Halifax Water
Halifax Regional Water Commission

ITEM # 3C
HRWC Board
February 23, 2012

TO: Colleen Purcell, C.A., Chair, and Members of the Halifax Regional Water Commission Board

SUBMITTED BY: Susheel Arora, P.Eng.
Director, Wastewater Operations

APPROVED: Carl D. Yates, M.A.Sc., P.Eng., General Manager

DATE: February 16, 2012

SUBJECT: **Bio-Solids Energy Project Development**

ORIGIN

Halifax Water Staff report submitted at the January 26, 2012 Board meeting and Feasibility Study for N-Viro Fuel® Fired 2.8 MW Cogeneration Plant

RECOMMENDATION

It is recommended that the Halifax Water Board:

1. Endorse the *"HRWC Energy from Bio-Solids Concept Plan"*, described within the Staff Report.
2. Approve proceeding with Phase 1 - COMFIT Project Registration/Application.
3. Direct Staff to seek Halifax Regional Municipality (HRM) Council support for the identified project.

BACKGROUND

In April 2010, the Government of Nova Scotia released its Renewable Electricity Plan to support and encourage increased development of renewable energy resources for electricity generation. The plan sets out a detailed path for the province to gradually move away from traditional energy sources to energy sources that are more local, clean, secure and sustainable.

In accordance with corporate policy, Halifax Water is focused on energy conservation, efficiency improvement, and renewable energy generation strategies to meet its long term energy, environmental and financial goals. Energy from bio-solids is one type of renewable and sustainable energy that is readily available from our municipal wastewater treatment facilities and from other municipalities.

Halifax Water and it's business partner N-Viro System Canada, LP is considering the development, installation, commissioning and operation of an N-Viro Fuel® Fired 2.8 MW Cogeneration facility, the purpose of which will be to generate and supply electrical energy under the Community Feed-In Tariff (COMFIT) program currently in place in Nova Scotia, and heat to the adjacent bio-solids processing facility.

Community Based Feed-In Tariffs (COMFIT)

The COMFIT program creates an opportunity for qualified entities to receive an established price for electrical energy from qualifying renewable resources. Among the groups qualified to participate under the COMFIT program are municipalities or a wholly owned subsidiary of a municipality. Being a wholly owned subsidiary of the Halifax Regional Municipality, Halifax Water is uniquely positioned and eligible to participate under the COMFIT program.

The COMFIT program is open to the following low-impact renewable energy sources:

- Wind (< 50 kW)
- Wind (> 50 kW)
- Biomass Combined Heat and Power (CHP)
- In-Stream Tidal
- Run-of-River Hydro

COMFIT projects must be connected to the grid at the distribution level. Projects are limited in size by the available distribution zone capacity which is set by the size of the electrical demand or load that it serves. It is expected that approximately 100 MW of capacity will be available province wide for projects under the COMFIT program.

Approved Tariffs

Tariffs to be applied under the COMFIT program were established by the Nova Scotia Utility and Review Board (NSUARB) on September 7th, 2011. The approved tariffs are summarized below:

Renewable Energy Source	Tariff (1)
Wind (<50 kW)	$0.499/kWh
Wind (>50 kW)	$0.131/kWh
Biomass CHP	$0.175/kWh
Run-of-River Hydro	$0.140/kWh
In-Stream Tidal	$0.652/kWh

(1) Ref. NSUARB Order: NSUARB-IRD-E-R-10, Dated Sep. 7, 2011, Document 195063

Staff are anticipating that the N-Viro Fuel® Fired 2.8 MW Cogeneration facility will qualify for a COMFIT Tariff based on "*as equivalent*" to Biomass CHP. A formal request was previously submitted by Halifax Water in 2010 to the Nova Scotia Department of Energy to allow bio-solids to qualify for the Biomass CHP COMFIT Tariff, and Halifax Water and N-Viro staff recently delivered a presentation to Provincial representatives as a follow up. This presentation was received favorably and Halifax Water staff are proposing next steps to advance a related bio-solids energy project.

DISCUSSION

The existing Bio-solids Processing Facility (BPF), located near the Stanfield International Airport, currently accepts and processes 30,000 tonnes per year of dewatered bio-solids from a number of wastewater treatment facilities owned and operated by the Halifax Regional Water Commission.

The bio-solids are delivered to the BPF with an average composition of 72% moisture and 28% solids. The bio-solids are then blended with two other alkaline components and then dried in a gas fired rotary drier to approximately 42% moisture to create N-Viro Soil® Amendment, which is then cured, stored on site and sold ready to be land applied as a soil amendment. Through recent research, modifications to the process that produces N-Viro Soil® Amendment has shown to yield an organic based product with a calorific

value that is approximately half that of bituminous coal. The resulting product is known as N-Viro Fuel®.

The opportunity exists to increase the processing capacity of the BPF from the existing 30,000 tonnes/year of bio-solids to over 120,000 tonnes/year, through the addition of 45,000 tonnes/year of organic waste and 45,500 tonnes/year of bio-solids from other sources. An N-Viro Fuel® Fired 2.8 MW Cogeneration (Combined Heat & Power) Plant is proposed to convert this organic based renewable fuel source to heat and electricity.

The heat generated by the N-Viro Fuel® would be used to dry the bio-solids and organic waste processed at the existing BPF, and a large portion (approx. 80%) of the total electrical energy generated would be sold to NSPI under the COMFIT program. The remaining 20% of electrical energy generated would be used to power the generating plant and N-Viro processing facility, and would eventually completely offset the electricity and natural gas currently used at the BPF. A schematic is included in the attached Executive Summary from the "N-Viro Fuel Fired 2.8 MW Cogeneration Plant" feasibility study to better illustrate the energy and business relationship between the existing BPF and the proposed Cogeneration Facility. It should be uoted that project technical details are preliminary and subject to change.

It is recommended that the HRWC Board approve the following for the project identified above:

Phase 1 – COMFIT Project Registration and Approval

Pursue and complete a COMFIT Registration and Application for the identified project. This will allow HRWC to place itself in the COMFIT and NSPI Queue for the identified project, thereby reserving space on the local NSPI distribution system. This process includes completing up to Step 1.12 as described in the attached *"COMFIT Project Implementation Plan"*. It should be noted that the expected cost for this phase is for a *Preliminary Interconnection Assessment Study* to be completed by NSPI for projects larger than 50 kW in size, a preliminary environmental screening, and a preliminary special places/heritage assessment. Total expected cost for the COMFIT registration and application is $3,000. In addition to this task, staff are proposing to seek preliminary legal and business advise at an additional cost of $12,000.

Once Phase 1 has been completed and the project has received *COMFIT Application Approval* from the NSDOE, it is expected that HRWC would then be in a position to proceed to the next step, that being completing a detailed business plan to validate project

viability, completing the required permitting and site assessments, completing a detailed fuel procurement plan, and the completion of a *Combined System Impact Study (SIS)* by NSPI. Costs to complete a SIS are identified as $12,000. These steps would be included as recommendations in subsequent submissions for HRWC Board approval only after COMFIT Application Approval has been received.

BUDGET IMPLICATIONS

From a regulatory perspective, any resulting energy project developments would be completed under Halifax Water's normal capital project program, subject to the same corporate and regulatory approvals as any other project proposed by Halifax Water Staff.

Operations

To enable work on this project to proceed, it is estimated a minimal amount could be spent ($15,000) by the end of the current fiscal year (March 31st, 2012) if we were to proceed with a COMFIT application for this project, with costs as outlined below:

Description	Amount
Estimated COMFIT Application Related Expenditures – FY 2011/12 & 2012/13	
- NSPI Preliminary Interconnection Assessment	$1,000
- Aboriginal Community Engagement	-
- Municipal Community Engagement	-
- Environmental Screening	$1,000
- Special Places/Archaeological Assessment	$1,000
Total	***$3,000***

In addition, it is also proposed that Halifax Water would seek preliminary legal and financial advice on possible business arrangements with N-Viro at an estimated cost of $12,000.

Funding for this work has not specifically been included in the 2011/12 or 2012/13 Operating Budgets, but funds are available from under spending within wastewater operations in the 2011/12 fiscal year. If the work leads to construction of assets, the costs would eventually be capitalized.

Capital

If the project proceeds, the projected capital cost would be in the range outlined in the attached Executive Summary from the *"N-Viro Fuel® Fired 2.8 MW Cogeneration Plant"* feasibility study and would be brought forward through future business planning/budget processes. The project would be subject to NSUARB approval and possibly HRM approval should a guarantee be sought for any debt incurred by Halifax Water.

A more detailed financial analysis of operating and capital budget implications, along with a detailed cash flow analysis and debt financing analysis would be prepared prior to submission for budget and funding approvals. The potential reduction in treatment costs at the biosolids processing facility would benefit both the urban core and satellite systems rate base, and the Aerotech/Airport rate base. The revenues from sale of electricity also have the potential to benefit both rate bases.

ATTACHMENTS

1. Executive Summary from the "*N-Viro Fuel ®Fired 2.8 MW Cogeneration Plant*", November 2011, prepared by K.J. Schwartz Engineering, Inc.
2. Bio-Solids CHP COMFIT Project Plan

Report Prepared by: Jeffrey R. Knapp, P.Eng.,
Manager, Energy Efficiency, 490-5736

Financial Review by: Cathie O'Toole, CA
Director, Finance & Customer Service, 490-3572

Feasibility Study For

N-ViroFuel Fired 2.8 MW Cogeneration Plant

Located Adjacent To

HALIFAX WATER COMMISSION - Biosolids Processing Facility

For

N-Viro Systems Canada, LP Goffs, Nova Scotia

Prepared By:

K. J. Schwartz Engineering, Inc.
CONSULTING ENGINEERS kjse@qwestoffice.net
233 West Rosser Ave ◆ PO Box 2381 ◆ Bismarck, ND 58502-2381 ◆ Ph: (701)222-0520 ◆ Fax: (701)222-3770

NOVEMBER 2011

SECTION ONE
EXECUTIVE SUMMARY

Halifax Water and N-Viro Systems Canada, LP, in a partnership format that is yet to be determined, are considering a plan to:

- Purchase and relocate to property adjacent to the current Halifax Water Biosolids Processing Facility, an existing electric generation plant capable of generating up to 2.8 MW of electric power and thermal energy. This new installation (the "Energy Facility") will have one steam turbine generator - 2.8 MW;

- Modifying the existing Halifax Water Biosolids Processing Facility to produce N-Rich® and N-Virofuel® (the "Modified Aerotech Facility");

- Physically link the Modified Aerotech Facility and the Energy Facility so that N-Virofuel® can be delivered to the Energy Facility and the Energy Facility waste heat can be used by the Modified Aerotech Facility;

- Establish commercial terms between the Energy Facility and the Modified Aerotech Facility to deal with the sale of N-Virofuel® and waste heat and other services.

Collectively, all of the above is called the "Project".

Appendix A contains information on the Energy Facility equipment to be acquired and relocated to the Aerotech site. Planned improvements include two (2) new stokers and combustion systems to combust biosolids and wood fuel efficiently and an air-cooled steam condenser as part of the electric generation process.

This study examines the feasibility of the Project. Section 4 describes the Provincial Environmental regulatory issues that the Project must comply with. Based upon the results of a full scale test burn of N-Virofuel®, the planned improvements including new stoker vibrating grate systems for the existing boilers will assist in obtaining more complete combustion. The vibrating grate and automatic ash removal system will help in increasing carbon burnout resulting in lower fuel consumption and less overall particulate emissions. The boilers provide steam for a 2.8 MW steam turbine to generate electric power. The technology that will be incorporated is described in Section 5 of this study.

The proposed site of the facility is adjacent to the Halifax Water Biosolids Processing Facility operations located along Highway 212. The wooded terrain provides visual obstruction and noise abatement. Highway 102 is in close proximity and provides good access to the surrounding area and a good year-round transportation route for delivery of biosolids. Woody biomass will be utilized to maintain plant operations until adequate biosolids or other waste organic feedstock are available. Established roads and dedicated long term

biosolids operations assures the selected site can remain in use for many years and operate synergistically with the existing operations in multiple ways:

A. The Modified Aerotech Facility will produce N-ViroFuel® for use as fuel for the 2.8 MW plant.

B. Heat from the Energy Facility in the form of hot gases from combustion will be utilized to provide heat energy to the Modified Aerotech Facility on a year round basis.

C. Bottom ash and collector ash generated from combustion in the boilers at the Energy Facility will be used at the Modified Aerotech Facility to produce N-Rich® displacing all or a portion of the current use of cement kiln dust.

D. Shared use of the Modified Aerotech Facility certified scale.

Figure 1 indicates a graphic illustration of the synergies and business relationship between the entities.

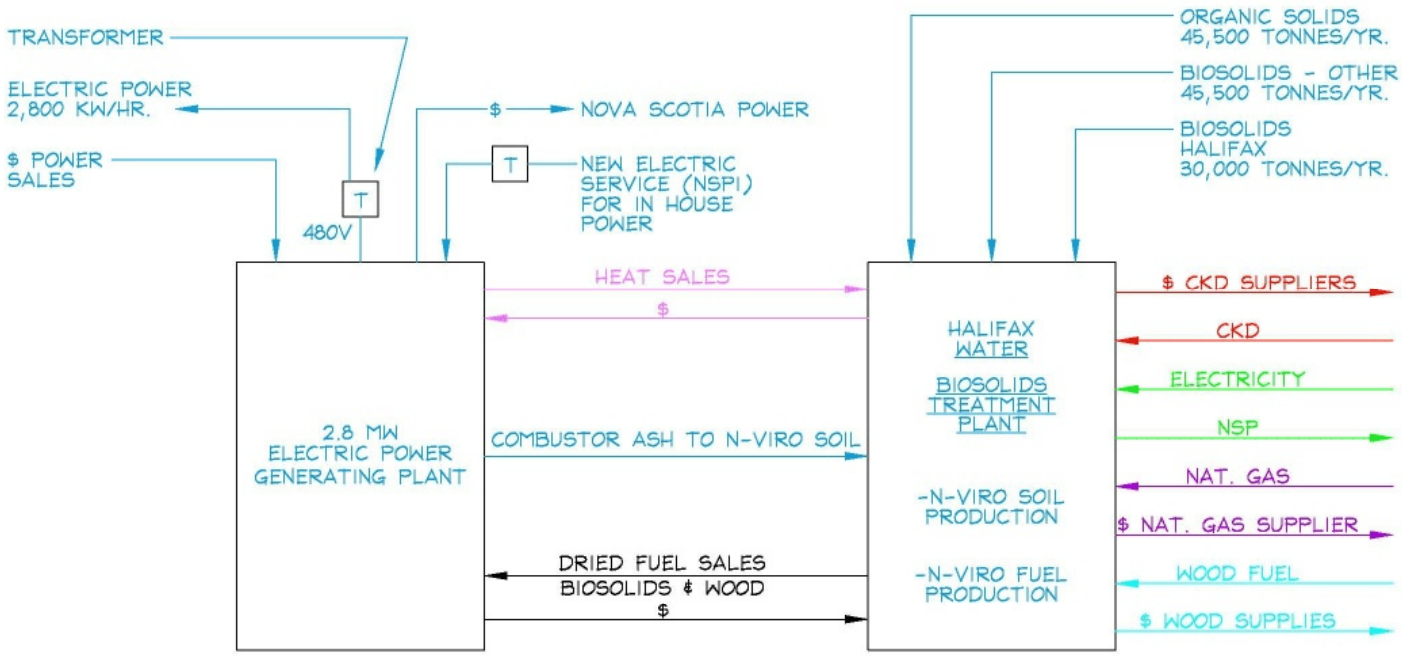

FIGURE 1 – BUSINESS ENTITIES SCHEMATIC

The use of the biosolids and biomass will result in a higher end use of these materials with greater benefit to the Modified Aerotech Facility owner, the Energy Facility owner, and the environment.

Section 2 provides an overview and description of the biosolids fuel, a history of the development and testing of N-ViroFuel®, combustion testing completed, and a comparison to other fuels.

Treating municipal waste water yields, amongst other things, organic waste typically referred to as biosolids. Organic wastes have not always been recognized as a valuable byproduct of treatment. The biosolids are an important resource and should be reused in a manner that is beneficial to society, cost effective for municipality rate payers, and publicly acceptable.

N-Viro has developed a process whereby dried organic wastes including biosolids can be utilized as a fuel for combustion similar to coal or combusted with other solid fuels such as coal, wood, or other biomass.

Biosolids rank alongside peat, biomass, and lignite coal in heat content. Biosolids do, however, contain higher levels of volatile matter with a lower fixed carbon content. Biosolids combustion produces more flaming as volatiles are oxidized as compared to coal. Although the composition of biosolids differs considerably from that of other fuels, the principles of combustion are basically the same.

Forest biomass represents a potential resource for energy production. Significant amounts of currently unmerchantable biomass are available from logging operations, forest resource management, and wood products manufacturing in the region. Biomass energy producing facilities provides a potential economic use for this material at a time when need exists for economic stimulus in communities and for reduced fuels loading in the forest. Section 2 identifies the amount of biomass feedstock available and the cost of feedstock delivered to the plant site. The information encourages public understanding of the opportunity and private sector interest in investment in biomass energy.

Information on biosolids, coal, and biomass fuel characteristics, fuel costs, energy value, potential impacts, and possible options are identified in Section 2. Potential biosolids and biomass fuels vary in quality and in particular moisture content which affects the energy produced per ton of dry weight. The available amounts of biomass are estimated to be able to fuel a 2.8 MW facility in a sustainable fashion for the remaining useful life of the cogeneration plant.

The Project being considered by Halifax Water and N-Viro is technically feasible. Commercial systems using stoker-grate or close coupled gasification (CCG) combustors in combination with steam boilers and a steam turbine are suitable for biomass to energy conversion. The recommended technology for this Project is a conventional vibrating grate style combustor in combination with steam boilers and a steam turbine. CCG has a proven history in burning biomass fuels and has lower capital cost for small scale plants (<30 MW).

Furthermore, the idle 2.8 MW generating facility can be relocated and assembled within 12 months. The 2.8 MW power plant can be supported from readily available biosolids fuel from municipal waste water treatment and biomass resources from the forest lands in the region. Both resources available will sustain the plant operation over the projected 35 year service life of the 2.8 MW plant.

Interconnection to the electrical power grid near the proposed site was investigated. Information on Nova Scotia Power and the initial evaluation is included in Appendix F.

The Power Facility would be a stand alone, separate legal entity from the existing Halifax Water Biosolids Processing Facility, and would supply energy to the grid under a COMFIT based Power Purchase Agreement (PPA). It was identified that a separately metered connection would be required to interconnect with the electric power distribution zone.

The local distribution zone was reviewed for its current peak and minimum loads. Peak loading was found to be approximately 23 MVA, while the minimum loading was found to be approximately 5 to 6 MVA. Based on the minimum load, it appears there is ample capacity for the installation and operation of the proposed 3.2 MVA generation system at the Aerotech facility. Additionally, since the facility is located close to the local sub-station, there should not be any significant interconnection or operational issues, (e.g. voltage loss).

The power plant will incorporate several types and stages of pollution controls to minimize emissions from the operations. Probable emissions calculations were completed and quantities identified in Section 6. Nova Scotia Air Quality regulations and limits are included. Based on investigative work completed previously on the combustion of biosolids (N-ViroFuel®) in a vibrating grate combustion system, the plant will be able to operate in compliance with the regulations. The Process Flow Diagram in Section 4 indicates the pollution control methods and measures to be implemented.

Tables ES.1, ES.2 and ES.3 Project Proforma summary on the following 2 pages identifies the overall operating characteristics, projected costs, probable financing arrangements, cash flows, and return on investment.

Table ES.1 Pro Forma for 2.8 MW Power Plant

Date; 10-Nov-11
Location: **Halifax, Nova Scotia**
Prepared By: **K. J. Schwartz Engineering, Inc.**

PROJECT SPECIFIC INFORMATION

Unit Size	2.8 MW	2,800 KW/hr		
Capacity Factor	350 days/yr	95.9% On-Line		
Development Costs	$100,000			
Working Capital	$300,000			
Installed Costs	$10,533,430	Equip. Cost	$6,019,104	
Subtotal	$10,933,430			
Grant Amount	$0			
Total Project Probable Cost	$10,933,430			

PHASE 1 - POWER GENERATION PLANT OPERATING CHARACTERISTICS :

(note 3)	Load Factor	100%	2,800	KW/Hr		
	Turbine Steam Flowrate	14.28 PPH/KW	39,984	PPH	18,175	kg/hr
	Steam Supply	300 PSIG	1,256	Btu/Lb	2,921	kJ/kg
		496 F			257.8	C
	Turbine Exit	3 in Hg	1,145	Btu/Lb	2,663	kJ/kg
	Condenser Condensate		212	F	100.0	C
			175	Btu/Lb	407	kJ/kg
	Turbine Heat Rate (Btu/KWh)		1,583	Btu/KWh	1.67	MJ/kWh
	Plant Steam Auxiliaries (%)	2%	800	PPH	363	kg/Hr
	Total Steam Flow Required		40,784	PPH	18,499	kg/Hr
	Plant Heat Rate (Btu/KWh)		20,171	Btu/KWh	21,281	kJ/kWh
	Boiler Load		44,082,150	Btu/Hr		
(note 4)	Combustion Efficiency (%)		80%			
	Total Boiler Input		55,102,687	Btu/Hr	58,133	MJ/Hr
	57.1% Biosolids Boiler #1 Combustor Input		31,463,634	Btu/Hr	33,194	MJ/Hr
	42.9% Biosolids Boiler #2 Combustor Input		23,639,053	Btu/Hr	24,939	MJ/Hr
	Heat Content of Biosolids Fuel	90% Solids	5,300	Btu/Lb	12,328	kJ/kg
	Heat Content of Wood Fuel	85% Solids	7,370	Btu/Lb	17,141	kJ/kg
	Annual Hours of Operation	24 Hrs/Day	8,400	hours		
	Capacity Factor		85.0%			
	Annual Production(KWh)		19,992,000	kWh		
	Annual Boiler Load		393,433	MMBTU/Yr	372,896	GJ/Yr
Phase 1	Biosolids to Dryer Feed Rate	25% of Total Input	2,568	Lb/Hr	1,165	kg/hr
	30,000 Tonnes @75% MC	8,333 Tonnes @ 10% MC	1.28	Ton/hr	1.16	Tonnes/hr
Phase 1	Wood Fuel to Dryer Feed Rate	75% of Total Input	5,630	Lb/Hr	2,554	kg/hr
	40,516 Tonnes @ 45% MC	21,449 Tonnes @ 15% MC	2.82	Ton/hr	2.55	Tonnes/hr

FUEL REQUIREMENTS:

Biosolids Fuel (note 1 & 6)	Annual Biosolids Fuel As Received Quantities 25% of Total Input	Avg. Boiler Feed Rates @ 8,400 Hrs/Yr 85% Capacity	Annual Fuel Cost Cost/ MMBtu Cost/GJ	Total Cost	Cost/Ton Cost/Tonne
Imp.	9,167 Tons/yr 10% MC	1.28 Tons/Hr	$2.99	$290,570	$31.70
Metric	8,333 Tonnes/yr 10% MC	1.16 Tonnes/Hr	$3.16	$290,570	$34.87
Wood Fuel (note 1 & 6)	**Annual Wood Fuel As Received Quantities 75% of Total Input**	**Avg. Boiler Feed Rates @ 8,400 Hrs/Yr 85% Capacity**	**Annual Fuel Cost Cost/ MMBtu Cost/GJ**	**Total Cost**	**Cost/Ton Cost/Tonne**
Imp.	23,594 Tons/yr 15% MC	2.82 Tons/Hr	$3.30	$977,680	$41.44
Metric	21,449 Tonnes/yr 15% MC	2.55 Tonnes/Hr	$3.48	$977,680	$45.58

Table ES.2 2.8 MW PLANT FUELS AND PRODUCTION ASSUMPTIONS

			Unit Cost	Qty	Total Qty	Cost/Yr
	Expense					
(note 5)		Biosolids Fuel Cost @ 10% MC			8,333 Tonnes/yr	$290,570
		Wood Fuel Costs at 15% MC			21,449 Tonnes/yr	$977,680
		Natural Gas	$8.28		0 CF/Yr	$0
		Water, $/m3	$3.45		7,783 m3/yr	$26,852
		Sewer	$0.00	included	0 units/yr	$0
		Labor	$30.00	3	8,400 Hrs/Yr	$756,000
		Admin & Insurance	6.0% of sales			$209,916
		Maintenance & Repairs	2.3% of Equip Cost			$135,430
		Purchased Electricity	$0.110	280	2,352,000 KWh	$258,720
		Standby Charge	$0 per month x		12 months/yr	$0
	Cogon Heat Sales					
		Heat Sales, $/MMBtu	$6.00	13.00	109,200 MMBtu/Yr	$655,200
	Electric Power Generated					
(note 7)	1.00	Electric Utility Sales	$0.175		19,992,000 KWh/Yr	$3,498,600
	1.00	Cost Savings-In house power	$0.000	0	0 KWh/Yr	$0
	Net Operating Revenue					**$1,498,633**

Notes and Assumptions:

1. Ample biosolids and wood fuel supplies are available for long term operations.
2. Utility will purchase all electric power produced (FIT). Owner will purchase plant operations power from the Utility providing Electric power and service to the plant.
3. Load Factor is based on assumed sales of electricity to Utility.
4. Probable Combustor Combustion Efficiency.
5. Processed fuel will be treated and dried to 10% moisture content (avg). This is estimated amount of dried fuel to pass through Combustor in Tonnes/Yr.
6. Estimated quantity of biosolids delivered to plant fuel preparation and handling systems.
7. Electricity Sales are based on Power Purchase Agreement with Power Company in accordance with FIT.

Table ES.3 Pro Forma for Power Generation Plant

Year				1	2	3	4	5	6	7	8	9	10
Revenue		Electric Utility Sales	(note 2 & 7)	$3,498,600	$3,603,558	$3,711,665	$3,823,015	$3,937,705	$4,055,836	$4,177,511	$4,302,837	$4,431,922	$4,564,879
		Offset Utility Power		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
		Stack Heat Sales		$655,200	$674,856	$695,102	$715,955	$737,433	$759,556	$782,343	$805,813	$829,988	$854,887
	Total Revenue			$4,153,800	$4,278,414	$4,406,766	$4,538,969	$4,675,138	$4,815,393	$4,959,854	$5,108,650	$5,261,910	$5,419,767
Expenses		Inflation	3.0%										
		Labor		$756,000	$778,680	$802,040	$826,102	$850,885	$876,411	$902,704	$929,785	$957,678	$986,409
		Biosolids Fuel Cost @ 10% MC		$290,570	$299,287	$308,266	$317,514	$327,039	$336,850	$346,956	$357,365	$368,086	$379,128
		Wood Fuel Costs at 15% MC		$977,680	$1,007,010	$1,037,220	$1,068,337	$1,100,387	$1,133,399	$1,167,400	$1,202,422	$1,238,495	$1,275,650
		Landfill Gas Cost		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
		Admin & Insurance		$209,916	$216,213	$222,700	$229,381	$236,262	$243,350	$250,651	$258,170	$265,915	$273,893
		Maintenance & Repairs		$135,430	$139,493	$143,678	$147,988	$152,427	$157,000	$161,710	$166,562	$171,558	$176,705
		Water		$26,852	$27,657	$28,487	$29,342	$30,222	$31,129	$32,063	$33,025	$34,015	$35,036
		Sewer		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
		Purchased Electricity		$258,720	$266,482	$274,476	$282,710	$291,192	$299,927	$308,925	$318,193	$327,739	$337,571
	Total Expenses			$2,655,167	$2,734,822	$2,816,867	$2,901,373	$2,988,414	$3,078,067	$3,170,409	$3,265,521	$3,363,487	$3,464,391
Operating Income				$1,498,633	$1,543,592	$1,589,899	$1,637,596	$1,686,724	$1,737,326	$1,789,446	$1,843,129	$1,898,423	$1,955,376
Financing			$10,533,430										
Equity		25%	$2,633,358										
Debt Service-Years		20	$7,900,073	($688,764)	($688,764)	($688,764)	($688,764)	($688,764)	($688,764)	($688,764)	($688,764)	($688,764)	($688,764)
Interest		6%											
Taxable income				$809,868	$854,827	$901,135	$948,832	$997,960	$1,048,562	$1,100,681	$1,154,365	$1,209,659	$1,266,611
Taxes		15%		$121,480	$128,224	$135,170	$142,325	$149,694	$157,284	$165,102	$173,155	$181,449	$189,992
Net Annual Operations Benefits (Cash Flow)				**$688,388**	**$726,603**	**$765,965**	**$806,507**	**$848,266**	**$891,277**	**$935,579**	**$981,210**	**$1,028,210**	**$1,076,620**

Probable Return on Investment (ROI) (10 Years) **16%**

Simple Payback Period without Financing Costs **7.03 Years** (Project Cost / First Year Operating Income)

Probable Return on Investment (ROI) with Finance costs and Taxes **10%**

Payback Period with Financing Costs and taxes **15.3 Years** (Project Cost/Yearly Cash Flow)

An existing but idle 2.8 MW generating facility has been located. This facility can be purchased, moved to Goffs, and made operational for approximately $10.9 million. Based on projected operations, the Energy Facility will develop a 7 year simple payback.

The probable cost of an all new 2.8 MW CHP plant is $16.5 million.

Section 4 of this study contains detailed information on the proposed Project site and a preliminary plan.

The 2.8 MW Energy Facility will qualify as a renewable power source and will also be carbon neutral. Under the NS Department of Energy Renewable Electricity Program (Appendix B), the Energy Facility will qualify as a renewable electricity generator. At 2.8 MW output, the Energy Facility will consume 30,500 bone dry tonnes of biomass per year. The Energy Facility will employ 8 people and will support an additional 10 full time equivalent jobs in the area hauling biosolids and harvesting the biomass, totalling 18 jobs.

Economic factors that include rising fuel costs and mandates for cleaner fuels, the COMFIT program and forest health restoration initiative will be important drivers to make this Project feasible for the long term. The Energy Facility will be utilized to provide electric power generation for sale to the grid and the on site use of thermal power required for the processes at low cost and stable prices.

CONCLUSIONS AND PROJECT CONSIDERATIONS

Nova Scotia has ample biosolids and biomass resources to support a 2.8 MW Combined Heat and Power (CHP) plant. Furthermore, as analyzed, direct conversion to energy via CHP of the feedstocks appear to be logistically and financially viable business propositions.

Halifax Water and N-Viro Systems Canada, LP plan to use feedstocks whose process and delivery mechanisms have been fully developed, and will use conversion technologies that are fully commercially proven.

If the decision is made to proceed with further development of the Project, N-Viro Systems Canada, LP and Halifax Water members will focus efforts on:

1. Assigning management for development and operation of the Project and secure the Power Plant.

2. Developing a biosolids and biomass supply and procurement plan.

    - Negotiating terms and pricing for contracts with municipalities for biosolids and/or loggers for roundwood and logging residues.

3. Negotiating a Power Purchase Agreement.

   - At this larger scale, negotiations for grid access will involve Nova Scotia Power.

   - Halifax Water / N-Viro Systems to apply for COMFIT program through the NS Department of Energy.

4. Engaging professional engineering services for detailed design and permitting of the facility.

   - Assemble information and calculations for permitting process.

   - Environmental Assessment will not be required.

   - A detailed cost estimate should come from this effort.

   - This firm may also be able to assist in developing the construction timeline so that long lead-time items do not delay construction.

5. Pursue incentives such as COMFIT (Appendix B) to improve the feasibility of this Project and create a sustainable cogeneration facility.

The successful development of this biopower Project will accomplish several objectives:

A. Utilizing the biosolids/organic wastes and wood resources from surrounding areas for power production provides a higher and better use as renewable energy sources.

B. Thermal power in the form of hot gases will be utilized to reduce costs to operate dryers. Electricity will be sold to the grid. The cogeneration aspect improves overall efficiency and use of renewable energy.

C. The ash generated from the combustion process can be returned to the biosolids process area to be mixed into N-Rich®.

D. Hot flue gases heat from Energy Facility operations will be utilized by the Modified Aerotech Facility to enhance the N-ViroFuel® and N-Rich® production.

E. The distributed generation aspect will help Nova Scotia electric consumers stabilize their electric power supply, provide better power quality, help minimize outages, and assist the overall alternative energy use program.

F. Wood residues coming into the process plant will be processed and consumed in the power plant to generate electricity.

G. Increasing the extraction of forest fuels will enhance growth of commercial wood products industry through enhanced thinning. Harvesting, thinning, and similar activities are some methods for increasing the availability of biomass for fuel.

H. The Project will help create new jobs in the area. Technical jobs are required to operate and maintain the power plant. Additional jobs for harvesting, transporting, and processing fuel for consumption in the power plant will be created.

I. This Project will help achieve the renewable fuels use goals of Nova Scotia. The electrical power produced by the plant will be contracted to Nova Scotia Power.

J. The Project will be an innovative use of proven technology in the waste to energy conversion industry and Nova Scotia will be a leader in the application of this technology.

The Project is feasible based on the project scope, equipment available, site selection, probable costs, and availability of a sustainable fuel supply. The recommendation is to proceed with the implementation of the Project.

Halifax Water - N-Viro Fuel Fired 2.8 MW Cogeneration Project
COMFIT Project Implementation Process

Preliminary

Project Title: N-Viro COMFIT Project Plan
Project Description: Distribution System Connected N-Viro Fuel Fired 2.8 MW Cogeneration Project
Project Type: N-Viro COMFIT Project
Project Details: N-Viro COMFIT Project

COMFIT Section	Description	Timeline (Weeks)	Estimated Cost ($CD)	Notes	Resp	Status
	Total Estimates	**0**	**$10,648,180**			
1.0	**COMFIT Application**	**0**	**$1,750**			
	1.1 Applicant Registration	**0**	**$0**			
	1.1.1 Registration w/COMFIT Site, including	0	$0			
	1.1.1 Legal Registered Name	0	$0			
	1.1.2 Business Name	0	$0			
	1.1.3 NSRJS Registry ID Number	0	$0			
	1.1.4 Physical/Mailing Address	0	$0			
	1.1.5 Email Address	0	$0			
	1.1.6 Telephone Number	0	$0			
	1.1.7 Registered User	0	$0			
	1.1.8 Username	0	$0			
	1.1.9 Password	0	$0			
	1.1.10 Fax Number	0	$0			
	1.1.11 Primary Applicant Type	0	$0			
	1.1.2 DOE COMFIT Registration Approval	0	$0		NSDOE	
	1.2 Ownership Structure	**0**	**$0**			
	1.2.1 Type of Ownership Structure	0	$0			
	1.2.2 Identify Partnerships	0	$0			
	1.2.3 Evidence of Knowledge of Ownership Requirements (Ref. Subsection 4A(8) of the Act)	0	$0			
	1.3 Project Information	**0**	**$0**			
	1.3.1 Type of Renewable Energy Generation Facility	0	$0			
	1.3.2 Description of Technology	0	$0			
	1.3.3 Proposed Size	0	$0			
	1.4 Site Information	**0**	**$0**			
	1.4.1 Provide Site + Project Location Information	0	$0			
	1.4.2 Geographic Coordinates or Property Identification Number	0	$0			
	1.4.3 Confirm Land Ownership + Access Details	0	$0			
	1.5 Technical Information	**0**	**$750**			
	1.5.1 Preliminary Interconnection Assessment by NSPI	0	$750			
	1.5.1.1 Completed Distribution Interconnection Request Form, including:	0	Included in 1.5.1			
	1.5.1.2 Electrical One Line Diagram (2 copies)	0	Included in 1.5.1			
	1.5.1.3 Map of Project Location (2 copies)	0	Included in 1.5.1			
	1.5.1.4 Physical Site Plan (2 copies)	0	Included in 1.5.1			
	1.5.1.5 Point of Contact Information (if applicable)	0	Included in 1.5.1			
	1.5.1.6 Submit Certified Cheque to NSPI	0	Included in 1.5.1			
	1.5.2 Preliminary Assessment Study Completed by NSPI	0	Included in 1.5.1		NSPI	
	1.6 Business Case and Supporting Information	**0**	**$0**			
	1.6.1 Business Planning	0	$0			
	1.6.1.1 Resource Assessment - Bio-Solids Fiuel Procurement/Supply Plan	0	$0			
	1.6.1.2 Financial Analysis	0	$0			
	1.6.1.3 Capital Cost Analysis	0	$0			
	1.6.1.4 Cost of Expected Sources of Capital	0	$0			
	1.7 Community Support and Engagement	**0**	**$0**			
	1.7.1 HRWC Board Resolution	0	$0			
	1.7.2 Municipal Council Resolution	0	$0			
	1.8 Aboriginal Community Support and Engagement	**0**	**$0**			
	1.8.1 Identification of Closest Affected Aboriginal Communities	0	$0			
	1.8.2 Evidence Demonstrating Engagement w/ Mi'Kmaw Community Concerns	0	$0	Letters to OAA, KMKNO, NCNS, GFN, IBFN		
	1.9 Environmental Requirements	**0**	**$1,000**			
	1.9.1 Provide an Acknowledgment of Environmental Requirements	**0**	**$0**			
	9.1.1 Federal Requirements	0	$0			
	9.1.2 Provincial Requirements	0	$0			
	9.1.3 Environmental Assessment Requirements	0	$0			
	1.9.2 Demonstrate Initial Contact Details with Applicable Government Departments	0	$0			
	1.9.3 ACCDC Screening	0	$500	Estimate Only		
	1.9.4 Environmental Screening	0	$500	Estimate Only		
	1.10 Special Places, Archaeological, and Heritage Resource Requirements	**0**	**$0**			
	1.10.1 Provide an Acknowledgment of Requirements	0	$0			
	1.10.2 Demonstrate Initial Contact Details with Applicable Government Departments	0	$0			
	1.11 Other Permits and Approvals	**0**	**$0**			
	1.11.1 Acknowledgment of Municipal Zoning By-Law Requirements	0	$0			
	1.11.2 Acknowledgement of Nova Scotia Environment Regulations and Requirements	0	$0			
	1.12 DOE COMFIT Application	**0**	**$0**			
	1.12.1 Affirming Statement + Signature	0	$0			
	1.12.2 Submit DOE COMFIT Application	0	$0			
	1.12.3 DOE COMFIT Application Approval	0	$0		NSDOE	
2.0	**Permits & Approvals**	**0**	**$1,000**			
	2.1 Environmental Requirements	**0**	**$0**			
	2.1.1 Environmental Assessments, Permits & Approvals				TBD	
	2.1.1.1 Federal Permits and Approvals	tbd	$0		TBD	
	2.1.1.2 Provincial Permits and Approvals	tbd	$0		TBD	
	2.1.1.3 Environmental Assessment	tbd	$0		TBD	
	2.1.2 Provide an Environmental Statement	0	$0		TBD	
	2.1.3 ACCDC Requirements	0	$0		TBD	
	2.2 Special Places, Archaeological, and Heritage Resource Requirements	**0**	**$0**			
	2.2.1 Complete the Environmental Screening Process	0	$0		TBD	
	2.2.1.1 Archaeological Resource Impact Assessment (Category C Permit), if Required	0	$0		TBD	
	2.2.1.1.1 Archaeological Resource Impact Assessment Plan, if Required	0	$0		TBD	
	2.2.1.2 Heritage Research Permit, if Required	0	$0		TBD	
		0				
	2.3 Other Permits and Approvals	**0**	**$1,000**			
	2.3.1 Municipal Zoning By-Law Approval/Permit	0	$1,000	Estimate Only		
3.0	**Detailed Resource Assessment**	**0**	**$0**			
	3.1 Detailed Resource Assessment	**0**	**$0**			
	3.1.1 Ref. N-Viro Fuel Analysis Study	0	$0			
4.0	**NSPI Interconnection Request**	**0**	**$12,000**			
	4.1 Interconnection Request (NSPI - IR Queue)	**0**	**$12,000**			
	4.1.1 Submit DOE COMFIT Approval to NSPI	0	$0			
	4.1.2 Submit Combined System Impact/Facilities Study Request to NSPI	0	$0			
	4.1.3 Submit Certified Cheque	0	$12,000			
	4.1.4 Placement in Interconnection Queue	0	$0		NSPI	
	4.1.5 Combined System Impact Study (SIS) Completed by NSPI	0	$0		NSPI	
	4.2 Small Generator Interconnection Agreement (SSGIA)	**0**	**$0**			
	4.2.1 IC Acceptance of SIS Requirements	0	$0		TBD	
	4.2.2 Develop Project Specific Terms of SSGIA	0	$0		TBD	
	4.2.3 IC Execution if SSGIA	0	$0		TBD	
5.0	**Construction / Installation / Commissioning / Testing**	**0**	**$10,633,430**			
	5.1 Construction / Installation / Commissioning / Testing	**0**	**$10,633,430**			
	5.1.1 2.8 MW Power Plant	0	$3,000,000	Estimate Only	TBD	
	5.1.2 Dis-Assembly of Equipment and Match Marking	0	$916,840	Estimate Only	TBD	
	5.1.3 Freight	0	$362,160	Estimate Only	TBD	
	5.1.4 Re-installation of Equipment on site	0	$1,985,000	Estimate Only	TBD	
	5.1.5 New Stoker Packages (Boilers 1 & 2)	0	$1,050,000	Estimate Only	TBD	
	5.1.6 New Fue Handling and Storage System	0	$250,000	Estimate Only	TBD	
	5.1.7 Air Cooled Steam Coindensing System	0	$800,000	Estimate Only	TBD	
	5.1.8 Water Treatment System Modifications	0	$25,000	Estimate Only	TBD	
	5.1.9 Site Costs and Buidling Construction	0	$800,000	Estimate Only	TBD	
	5.1.10 NSPI related feeder upgrading costs, recloser and controls, revenue metering, switching, etc.	0	$275,000	Estimate Only	TBD	
	5.1.11 Engineering services	0	$567,840	Estimate Only	TBD	
	5.1.12 Contingency (5%)	0	$501,590	Estimate Only	TBD	
	5.1.13 SSGIA Requirements Met - NSPI Execution of SSGIA					
	5.1.14 Reconciliation of Interconnection Costs	0	$100,000	Estimate Only	TBD	
	5.1.15 Project Completion and Start of Generation					
6.0	**Reporting**	**0**	**$0**			
	6.1 Capital Cost Report + Supplier Report to Minister of NSDOE	**0**	**$0**			
	6.1.1 Create Capital Cost Report	0	$0		TBD	
	6.1.2 Submit to Minister of NSDOE	0	$0		TBD	