261		
70	566,261	0	566,261	17,342	10,617	6,724	559,537		
71	559,537	0	559,537	17,342	10,491	6,850	552,686		
72	552,686	0	552,686	17,342	10,363	6,979	545,708	42,213	27,154
73	545,708	0	545,708	17,342	10,232	7,110	538,598		
74	538,598	0	538,598	17,342	10,099	7,243	531,355		
75	531,355	0	531,355	17,342	9,963	7,379	523,977		
76	523,977	0	523,977	17,342	9,825	7,517	516,460	40,118	29,248
77	516,460	0	516,460	17,342	9,684	7,658	508,802		
78	508,802	0	508,802	17,342	9,540	7,802	501,000		
79	501,000	0	501,000	17,342	9,394	7,948	493,052		
80	493,052	0	493,052	17,342	9,245	8,097	484,955	37,862	31,504
81	484,955	0	484,955	17,342	9,093	8,249	476,707		
82	476,707	0	476,707	17,342	8,938	8,403	468,303		
83	468,303	0	468,303	17,342	8,781	8,561	459,742		
84	459,742	0	459,742	17,342	8,620	8,721	451,021	35,432	33,934
85	451,021	0	451,021	17,342	8,457	8,885	442,136		
86	442,136	0	442,136	17,342	8,290	9,052	433,085		
87	433,085	0	433,085	17,342	8,120	9,221	423,863		
88	423,863	0	423,863	17,342	7,947	9,394	414,469	32,814	36,552
89	414,469	0	414,469	17,342	7,771	9,570	404,899		
90	404,899	0	404,899	17,342	7,592	9,750	395,149		
91	395,149	0	395,149	17,342	7,409	9,933	385,217		
92	385,217	0	385,217	17,342	7,223	10,119	375,098	29,995	39,371
93	375,098	0	375,098	17,342	7,033	10,308	364,789		
94	364,789	0	364,789	17,342	6,840	10,502	354,288		
95	354,288	0	354,288	17,342	6,643	10,699	343,589		
96	343,589	0	343,589	17,342	6,442	10,899	332,690	26,958	42,408
97	332,690	0	332,690	17,342	6,238	11,104	321,586		
98	321,586	0	321,586	17,342	6,030	11,312	310,274		
99	310,274	0	310,274	17,342	5,818	11,524	298,750		
100	298,750	0	298,750	17,342	5,602	11,740	287,010	23,687	45,679

Tax Calculation

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Net Income Before Tax	9,250	12,362	15,569	18,878	22,291	25,815	29,455	33,217	37,107	41,132	45,299	49,615	54,088
Add:													
Depreciation and amort.	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023
Capital add. Amort.	0	0	0	0	0	0	0	0	0	0	0	0	0
Adjusted	64,274	67,385	70,593	73,901	77,314	80,839	84,479	88,241	92,131	96,156	100,322	104,638	109,112
Deduct:													
Capital Cost Allowance	330,140	528,224	316,934	190,161	114,096	68,458	41,075	24,645	14,787	8,872	5,323	3,194	1,916
Net tax deduct	330,140	528,224	316,934	190,161	114,096	68,458	41,075	24,645	14,787	8,872	5,323	3,194	1,916
Taxable income	-265,866	-460,839	-246,342	-116,260	-36,782	12,381	43,404	63,596	77,344	87,283	94,999	101,444	107,195
Taxes payable	0	0	0	0	0	0	0	0	0	0	0	0	0
Provision for corporate taxes	0	0	0	0	0	0	0	0	0	0	0	0	0
Deferred taxes	0	0	0	0	0	0	0	0	0	0	0	0	0
Accumulated deferred	0	0	0	0	0	0	0	0	0	0	0	0	0
Undepreciated Capital Cost - Beg.		1,320,560	792,336	475,402	285,241	171,145	102,687	61,612	36,967	22,180	13,308	7,985	4,791
Additions	1,650,700	0	0	0	0	0	0	0	0	0	0	0	0
	1,650,700	1,320,560	792,336	475,402	285,241	171,145	102,687	61,612	36,967	22,180	13,308	7,985	4,791
CCA	330,140	528,224	316,934	190,161	114,096	68,458	41,075	24,645	14,787	8,872	5,323	3,194	1,916
UCC End	1,320,560	792,336	475,402	285,241	171,145	102,687	61,612	36,967	22,180	13,308	7,985	4,791	2,875

Year	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Net Income Before Tax	58,728	63,543	68,543	73,739	79,142	84,764	90,618	96,718	103,079	109,717	116,649	123,892
Add:												
Depreciation and amort.	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023	55,023
Capital add. Amort.	0	0	0	0	0	0	0	0	0	0	0	0
Adjusted	113,751	118,566	123,566	128,762	134,165	139,787	145,641	151,741	158,102	164,740	171,672	178,916
Deduct:												
Capital Cost Allowance	1,150	690	414	248	149	89	54	32	19	12	7	4
Net tax deduct	1,150	690	414	248	149	89	54	32	19	12	7	4
Taxable income	112,601	117,876	123,152	128,514	134,016	139,698	145,588	151,709	158,083	164,729	171,665	178,912
Taxes payable	0	0	0	0	0	0	0	0	0	0	0	0
Provision for corporate taxes	0	0	0	0	0	0	0	0	0	0	0	0
Deferred taxes	0	0	0	0	0	0	0	0	0	0	0	0
Accumulated deferred	0	0	0	0	0	0	0	0	0	0	0	0
Undepreciated Capital Cost - Beg.	2,875	1,725	1,035	621	373	224	134	80	48	29	17	10
Additions	0	0	0	0	0	0	0	0	0	0	0	0
	2,875	1,725	1,035	621	373	224	134	80	48	29	17	10
CCA	1,150	690	414	248	149	89	54	32	19	12	7	4
UCC End	1,725	1,035	621	373	224	134	80	48	29	17	10	6