Independent Power and Heat for Business and Worship Centres

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Business Overview

Business History

Energhx Green Energy Corporation ("Energhx") is an engineering consortium, specialised in green energy solution development, including the design and demonstration of alternative energy solution for residential and commercial clients. Driven by the increasing need for clean energy system, Energhx provides affordable independent power and heat from solar-wind energy resources. The desire to design, develop and deliver distributed power and heat, which started in January 2008 when Energhx was registered in the Province of Ontario, has resulted in the processing and possession of regulatory and professional licences, including Certificate of Authorization to provide engineering services; Gas Marketer licence to supply natural gas, and Electricity Retailer licence to supply electricity. Being a licensed Market Participant in the energy industry, Energhx is able to effectively work with Utilities and regulatory bodies in providing clients with independent power and heat.

Vision and Mission Statement

Energhx visions are focussed on being a strategic centre for training of prospective green energy labour force; and the design of advanced energy systems. The following addresses her mission statements: 1. To recruit and train prospective solar-wind system installers for residential and commercial power and heat generation services; and 2. To install hybrid solar-wind generators and solar domestic hot water and solar air systems for independent application in homes and businesses.

Objectives

Energhx understands that the development of green energy and economy in Ontario starts with good energy assessment services for existing home and commerce. Thereafter, customized power and heat generation facilities can be design, develop, and delivered for independent application. These objectives will be implemented as follows: 1. Application for generator contract to develop independent power generation facility on individual clients' land asset, either for clients ownership or lease agreement; 2. Processing of financing for each project; 3. Installation of customised solar-wind generators and solar domestic hot water/air collectors; 4. Connection of the embedded generator to the distribution system; and 5. Delivery and management of energy commodity supplies.

Especially for business and worship centres in Ontario where the control of the use of power and heat is not encouraged during business hours, integration of these solutions can help generate additional line of income and reduce business expenses. Hence, the rest of this material is focussed on independent power and heat for business and worship centres.

Energy Systems for Independent Power and Heat

Description of Solar-Wind Resources

Solar-Wind Resources comprise the hybrid of solar energy and wind energy. While solar energy is further broken into solar thermal and solar PV systems, wind energy is the conversion of kinetic energy of moving air into electricity through the help of strategically positioned wind turbines. Wind turbines may be employed individually, but are often installed in groups to form “wind farms” or “wind power plants.” Electricity generated by wind farms may be used locally, or placed on the electric grid to power homes and businesses farther away. Using wind energy reduces the environmental impact of generating electricity because it requires no fuel and does not produce pollution or greenhouse gases.

On the other hand, solar photovoltaic (PV) technology chemically converts the solar irradiation into direct current electricity while solar thermal technology converts the solar irradiation into heat.

Solar PV Systems

Solar PV system comprises of solar modules, alternating current (AC) inverters, and battery (if necessary, especially for off-grid systems). The size of the solar modules, battery bank, and AC inverter required for a typical solar PV application depends on a number of factors, such as the amount of electricity you use, the amount of sunlight at the site, the number of days without backup that you require, and the peak electricity demand at any given time.

Vertical Axis Wind Turbine Systems

Small wind turbines are very different than large wind turbines. Large turbines, often grouped in wind farms, are widely used by utilities across Canada to provide grid electricity. Although small wind turbines may look like "miniature" versions of these large turbines, there are some important differences. In order to further reduce the adaptability of small wind turbines for independent power generation in homes and businesses, Energhx has adopted the Vertical Axis Wind Turbines (VAWT) systems for business and worship centres. Unlike conventional horizontal axis small wind turbines, VAWT has received excellent power curve, noise level, and vibration performances. Previous designs include the use of 600W VAWT for hybrid street lights.

VAWTs can turn wasteful business parking lots into attractive useful business arena, without creating distracting noise.

Solar Domestic Hot Water Systems

Solar domestic hot water (SDHW) systems convert solar irradiation into heat for warming water, commonly used for washing and drinking, radiant floor heating, and swimming pools. This system comprises of solar collectors, heat exchanger, control devices, piping, and tanks. Depending on the configuration of the designed system, SDHW system can reduce or replace the dependence on natural gas for hot water production.

Solar Air Systems

Solar energy can heat air that is to be used in business and worship centres. Collector panels are affixed to the south wall of the facility, thereby causing air rises through the panels, when heated by solar rays and the heated air is vented into the building when it reaches the top of the collectors. The

technology is not designed to heat all the air required, but to serve as a pre-heat supplement. The amount of collector panels required for a site depends on a number of factors, such as the size of your load (i.e., how much air do you need to pre-heat), the amount of solar radiation at the site, etc.

Federal and Provincial Incentives

All the energy system solutions provided by Energhx are supported by both federal and provincial incentives, like the ecoENERGY for Renewable Power[1] and the ecoENERGY for Renewable Heat[2] programs of the Natural Resources Canada; and the microFIT and Feed-in-Tariff[3] programs of the Ontario Power Authority. While ecoENERGY for Renewable Power will provide an incentive of one cent per kilowatt-hour for up to 10 years to eligible low-impact, renewable electricity projects constructed by March 31, 2011, ecoENERGY for Renewable Heat will offer an incentive to industrial, commercial and institutional purchasers of solar heating systems. The anticipated Incentive amount is calculated as follows: Performance Factor x Incentive Rate x Area of Collector.

Applicable provincial incentives for power generation is administered by the Ontario Power Authority under the micro Feed-in-Tariff (microFIT) program for all projects within 10 kW; and Feed-in-Tariff (FIT) program for all systems above the 10 kW threshold. While electricity generated through the wind turbines is guaranteed a 20 years contract price of 13.6 cents / kWh, solar PV generated power will be paid 80.2 cents / kWh (certain changes and conditions are applied, depending on size and installation methods).

[1] http://www.ecoaction.gc.ca/ecoenergy-ecoenergie/power-electricite/index-eng.cfm
[2] http://www.ecoaction.gc.ca/ecoenergy-ecoenergie/heat-chauffage/index-eng.cfm
[3] http://fit.powerauthority.on.ca/

Installation and Connection Procedures

Site Assessment and Procurement Services

After Energhx obtains the authorization to commence the green energy project, the following site assessment and procurement services will enable proper delivery of Energhx services:

1. **Solar Readiness**. Except with ground-mounted installation, right orientation of the available roof space that will be used for mounting the Solar panels must be the first point of assessment. The space area must be sufficient for the designed system size and facing either south-west or south-east.

2. **Irradiation and Wind Data**. Solar Irradiation and wind data are available in most government publications including Environment Canada. However, most green energy project developers use RETScreen™, a set of free tools developed by NRCan's International Renewable Energy Decision Support Centre; and this tool is used by Energhx, in addition to others, to develop the energy model, and analyse the economic viability of the project.

3. **Historical Usage Data**. Given the authorization of clients, Energhx is able to request for up to 24 months of historical usage information directly from local distribution company, like Hydro Ottawa and Hydro One Network. Rather than relying on the scanty or unavailable information from client's previous electricity bills, historical data from the Utility enables the projection of the required size of Solar PV system that can displace load demands. Also, Energhx service agreement with local Utilities can save clients the risk of forfeiting their conditional contract with federal and provincial authorities, after incurring the cost of project implementation, for failure to connect their project to the grid within the period specified in the contract.

4. **Procurement of Appliances**. Energhx has dealership arrangement with manufacturers of Solar PV appliances, solar collectors, wind turbines, and can guarantee reliable and cost-effective supply for all clients. Direct procurement to installation is made after regulatory and connection permits have been processed.

Design and Regulatory Procedures

The implementation of energy system solution services requires regulatory permits from Utility, Electrical Safety Authority (ESA), and the Municipality (City of Ottawa). Among other documents that needed review before Connection, Safety, and Building Permits are given, the sets of drawings showing proper design of anchorage, and the electrical lines represent the significant part of all the regulatory procedures. Energhx design team comprises of experts with experience in the use of SolidWorks and other drafting tools. The installation of a Solar PV energy system on an existing building requires, according to the Ontario Building Code Act, the preparation and submission of relevant drawings, including the site plan and elevation of the proposed building. Copies of these drawings will be prepared and submitted to the City of Ottawa by Energhx.

Before the generator can be connected to the electrical system it must be inspected and approved by the Electrical Safety Authority. The Ontario Electrical Safety Code ("OESC") requires an Application for Inspection to be submitted by the contractor doing the electrical installation. The inspection provides assurance that the installation meets the safety requirements of the OESC and does not pose a hazard to anyone during and after the completion of the project. It also provides an assurance that the installation will not pose a hazard to the local utility workers who may be required to service or repair the electrical supply to your home. Energhx will coordinate the processing of this permit.

Communication Protocol with Utility

Being a Market Participant, licensed by the Ontario Energy Board, Energhx is able to effectively establish an Electronic Business Transaction (EBT) with client's local distribution company. Therefore, access to relevant information required for design, installation, and connection of the solar-wind system to the grid is possible. The Ontario Energy Board has outlined the standard

connection procedure, and all Market Participants are required to comply, if proper communication protocol is followed.

The local distribution companies are licensed by the Ontario Energy Board (OEB) to supply electricity to consumers through the distribution grid. For example, Hydro Ottawa has the mandate to operate distribution facilities within its licensed area. The defined area, as defined in its distribution license, is the former municipalities of Ottawa, Vanier, Nepean, Gloucester, and Kanata, plus Manotick, the Township of Goulbourn, the Village of Casselman (County of Russell), the Village of Rockcliffe Park, and the portion of the former township of Rideau on Long Island, north of Bridge Street. This service area is subject to change with the OEB's approval. Since the proposed embedded generator will be grid-tied, OEB has detailed the procedure for connection of the proposed generator to the distribution grid. Being an OEB-licensed electricity retailer, Energhx has additional privilege of administering the processing of the connection permit through Hydro Ottawa. The flowchart of the connection process is shown below:

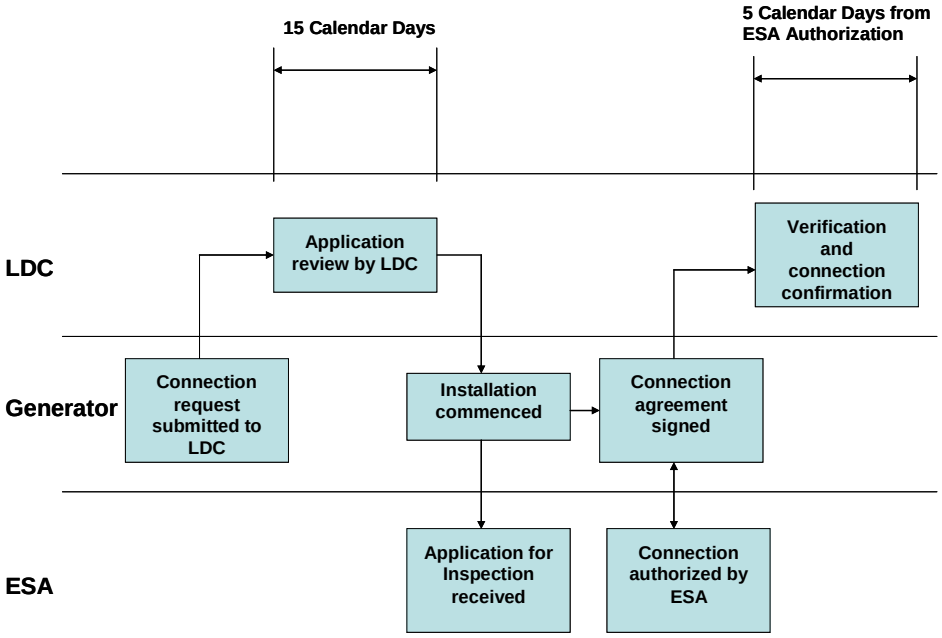

Figure 1: Grid Connection Process

Use of Certified Installers

Energhx is a corporate member of the Canadian Solar Industries Association (CanSIA), a body which promote the professional and practical use of solar technologies in Canada; the Canadian Wind Energy Association (CanWEA); and has unrestrained access to pool of certified installers. In addition, Energhx ensures that Electricians with Master Licence are retained for all installation procedure.

Activity Pricing and Schedules

A sample case of solar PV system is used for pricing and activity illustration, considering only the micro FIT program.

Solar PV Project Sizes and Costs

Every Solar PV module comes in standard sizes, in term of length, width, and height; or simply square area. The system power of any project is obtained by adding up the power rating of each module. Given the available space for installation, it is straightforward to obtain the number of module required and the cost of modules. Table 1 provides the space and cost analysis for five different project sizes, using a SolarWorld 230 Watt Module.

Table 1 – Space and Cost Analysis of Solar PV Projects

ENERGHX Exergetic Design of Energy Systems			meters		Solar Project Estimates				
	Unit Price ($)	Power Rating (W)	Unit Size (L x B)	Square Area (meters)	1.5 kW	2 kW	3 kW	5 kW	10 kW
System Power (kW)					1.5	2	3	5	10
Number of PV Modules					7	9	14	22	44
SolarWorld 230 Watt Module	892	230	1.622 x 0.814	1.320308	$6,244.00	$8,028.00	$12,488.00	$19,624.00	$39,248.00
Required Solar PV Space (square meters)					9.242156	11.882772	18.484312	29.046776	58.093552
10 MOD VERT ROOF / GROUND MOUNT	1095				$0.00	$1,095.00	$0.00	$0.00	$0.00
8 MOD ROOF / GROUND MOUNT	644				$644.00	$0.00	$1,288.00	$1,932.00	$3,864.00
XW SERIES, 6.0 KW, 48 VDC INVERTER	4950				$4,950.00	$4,950.00	$4,950.00	$4,950.00	$4,950.00
Connection, Cabling, Switch, & accessories	500				$750.00	$1,000.00	$1,500.00	$2,500.00	$5,000.00
Permits & Contract Processing (per kW system)	1000				$1,500.00	$2,000.00	$3,000.00	$5,000.00	$10,000.00
				Subtotal	$14,097.24	$17,084.88	$23,244.48	$34,035.05	$63,120.09
Engineering & Project Mgt Cost					$3,099.98	$3,756.97	$5,111.46	$7,484.31	$13,880.11
				Project Cost	$17,197.23	$20,841.85	$28,355.95	$41,519.35	$77,000.20

Demand Side Monitoring

Apart from access to historical usage information from Hydro Ottawa, Energhx uses HOT2000 software for the estimation of current client's electricity consumption (load). The monitoring of client's energy demand provides the performance assessment tool, even after the commissioning of Solar PV system. Although Energhx clients continue to be supplied their electricity at Market Price (currently around 6.0 cents per kWh), every kWh of electricity generated through the Solar PV generator will be paid at the contract price of 80.2 cents.

Revenue Estimation

Contrary to the misconception of many, revenue from OPA is not based on the net power supplied to the grid. The local Utility, on behalf of OPA, pays for every kWh of electricity generated through the microFIT project. Apart from the load account, the Solar PV project will be dedicated a separate account (cost of new meter is included in the connection fee, received from Hydro Ottawa). Therefore, the estimation of the expected revenue is solely dependent on the size of the system, the efficiency of system integration, and the local solar resources.

Using Energhx Solar PV Calculator (based on 60% capacity on an average of 6 hours harvest per day), the estimated revenue for 2-kW, 5-kW, and 10-kW systems are shown in Tables 2, 3, & 4 respectively. Using an annual interest rate of about 7.0%, the cost of borrowing the sum of $20,841.85 for 2-kW system, compounded annually, is about $4,573.82. It implies that, for about $279.55 additional monthly commitment (including the repayment to bank, maintenance, and taxes), client can pay up the cost of a 2-kW Solar PV System within 5 years (The monthly commitment may

be reduced by increasing the amortization up to 10 years; however, the cost of borrowing will increase above $7,000 at an estimate of 7.5% interest rate for the second term). Thereafter, he/she is guaranteed annual income of about $2,000 for the remaining 15 years of the contract. By comparing the ratio of OPA Payment to Client Supplement toward the project cost, for the three systems, it is observed that the return of investment increases with the size of the Solar PV system (see Figure 2).

Table 2 – Cash Flow Analysis for a 2-kW Solar PV System

Client Ownership Option, for 2-kW System on 5 years amortization

	Year 1	Year 2	Year 3	Year 4	Year 5
OPA Payment	$2,078.78	$2,078.78	$2,078.78	$2,078.78	$2,078.78
Client Supplement	$3,354.60	$3,354.60	$3,354.60	$3,354.60	$3,354.60
Gross Payment	$5,433.38	$5,433.38	$5,433.38	$5,433.38	$5,433.38
Repayment Commitment	$5,083.13	$5,083.13	$5,083.13	$5,083.13	$5,083.13
Expenses:					
Term-Value of Loan	$20,841.85				
Project Cost	$20,841.85	$0.00	$0.00	$0.00	$0.00
Maintenance	$0.00	$100.00	$100.00	$100.00	$100.00
Interest Term Loan	$914.76	$914.76	$914.76	$914.76	$914.76
Total Expenses	$21,756.61	$1,014.76	$1,014.76	$1,014.76	$1,014.76
Net Income Before Taxes	-$16,323.23	$4,418.62	$4,418.62	$4,418.62	$4,418.62
Less: Inc Taxes (13%)	-$270.24	-$270.24	-$270.24	-$270.24	-$270.24
Cash Balance	-$16,593.47	$4,148.38	$4,148.38	$4,148.38	$4,148.38

Table 3 – Cash Flow Analysis for a 5-kW Solar PV System

Client Ownership Option, for 5-kW System on 5 years amortization

	Year 1	Year 2	Year 3	Year 4	Year 5
OPA Payment	$5,196.96	$5,196.96	$5,196.96	$5,196.96	$5,196.96
Client Supplement	$5,684.83	$5,684.83	$5,684.83	$5,684.83	$5,684.83
Gross Payment	$10,881.79	$10,881.79	$10,881.79	$10,881.79	$10,881.79
Repayment Commitment	$10,126.18	$10,126.18	$10,126.18	$10,126.18	$10,126.18
Expenses:					
Term-Value of Loan	$41,519.35				
Project Cost	$41,519.35	$0.00	$0.00	$0.00	$0.00
Maintenance	$0.00	$100.00	$100.00	$100.00	$100.00
Interest Term Loan	$1,822.31	$1,822.31	$1,822.31	$1,822.31	$1,822.31
Total Expenses	$43,341.66	$1,922.31	$1,922.31	$1,922.31	$1,922.31
Net Income Before Taxes	-$32,459.87	$8,959.48	$8,959.48	$8,959.48	$8,959.48
Less: Inc Taxes (13%)	-$675.60	-$675.60	-$675.60	-$675.60	-$675.60
Cash Balance	-$33,135.48	$8,283.87	$8,283.87	$8,283.87	$8,283.87

Table 4 – Cash Flow Analysis for a 10-kW Solar PV System

Client Ownership Option, for 10-kW System on 5 years amortization

	Year 1	Year 2	Year 3	Year 4	Year 5
OPA Payment	$10,393.92	$10,393.92	$10,393.92	$10,393.92	$10,393.92
Client Supplement	$9,816.93	$9,816.93	$9,816.93	$9,816.93	$9,816.93
Gross Payment	$20,210.85	$20,210.85	$20,210.85	$20,210.85	$20,210.85
Repayment Commitment	$18,779.63	$18,779.63	$18,779.63	$18,779.63	$18,779.63
Expenses:					
Term-Value of Loan	$77,000.20				
Project Cost	$77,000.20	$0.00	$0.00	$0.00	$0.00
Maintenance	$0.00	$100.00	$100.00	$100.00	$100.00
Interest Term Loan	$3,379.59	$3,379.59	$3,379.59	$3,379.59	$3,379.59
Total Expenses	$80,379.79	$3,479.59	$3,479.59	$3,479.59	$3,479.59
Net Income Before Taxes	-$60,168.94	$16,731.26	$16,731.26	$16,731.26	$16,731.26
Less: Inc Taxes (13%)	-$1,351.21	-$1,351.21	-$1,351.21	-$1,351.21	-$1,351.21
Cash Balance	-$61,520.15	$15,380.05	$15,380.05	$15,380.05	$15,380.05

Exergetic Design of Energy Systems

Apart from the manufacturer efficiency of solar PV modules and the intensity of solar irradiation at the project location, conventional integration of solar PV systems are often designed without effective consideration of the import of energy conversion on system efficiency. The exergetic design of energy system is possible by considering the optimization of available resources. Energhx has conducted series of sensitivity techniques towards selection of optimized system configuration for maximum solar energy harvest. Using in-house software (e.g., *Energhxflow*) and solution techniques, the best solar tracking system will be designed for maximum return of investment.

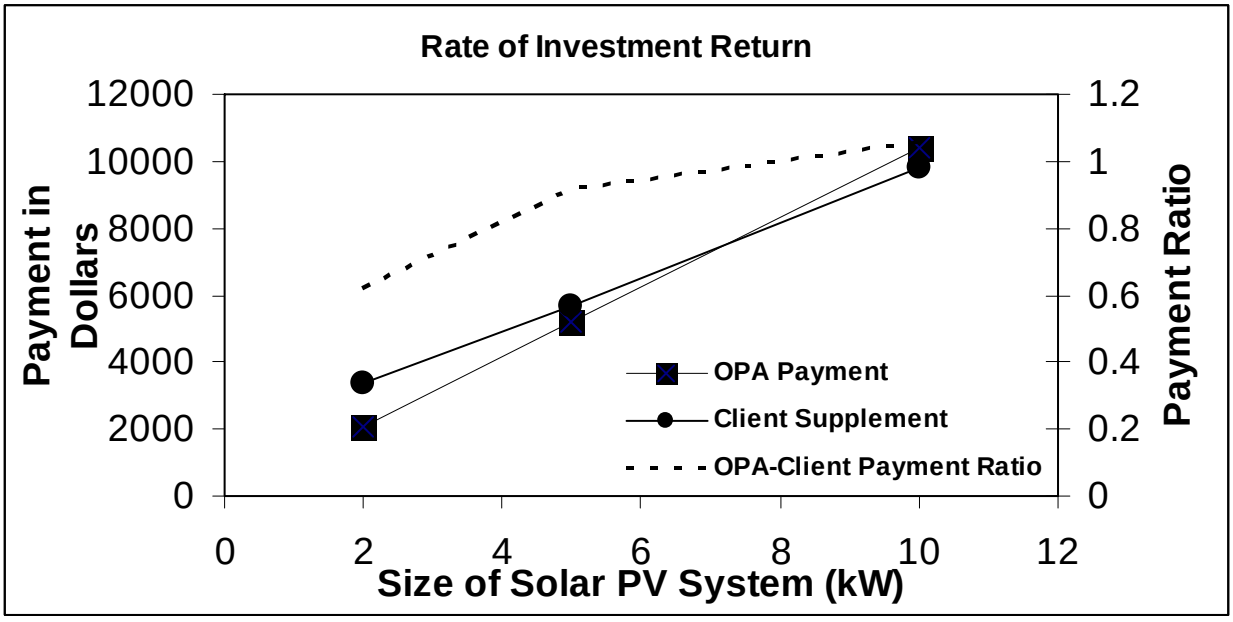

Figure 2 – Ratio of OPA Payment to Client Supplement with Project Size