OSEA

Solar PV Community Action Manual

OSEA CanSIA Solar PV Community Action Manual

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Final Notes / Disclaimer

There are a variety of tax-related and legal implications resulting from many of the options outlined in this manual. The manual is intended to provide introductory information only, and advice should be sought from trusted legal or financial counsel before signing any contract or agreement.

Financing structures discussed in this manual with have varied results for various individuals and businesses. Individuals and organizations interested in investing in a system should consult a financial advisor about accompanying loans, subsidies or newly acquired assets.

No section of this manual should be considered tax, financial, or legal advice, and OSEA and CanSIA are not liable for any resulting actions taken based on information in this manual. Furthermore, all examples in this Guidebook are intended as examples and conceptual illustrations only.

Use of RETScreen should be done only in conjunction with its manual to avoid errors that may significantly alter the financial outcome of a project.

Table of Contents

1. Introduction

1.1 Solar PV Community Action Manual: Purpose and Audience

The Solar PV Community Action Manual is designed for residents of Canada who would like information on residential-scale, or small-scale commercial Solar PV installations, and information on initiating a community-based Solar PV organization or group situated in their neighbourhood.

Solar PV is a form of energy generation that converts solar radiation into electricity that can be fed into the electricity grid, used immediately on-site, or stored on site for later use.

Community-based project ownership, or Community Power, is a type of project ownership whereby various residents of a community pool their investment into a single or multiple renewable energy generation project(s). Two main models of ownership structure have emerged; individual, residential-scale systems through individual purchase or neighbourhood bulk-purchase, and remotely-sited large or utility-scale installations, funded by local investment. Though the guide examines all ownership options, it focuses primarily on the community ownership model.

This manual discusses Solar PV technologies that are currently available in Canada, and outlines which technologies are best suited for different applications. Factors that affect the viability of a Solar PV project, such as site feasibility and regulatory issues are discussed. Ownership options are outlined, and a primer on financing Solar PV projects is provided. Also discussed is the process of choosing a supplier and installer, and the final chapters of this manual address possible developments that will affect the future of Solar PV technology in Canada.

Throughout this guidebook there are references to other resources regarding Solar PV. The most extensive and useful sources of information can be found at CanSIA and CanREN.

1.2 OSEA and CanSIA

This guide was created by the Ontario Sustainable Energy Association (OSEA) in conjunction with the Canadian Solar Industries Association (CanSIA).

OSEA (Ontario Sustainable Energy Association) is a not-for-profit member-based association of renewable energy organizations in the Province of Ontario. The mandate of OSEA is to initiate, facilitate and support the work of community-based sustainable energy projects and organizations across Ontario. OSEA's member services are designed to support members as they develop their projects and to host and facilitate discussions surrounding a supportive policy framework for community power projects. To date, OSEA has focused on community wind power projects by supporting co-operatively-owned projects, and to promote renewable energy development

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encouraging the Provincial government to adopt a payment system for small scale renewable generation. OSEA is expanding its services to provide support for community-based biomass, small hydro, Solar PV and Solar Thermal projects. For more information on the support services OSEA provides, please visit their website at www.ontario-sea.org.

OSEA's work in policy development has centered on the Renewable Energy Standard Offer Program. This program includes provisions for community wind, biomass, small hydro and Solar PV, which are discussed further in Section 3.3.2.2.

CanSIA (Canadian Solar Industries Association) is a federally registered not-for-profit association with a membership comprised of individuals, organizations and companies who share an interest in solar technology. CanSIA is working to strengthen the Canadian solar industry and to promote the use of solar renewable energies. (www.cansia.ca)

1.3 The Benefits of Community Owned Solar PV

Solar is a clean and reliable source of energy. It reduces pollution while producing a dependable source of energy that is not affected by international fuel supplies or events. It directly replaces energy consumption from non-renewable energy sources, including:

- Heating predominantly from natural gas, oil, propane and wood
- Electricity from coal, nuclear, natural gas, and oil

Energy created by non-renewable resources creates:

- Greenhouse gas (GHG) emissions associated with climate change
- Smog-related emissions that effect air quality and health
- Long-term radioactive waste issues from nuclear

Solar energy generation is a decentralized approach to energy production. It generates energy where it is needed, reducing the need for energy to travel long distances which can result in electricity loss through transmission lines. It may also generate revenue. As solar technologies evolve and supportive policy is implemented, the industry will expand; new high-trained jobs will be created and local wealth will increase. This will be especially true in Provinces such as Ontario, which have begun implementing programs to encourage industry growth.

Community ownership has benefits over and above those realized by individual ownership. By pooling the skills and resources of communities, larger economies of scale can be achieved, reducing the average cost for each member. Even though the total cost of a large system will be greater than an individual system, the average cost per kW (Kilowatt) of a large solar installation for each investor will be less. Economies of scale will be explained further in section 5.4.

Community ownership also has other benefits, including increasing

public knowledge and recognition of solar power, reducing many of the risks associated with having an individual system, and many other advantages explained in section 5.4.3.

2. Overview of Solar Photovoltaic Technology in Canada

2.1 Definitions & Acronyms

The following are some definitions used in this manual.

Solar Cell: Building block of a solar PV system and usually made of silicon.

Solar Module: A solar module (Solar Panel) is made up of a series of solar cells that are connected together.

String: Is a collection solar modules connected in a series

PV: Photovoltaic (PV) the term used for the technology used to convert solar radiant energy directly into electricity.

Solar Array: A number of strings connected in parallel to form a solar array.

DC electricity: Direct current electricity which is produced by solar modules and is the same form of electricity as from a battery.

AC electricity: Alternating current, such as standard household electricity in North America, cycles 60 times a second.

Inverter: Converts DC electricity to AC electricity

LDC: Local Distribution Company; the utility that supplies electricity to customers in a municipality or region.

OESC: Ontario Electrical Safety Code. This is the Ontario safety code that must be followed for all electrical installations in the Province.

ESA: Electrical Safety Authority is the regulating body that is responsible for the safety of electrical installations in Ontario. They inspect solar PV systems for code compliance to the OESC.

CSA: Canadian Standards Association. CSA is responsible for defining the safety standards that are used by the ESA for inspection, and safety approvals for components and equipment.

OEB: Ontario Energy Board, regulates the utilities such as the local distribution companies..

OPA: Ontario Power Authority

RESOP: Ontario's Renewable Energy Standard Offer Program, is a program with standard pricing, eligibility, contracting and other rules for small renewable energy electricity generating projects.

NPV: Net Present Value, the value today of a future series of payments, allowing inflation and potential interest over time

PST: Provincial Sales Tax, or Retail Sales Tax

Figure 2:
Monocrystalline Solar PV Cell
Source: Sanyo Electronics[2]

Figure 3:
Multicrystalline Solar PV Module
Source: Sharp Electronics[3]

Figure 4:
Amorphous Solar PV Module
Source: United Solar Systems Corp[4]

2.2 Introduction to Solar Energy

Solar Energy is a form of renewable energy generation. Renewable energy is generated such that it does not depend on a resource or fuel that will eventually be exhausted. The sun generates radiant energy that travels to earth, and can in turn be converted into useable energy by solar energy technologies.

Two forms of energy that can be generated from the sun are heat and electricity. Heat is produced using Solar Thermal technology, whereby the sun's energy is transformed into heat by being absorbed through a solar collector. The heat is then transferred into either air or liquid, which carries the heat to where it is needed. OSEA has recently published the *Solar Thermal Community Action Manual*[1], which explores Solar Thermal technology in depth.

Another well-known form of energy generation from solar applications is Solar Photovoltaic (PV).

2.3 Introduction to Solar Photovoltaic

Solar Photovoltaic (PV) technology converts the sun's radiant energy directly into electricity. Silicon, a semiconductor material (also used to make computer chips), is the component of solar cells that makes electricity generation possible. Radiant energy from the sun in the form of photons bump electrons of the silicon out of orbit around their nuclei, creating a flow of electrons known as Direct Current (DC) electricity.

Silicon is currently used to fabricate 3 main types of solar cells: Monocrystalline *(Figure 2)*, Multicrystalline (or Polycrystalline) *(Figure 3)*, and Amorphous (or 'thin-film') *(Figure 4)*. Monocrystalline cells create the most electricity (per square meter), and Amorphous creates the least; however, Monocrystalline is more expensive. Amorphous technology is relatively new, and is typically not used on rooftops in Canada.

During the manufacturing of a solar panel, the manufacturer will connect a series of solar cells together in a framed panel to create a solar module. The solar cells of a solar module are protected on top by either a clear sheet of tempered glass or a laminated layer of protective plastic, and on the bottom by a layer of material to give it strength. The entire unit is then framed with aluminum, making it easier for handling and mounting. Figure 3 shows a picture of a multicrystalline solar module.

2.4 Solar in Ontario

The graph in Table 2 shows Canada's rank worldwide, for total installed PV capacity. The graph shows Japan and Germany leading

1 *Solar Thermal Community Action Manual*: www.ontario-sea.org/pdf/SolarThermalCommunityActionManual.pdf
2 Sanyo Canada: http://ca.sanyo.com/en-CA/Industrial/Solar/
3 Sharp Electronics, http://solar.sharpusa.com/solar/home/0,2462,,00.html
4 UniSolar, www.uni-solar.com

in installed capacity by a wide margin in 2003.

The intent of Ontario's RESOP[5] (Section 3.3.2.2), when it was announced in March 2006, was to help Ontario meet its renewable energy supply targets by providing a standard pricing regime and simplified eligibility, contracting and other rules for small renewable energy electricity generating projects, like Solar PV. The RESOP has provided huge potential for growth in the solar PV industry in Ontario. Table 3 shows the growth of installed Solar PV capacity in Germany, and compares it to projections by the Canadian Solar Industries Association (CanSIA), and the Ontario Power Authority (OPA). This comparison and projection has been made because Ontario's announcement of the RESOP mirrors a similar announcement made in Germany 15 years earlier.

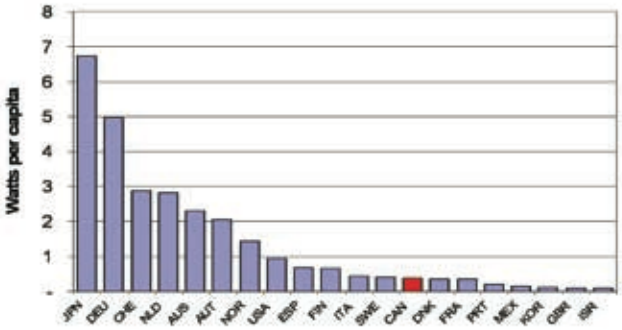


Table 2:
Canada PV Ranking
Source: IEA 2003

2.5 Solar Resource Potential in Ontario

Solar resource potential is quantified by the intensity of the sun's rays, hours of direct sunlight and daily temperatures. In Canada, the solar resource potential is generally concentrated in the southern part of the country, with the very best potential concentrated around southeast Alberta, southern Saskatchewan and in the southern half of the remaining Prairie Provinces. Some areas in southeastern British Columbia, and most of Ontario, south of Sault St. Marie and Ottawa also possess good solar PV potential. The Maritimes have almost the same solar potential as areas around the great lakes.

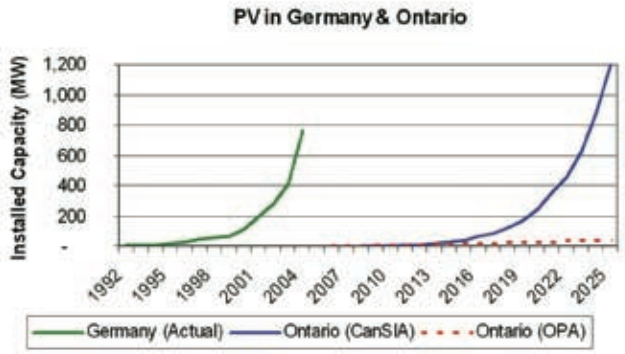


Table 3:
PV Installed Capacity Ontario versus Germany
Source: CANSIA

For graphical representations of average Canadian solar radiation, refer to Appendix A. The Atlas of Canada Solar Radiation, or RETScreen are both online resources with more detailed geographical solar radiation information. Although RETScreen is primarily intended for use as a financial tool (discussed in Section 6.3.8), it includes an extensive database on solar radiation potential for a large number of Canadian cities. The National Renewable Energy Lab (NREL) program 'PVWatts' is one of the most advanced tools in North America, but unfortunately it has not yet mapped Canada.

Table 4 compares the average solar radiation in Miami and Toronto. It is intended to show that many areas of Canada do in fact have favourable solar regimes.

Although the number of hours of direct sunlight is a major contributor to the amount of electricity generated by solar panels, daytime temperature plays a large role as well. As panel temperature increases, efficiency decreases, up to as much as 20%. This can have a large effect on the comparison of Miami to Toronto, in that Toronto's cooler climate will result in more electricity generation throughout the year.

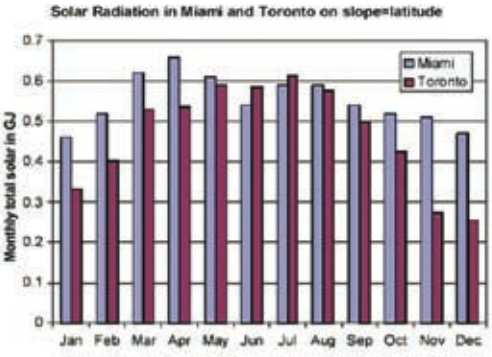


Table 4 :
Annual Solar Radiation in Toronto
Source: CANSIA

[5] Ontario Power Authority: www.powerauthority.on.ca/SOP/

3. Types of Solar Systems and Connections

When considering an investment in a solar system, there are two important choices relating to the type of system, installation, and metering that need to be considered.

1. The manner in which the system will interact with the electricity grid and the appliances in your home, and
2. The manner in which the electricity will be metered, and purchased from the system owner.

Selecting between a Grid-Tie PV system and a Grid-Interactive PV system will affect how and when electricity from the system will be utilized, and how it will interact with the grid. Selecting to connect a solar system through Net Metering, or through a Power Purchase Agreement (such as Ontario's RESOP) will affect the manner in which the electricity will be metered, and the price that will be received for the electricity.

3.1 Grid-Tie PV System

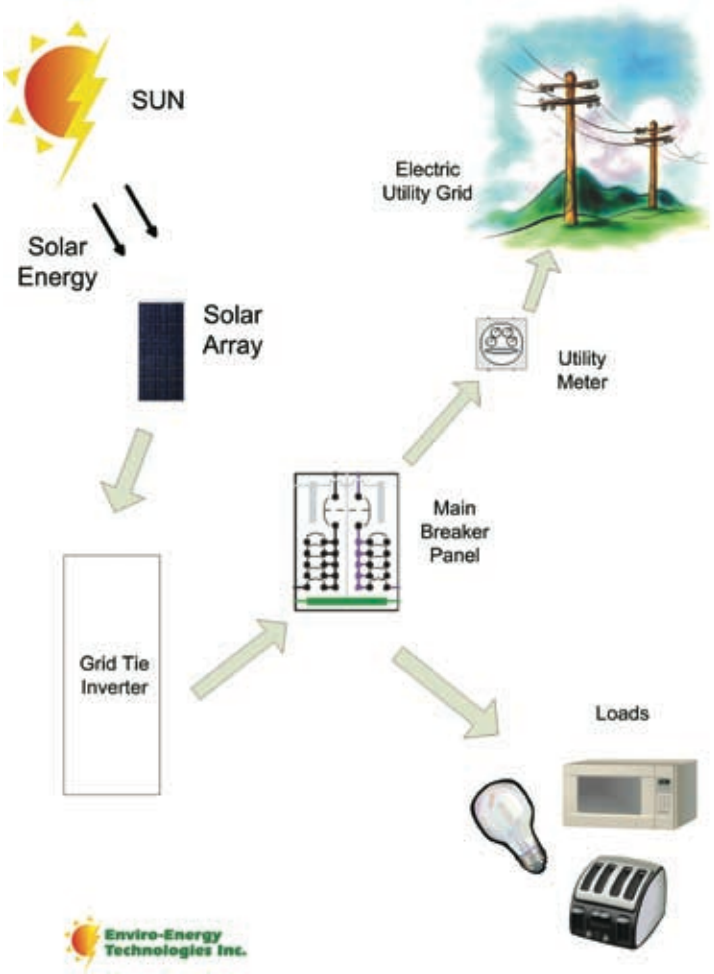


Figure 5:
Grid Tie PV System connected under Net Metering
Source: Xantrex Technology Inc.[7]

A Grid-Tie PV system is the simplest method of connecting a system to the electricity grid and it is, in most cases, the easiest to install. In a standard Grid-Tie system, solar energy is converted by solar modules into DC electricity, which flows into a Grid-Tie Inverter, being converted into alternating current (AC). The inverter then synchronizes the voltage and frequency with that from the grid, and the electricity can be used in the home by standard appliances or fed through a meter, back into the electricity grid.

Grid-Tie systems will only generate electricity if the electricity grid is available to feed electricity to the home or business. The Grid-Tie Inverter is the system component that interacts with the grid, and is programmed to shut off if there is a grid power failure, and break in the flow of electricity to the grid. In other words, if the grid goes down, the system will shut off. This is a legal electrical code requirement. This is primarily for safety reasons; if a utility employee is servicing a line that they believe has no current, and a private solar system is sending electricity into the grid, it could result is an extremely hazardous situation.

The main difference between a Grid-Tie system and other systems is that there are no batteries, making the system less expensive, simpler to install, and more efficient overall. Grid-Tie systems require little ongoing maintenance, cost less than more complex systems, and are highly reliable.

[7] Xantrex Technology Inc., www.xantrex.com/products.asp

3.1.1 Advantages and Disadvantage of a Grid Tie PV System

Advantages of Grid Tie PV	Disadvantages of Grid Tie PV
High System Efficiency: A simple system configuration and low complexity maximizes the efficiency of the system.	**No Backup Power:** The system will not be capable of delivering power during a grid power failure.
High System Reliability: Fewer system components decreases the risk of component failure.	
Cost: The simple system configuration makes installation easier and faster than other systems, lowering overall cost.	
Eligible for a Power Purchase Agreement (PPA): Grid-Tie systems can be metered separately, and thus qualify for a PPA (described in section 3.3.2).	

3.2 Grid-Interactive PV System

A Grid-Interactive PV system includes the installation of batteries for backup power capability. The solar system will still be capable of producing electricity regardless of whether the electricity grid is experiencing a power failure.

In a standard Grid-Interactive system, solar energy is converted by solar modules into DC electricity, which flows into the Grid-Interactive Inverter. The Inverter then directs the electricity to a battery bank to maintain its charge, to household electrical loads, and/or through a meter and fed into the electricity grid. In the event that there is a grid power failure, the Grid-Interactive inverter will completely shut off the connection to the grid, and allow electricity from the solar system and battery bank to flow through the inverter, to household electrical loads as needed. Typically, system owners will select a few key appliances or loads that they would like to be able to use during a power failure (eg. computer, internet router, cordless phone, clocks, main lighting, refrigerator, etc.) and connect them to the Grid-Interactive inverter through a 'critical load breaker'. In this case, the system and battery bank electricity will flow from the Inverter to the critical load breaker only, allowing the critical loads to operate for much longer during a power failure.

Figure 6:
Solar PV Roof-Mounted Array
Source: Enviro-Energy Technologies Inc.[8]

Figure 7:
Pole–Mount Solar PV Array
Source: Enviro-Energy Technologies Inc.

3.2.1 Grid Interactive Inverter

As in a Grid-Tie system, the inverter in a grid interactive system is responsible for synchronizing the voltage and frequency of solar electricity with that of the electricity grid before the electricity from the solar array can be used. Once synchronized with the grid, the

[8] www.enviro-energytech.com

Figure 8: *Grid-Tie PV Inverter Installation*
Source: Enviro-Energy Technologies Inc.

inverter can send electricity to the house for consumption, to the batteries, or through a meter into the electricity grid.

3.2.2 Battery Bank

In a Grid-Interactive system, the battery bank should be sized based on two factors: the amount of electricity required for critical loads, and the length of time the system owner would like to be able to operate these loads under a backup scenario. A smaller battery bank offers less reserve power but higher overall efficiency, whereas a large battery bank offers greater electrical reserve but decreased system efficiency as some electricity is used to maintain the charge of the batteries. A CanSIA certified installer will be able to assist in sizing a battery bank.

3.2.3 Advantages of a Grid Interactive PV System

Advantages of Grid Interactive PV	Disadvantages of Grid Interactive PV
Backup Power: In the event of a grid power failure, system owners will still be able to operate some or all of their appliances and other electricity loads.	**Higher Cost:** Due to more components and increased complexity of the system, these systems can be more expensive; a rough approximation is to add 30% to the cost of a Grid-Tie system.
	Battery maintenance & replacement: A battery bank will need to be kept in moderately warm environment, inspected regularly, and will need replacing during the life of the system.
	Lower Efficiency: Since electricity is being used to maintain the batteries' charge, overall system efficiency decreases.
	Not Eligible for PPA: Grid-Interactive systems, as described above, are not eligible for power purchase contracts such as Ontario's RESOP. Separating the solar system and backup power system by using two inverters & meters would make systems eligible, but very expensive

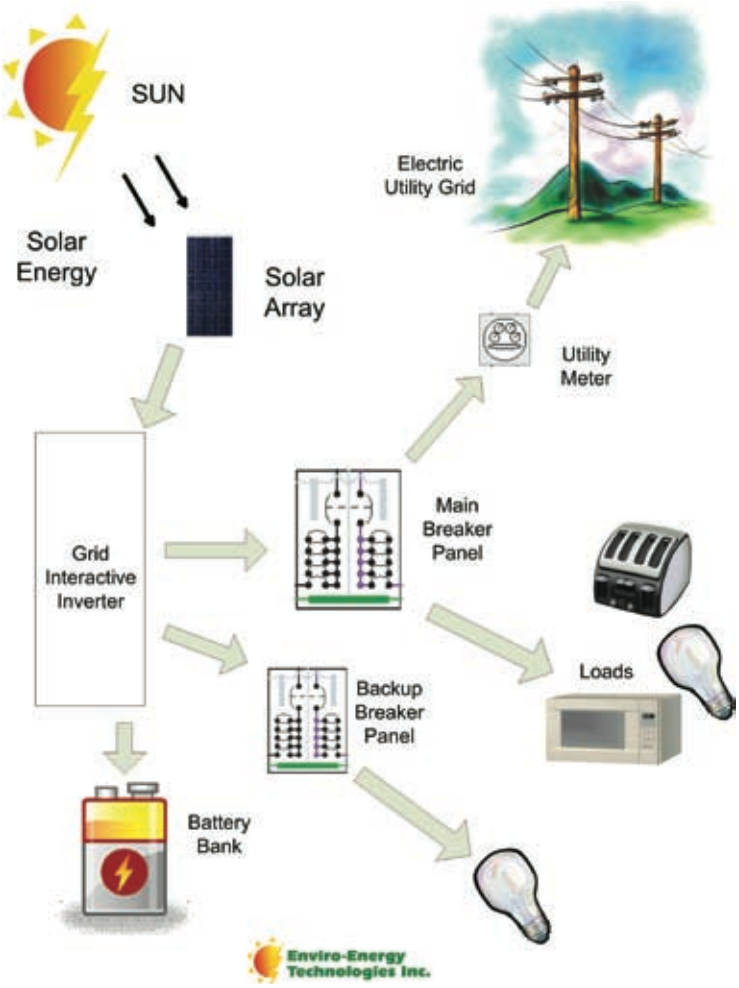


Figure 9:
Grid Interactive PV System
Source: Beacon Power Corporation[9]

3.2.4 Grid Interactive Installation Examples

Figure 10: *Roof-Mounted Solar PV Array*
Source: Enviro-Energy Technologies Inc.

Figure 11: *Grid-Interactive Inverter & Battery Bank*
Source: Enviro-Energy Technologies Inc.

[9] Beacon Power Corporation

3.3 Grid Connection and Power Purchase Agreements

In some provinces, new PV system owners have two options as to how they will receive payment for the electricity generated by a solar system. Selecting to connect a solar system through Net Metering, or through a Power Purchase Agreement (such as Ontario's RESOP) will affect the manner in which the electricity will be metered, and the price that will be received for the electricity.

3.3.1 Net Metering

Net Metering is a method of metering electricity by calculating overall home or business usage of electricity, taking into account electricity used from the grid and electricity generated by a solar system. It does not differentiate between the types of electricity; it will simply use a forward/reverse-flow meter to subtract the amount of electricity fed into the grid from the amount of electricity imported from the grid.

Under Net Metering, a PV system owner will 'use the solar electricity first', meaning that if appliances and other loads are consuming the same amount of electricity as the PV system is producing at a point in time, the meter will appear still, showing no overall use of electricity. If loads require more electricity than the PV system is generating, then the meter will show electricity being used. If loads require less electricity than is being produced, then the meter will subtract electricity from the total amount used (or, in the case of an older analog meter, it will spin in reverse).

Excellent resources to learn more about Net Metering are the government of Ontario's Net Metering website[10], and BC Hydro's description of the Net Metering Process[11].

Under Net Metering, system owners are not paid for their electricity generated, but are able to offset the cost of electricity that would have been used without the solar PV system. For example, if a utility customer is being charged 5¢ per kWh (kilowatt x hour) for electricity, 4¢/kWh for distribution, and 3¢/kWh in other fees (eg. debt retirement charges, etc.), the value of the electricity generated by a solar system to the Net-Metered system owner will be 12¢/kWh (5+4+3). This price will vary year-to-year based on the cost of electricity.

As stated earlier, system owners are not paid directly for the electricity they generate, but receive a credit towards their total electricity usage. If during a billing period a system owner is able to generate more electricity than is used and there is a net surplus of electricity, it will be counted as a credit against future electricity usage. If the system continuously produces more electricity than is used, the credit will continue to grow. In Ontario, this surplus credit expires yearly.

[10] Ontario Ministry of Energy Net Metering: www.energy.gov.on.ca/index.cfm?fuseaction=renewable.netmetering

[11] British Columbia Net Metering, www.bchydro.com/info/ipp/ipp8842.html

In most cases, the process for connecting a system under Net Metering is unique to local utilities. A certified CanSIA installer will be able to advise new system owners on the process for connecting a system under Net Metering.

3.3.1.1 Advantages & Disadvantages of Net Metering

Advantages	Disadvantages
Simple Process: There are fewer steps in setting up a Net Metering account with an LDC.	**No Revenue:** Net Metering will only be able to offset the cost of electricity as opposed to generate income.
System Cost: There are typically fewer system components involved in a Net Metered System, resulting in slightly lower overall cost.	**Price:** The cost of grid-fed electricity offset by the system is usually far lower than the price received through a PPA contract.
Yearly Calculation: In Ontario, electricity credits are able to be carried-over monthly for one year, allowing system owners to produce more energy one month, counting the credit toward electricity use in another month.	
Grid-Interactive System Capability: Net Metering will make integrated back-up power systems much easier and less expensive to install.	

3.3.2 Power Purchase Agreements

In Canada, there are two types of Power Purchase Agreements (PPAs) a new system owner can pursue. Commercial PPAs are contracts between a system owner and either municipal government, or a business entity in the commercial or industrial sector. The Ontario Standard Offer Program is a type of PPA offered by the Provincial Government, which contracts guaranteed price for any electricity generated by a renewable energy system.

Commercial PPAs are historically only pursued by large-scale system owners and do not apply to individuals with systems installed on their homes. Currently, only Ontario is offering a commercial Power Purchase Agreement.

3.3.2.1 Commercial PPAs

Renewable Energy Service Companies (RESCOs) are businesses that install, and maintain ownership of renewable energy systems on or near buildings owned by government or other commercial or industrial enterprises, or potentially residential housing complexes. RESCOs, having made the capital cost investment in a system will recoup their investment by entering in to a contract with the host company or housing complex residents to sell the solar electricity at an agreed upon rate.

The host will have the benefit of being able to use clean electricity, foregoing up-front investment in the capital cost of a PV system, and gain positive public recognition for making an environmentally-

friendly business decision. They may also benefit from energy cost savings, or may have the option to own the system at some future date. The RESCO will set the price of electricity such that they will be able to recoup more than their initial investment (making a financial return) over the life of the contract.

Communities interested in this model could organize into a co-operative style company (Section 4.4), pool equity to invest in a larger-scale solar PV system, and install it on a local business, government building or community centre, entering into a long-term PPA with the host.

3.3.2.2 Standardized Power Purchase Agreements

Standardized Power Purchase Agreements are contracts guaranteeing a fixed price for electricity generation from renewable energy systems for a specified period of time. Unlike Commercial PPAs, Standardized Power Purchase Agreements are available to every system owner, including homeowners.

The Government of Ontario is currently leading the country with its ground-breaking Renewable Energy Standard Offer Program[12] (RESOP), the first Renewable Power Purchase Agreement available in North America. Unfortunately, similar programs are not yet available anywhere else in Canada. However, British Columbia is (at the time of this manual's creation) in the process of developing a similar program[13]. The most recent draft rules of BC's Power Purchase Agreement program propose excluding systems under 50kW from the program[14], which would exclude virtually all home-based PV systems, and most small-scale commercial PV systems.

Ontario's RESOP was originally proposed by the Ontario Sustainable Energy Association in 2004, and was adapted and implemented by the Ontario Power Authority between March and November 2006.

Ontario's RESOP for solar PV:

- The contracts guarantee a price of 42¢/kWh for electricity generated from solar PV systems.
- The contracts guarantee this price for a period of 20 years from signing the contract
- The program is available to any new solar PV system owner in the Province of Ontario
- There is no minimum project size under the program
- The maximum project size is 10MW (megawatts), or 10,000kW (the equivalent to approximately 3,300-5,000 residential PV systems)
- There is potential for grandfathering
- Net-Metered systems can be transfered

[12] Ontario Power Authority: Standard Offer Website www.powerauthority.on.ca/SOP/

[13] BC Hydro: Standing Offer Program website: www.bchydro.com/info/ipp/ipp51323.html

[14] BC Standing Offer Program Draft Rules; p.3 www.bchydro.com/rx_files/info/info54026.pdf

Ontario's RESOP is scheduled for review bi-annually to evaluate the effectiveness of the program, with the first official review of the program to take place November 2008. The Ontario Sustainable Energy Association has recently published a discussion paper entitled 'Renewables Without Limits'[15]. The discussion paper makes several recommendations for evolving Ontario's ground-breaking program.

3.3.2.3 Advantages and Disadvantages of PPAs

Advantages	Disadvantages
Price: Typically, with the RESOP, the price offered for solar electricity is greater than the cost of electricity offset under Net Metering.	**Complex Process:** Currently, the process for securing a RESOP contract is complicated. The process is described in Section 7.
Revenue: Fairly steady revenue is generated from the sale of electricity generated.	**Generator Fees:** Some LDCs charge a monthly fee to generate electricity under the RESOP, potentially representing a portion of the monthly revenue that could be generated.
Decreased Financial Risk: Unlike Net Metered systems which offset electricity with a variable price over 20 years, price is guaranteed, making revenue predictable.	

3.3.3 System Differences Between Net Metering and PPAs

There are some differences in systems connected through Net Metering and through PPAs. All PV systems will feed into an inverter. Beyond this point, systems will differ based on the owner's choice between Net Metering and a PPA.

Solar electricity generated by systems connected through Net Metering will typically flow from the inverter into the main breaker panel, a critical load panel, a battery bank, or some combination of these. Once there, the electricity will be used by the home or business, along with any additional electricity needed from the grid. If there is any additional electricity, it will flow out through the breaker panel, passing through the home or business's Net Meter, and out to the grid.

Systems designed to sell electricity back onto the grid through a PPA are almost exclusively Grid-Tie systems. In these systems, solar generated electricity flows from the inverter out through a separate meter directly onto the utility grid. The meter calculates the total amount of electricity generated by the Solar system, and none of the electricity is used by the home or business.

[15] Renewables Without Limits; OSEA www.ontario-sea.org/pdf/RenewablesWithoutLimits.pdf

4. Solar Site Assessment

4.1 Site Feasibility Considerations

There are several important considerations when determining the proper location for a Solar PV system. An accredited Solar PV installer should make the final determination of site feasibility, as they will have the tools and knowledge necessary to make an informed and comprehensive decision. The considerations listed below are the main criteria for their site inspection.

- **Orientation:** In Canada, solar collectors must be mounted facing South, or as close to south as possible with a certain degree of accuracy taking into consideration aesthetics. A south-facing rooftop is optimal.
- **Load Factor:** The structure(s) upon which the collectors will be mounted support the weight of the system. Factors taken into account include the age and type of construction of the building. The weight of the system, as well as wind loads, will affect this consideration.
- **Age of the Roof:** An ideal site should not need roof replacement or major maintenance within 25 years, however Solar PV arrays can be temporarily removed for installing a new roof. Long-term warranties on a roof are difficult to protect from being voided unless the roofers perform the flashing around the mounts or seal the mounts themselves. If a warranty is desired, this is an important consideration.
- **Angle:** The angle of a solar PV array mount will vary depending upon the season and the latitude of the site. PV panels may be mounted at a fixed angle, or have adjustable mounts. Your PV installer will consult an atlas, map or GPS (Global Positioning System) to determine your latitude and the best angle.
- **Adjustable Mounts:** The angle that an adjustable solar PV array should be mounted at is approximately equal to the site's latitude in the spring and fall, 15° more in the winter and 15° less in the summer.
- **Fixed Mounts:** A solar PV Array can be mounted at an angle slightly higher than the site's latitude, to help shed snow from the module in the winter. Note that optimizing for winter does not yield a large annual production gain due to the shorter & cloudier days.
- **Potential Solar Radiation Blocking:** Mounting arrays where there are shadows cast on the site at certain times of the day can severely cut efficiency. Even a small tree branch can significantly affect the efficiency of a solar PV array. Professional installers will often use a device called a Solar Pathfinder to scan the southerly exposure to the sky from the proposed panel mounting location and determine whether any obstructions exist.

- **Future obstructions:** Solar PV modules have 20 to 25 year warranties with a design life of 40 to 60 years, so it is important to consider potential future obstructions. Small or recently planted trees in neighbouring yards can grow and block sunlight over time, and new buildings or additions in adjoining lots can cast shadows in the future.
- **Time of year:** Although there may be no obstructions in the summer, the sun follows a lower path during winter months and neighbouring trees or roofs can cause unforeseen blocks.
- **Radiation Supply:** Radiation potential data obtained by using solar resource maps (Appendix A) can be used to assess the yearly supply of radiation.

4.2 Regulatory Considerations

This section examines the regulatory consideration for solar PV system owners and installers connecting systems to the electricity grid. Some requirements apply to all solar systems, while some are unique to the manner in which systems are connected.

4.2.1 Regulatory Issues Applicable to all Solar Systems

- All installed equipment and system components must be certified to meet CSA standards.
- Installers must secure a building permit from the local municipality, as this is an essential legal requirement for all new installations on new or existing buildings[16]. This will ensure that system owners will not be held liable should the system for some reason cause damage to other persons or property, and ensure that no complications arise with the system owner's home or business insurance coverage. Some municipalities including Toronto & Kingston are working to streamline the process for securing permits and may soon offer them at a reduced price, or no charge.

4.2.2 Regulatory Issues Exclusive to Solar PV

- An electrical permit is a legal requirement for the installation of a solar PV system, regardless of whether it is connected to the electricity grid or not.
- Grid-tie systems must be inspected to meet the Canadian Electrical Code[17] or its provincial equivalent[18] such as the Ontario Electrical Safety Code (OESC), to ensure that the system has been installed safely according to requirements. This safeguard is intended to protect the system owner and ensure coverage for liability by the owner's insurance provider.

[16] Ontario Building Codes, www.obc.mah.gov.on.ca/site4.aspx

[17] Canadian Electrical Code, www.csa.ca/standards/electrical/Default.asp?language=english

[18] Ontario Electrical Safety Code Purchase, www.orderline.com/default.asp?category=20

- A Connection Impact Assessment will need to be performed by the LDC, to determine whether there will be any potential impact on their network. The LDC will also make the final physical connection of the PV system to the grid.

4.2.3 Regulatory Issues Exclusive to RESOP connected systems

- Most large systems in South-Western Ontario have been excluded from the RESOP, due to transmission constraints. The OPA has illustrated the geographic areas constrained[19], and projects over 10kW cannot secure a Standard Offer Contract in this constraint zone. Most residential systems are under 5kW, and are therefore unaffected by this constraint.
- In the absence of a provincially established process for LDCs with regard to RESOP connections, each LDC has different requirements[20] for timelines, assessments, fees, connections, etc. A certified CanSIA installer will be able to identify and meet these local requirements.
- In Ontario, Solar PV systems 10kW and larger require a generators license from the Ontario Energy Board[21].
- In Ontario, projects 10kW and larger have a variety of other requirements, outlined in the Final Rules of the RESOP[22].
- Municipal planning acts are unclear on zoning requirements for land with solar electricity generating systems. Although there have been very few issues with zoning for residential systems, municipalities may require that any land with a solar PV system be zoned as commercial or industrial.

[19] Ontario Power Authority Constraint Zone: www.powerauthority.on.ca/SOP/Page.asp?PageID=829&ContentID=4061&SiteNodeID=162&BL_ExpandID=161

[20] LDC Connection Information, www.powerauthority.on.ca/SOP/Page.asp?PageID=122&ContentID=5451&SiteNodeID=170&BL_ExpandID=158

[21] Ontario Energy Board: License Application www.oeb.gov.on.ca/html/en/industryrelations/ongoingprojects_standardofferprogram.htm

[22] Ontario Power Authority: RESOP Final Rules www.powerauthority.on.ca/SOP/Page.asp?PageID=122&ContentID=4107&SiteNodeID=162&BL_ExpandID=161

5. Ownership Options for Organizational Structure

A number of criteria should be assessed when considering the type of organizational structure that would be best suited for specific situations and Solar PV needs. Ownership options, organizational structures and suggested applications listed in this chapter are by no means exhaustive, however some of the following considerations should be kept in mind when considering the different options for organizational structure. These include:

- **Capital Investment Needs:** Each option presents different requirements for initial (capital) investment.
- **Risk:** Financial and legal risks are specific to each organizational structure.
- **Long-Term Financial Implications:** Future revenue or cost savings from Solar PV systems will last for decades, involving long-term implications such as property ownership or lease agreements, and who will benefit from energy savings in future years.
- **Maintenance:** Future maintenance costs and contractual implications vary with different organizational structures.

5.1 Exclusive Ownership (Individual or Institutional)

Exclusive ownership is considered an initiative by an individual or institution to adopt the use of Solar PV technology on a small or individual scale. Likely, the person or organization chooses to install a solar PV system on their residence or place of business.

5.1.1 Best-Suited Applications

Individual ownership structure would work well in circumstances where that individual would benefit more from adopting Solar PV technology than from other electricity options. A good example would be a cottager on an island, who would purchase a solar PV system and battery bank to meet basic electricity needs, rather than paying for underwater utility cables to be extended from the mainland. Institutional ownership would work well in circumstances where the system owner could install a fairly large-sized rooftop system that would qualify for securing a SOP contract, and where the institution would be able to have large enough taxable income from other business activities to take full advantage of the tax benefits from installing a solar PV system (described further in Section 6.3.6).

Advantages	Disadvantages
Exclusively Internal Benefits: Since the investment is in assets that will remain internal (ie. not shared), all possible revenue, or benefits from cost savings remain with the individual owner.	**Risk:** Exclusive ownership places full financial and legal responsibility on the individual or the organization. They are held accountable for any loans used to purchase the technology, and potential financial losses arising from the project will not be shared. This risk can be mitigated by sufficient research into the most appropriate system and by realistic financial and viability studies.
Social Positioning Benefits: Reflective of growing public concern over climate change and international efforts to reduce energy use, an individual or business may benefit from the environmental implications and subsequent social positioning of their investment. For an individual, this may be an affirmation of personal conviction; for a business, it may create 'green market value' or environmental brand power.	**Lack of Expertise:** Individual project owners must either have knowledge of all issues relating to the project and undertake all aspects of the project, or outsource parts of the project at potentially significant cost.
Increased Cost Certainty / Decreased Risk: Reducing reliance on electricity from non-renewable fuels reduces unknown future market price fluctuations in the price of electricity.	**Cost Prohibitive:** Solar PV technology is a long-term, capital intensive project with large upfront costs and gradual returns, which may be a barrier to a single person or business. Other options, outlined below, include joint development, bulk purchase or forming a co-operative.
	Economy of Scale: Since the installation is individual, the cost (per unit of energy) of the system components, design, and installation will be much greater than a large-scale community power project.

5.2 Joint Development or Joint Venture

A Joint Venture (JV) or partnership involves the cooperation of two or more separate groups or individuals on a single Solar PV project. All parties contribute funding to the project, co-own the project and share in project-related revenues and expenses in proportion to the party's funding of the project.

5.2.1 Best-Suited Applications

Forming a JV between community-based parties (for example, community groups or co-operatives) and private firms or companies interested in renewable energy has many advantages. These include the combination of market knowledge and expertise with the distribution of the capital load of the project. There are many possible JV configurations.

5.2.2 Potential Partner Organizations

JV's and/or partnerships can be arranged between the following groups:

- Interested Individuals
- Sole Proprietorships
- Privately-owned Businesses and Limited Liability Corporations
- Existing Partnered or JV Organizations
- Non-Governmental Organizations
- Not-For-Profit Organizations
- For-Profit Community Organizations
- Municipalities
- Government-Owned Entities Including
  - o Utilities
  - o School Boards
  - o Community Centres
- Co-operatives
- Publicly-owned Businesses

Example 1:
Partnership between three adjoining townhouse owners

Three next-door-neighbours, living in attached townhouses, have a continuous south-facing roof spanning all three homes, and decide to install a 9kW Grid-Tied PV system on their roof, investing equal parts in the system. The cost per homeowner for their 3kW portion of the project is much less than if they had pursued individual systems, since their combined system will only require one installation, one Grid-Tie inverter, and one meter. Upon signing a contract through the RESOP, an account is established with the local utility, and each month the three homeowners split the revenue. None of the partners need to worry about what will happen if they decide to move, since the three have tied the investment and revenues to their properties. In addition, one partner may choose to pay for their portion up-front, while another may chose to finance their portion with a home-equity line of credit.

Example 2:
Joint Venture between a Co-operative and a Community Centre

One appropriate neighbourhood-based joint venture may involve a member-owned Solar PV co-operative and a non-profit community center. Capital investment pooled by the co-operative members fund a large-scale Solar PV system, installed on the roof of the community centre. The community centre could in exchange lend its roof to the co-operative free-of-charge, and potentially invest in a portion of the project. Optimally, the project would be eligible for a Power Purchase Agreement from the Government, generating a steady form of revenue for the co-op members. If there are no financial incentives from government, the co-operative may sign a PPA with the community centre, selling the electricity to the centre at an agreed upon rate.

5.2.3 Advantages and Disadvantages

Advantages	Disadvantages
Lower Initial Investment: Partners are able to spread initial capital costs of a Solar PV system between multiple partners.	**Conflicting views:** Solar PV projects are long-term projects, and it is crucial to ensure that all potential JV partners share similar values, have similar long-term goals, and agree on the specifics of the project prior to forming the JV. A long-term JV contract that articulates goals and views of the JV members can mitigate this risk and avoid future disagreement on project-related issues.
Lower Risk: JV's diversify associated risk by sharing financial and legal responsibility among partners, particularly in cases where the Solar PV system underperforms for a limited amount of time.	**Liability:** Each partner remains partially legally liable for the project.
Expertise Sharing: Joint projects combine important skills and attributes of all partners, allowing each different type of partner organization to contribute their particular strengths (for example, communications, funding etc.)	
Limited Gain from Economies of Scale: As partnerships increase in number of partners, the size of the project may grow. Please refer to the "Bulk Purchase" section below for more information regarding economies of scale.	

5.3 Organized Bulk-Purchase

A bulk-purchase involves a group of local participants or volunteers interested in individual solar systems, combining their purchasing power by pursuing quantity discounts to achieve the best price per unit from a single supplier/installer. This is achieved by pooling the interest of multiple residents of a neighbourhood in purchasing similar systems.

5.3.1 Best-Suited Applications

To date, bulk-purchase has usually involved a small group of volunteers from a specific community that gathers a list of interested homeowners who would like to purchase Solar PV systems for their homes. The group issues a Request For Proposal or Request for Quote (RFP and RFQ; further described in Section 7.8, Appendix D) to various Solar PV manufacturing and installation companies to solicit competitive bids. Once the price is determined, each homeowner enters into a contract individually with the respective manufacturer / installer.

5.3.2 Advantages and Disadvantages

Advantages:	Disadvantages
Economies of Scale: The major advantage of choosing to purchase a Solar PV system through a bulk purchase organization is to take advantage of Economies of Scale. Also termed *Quantity Discounting* or *Bulk Purchase Discounting*, purchasers achieve a lower cost per unit as quantities increase. In Bulk Purchasing organizations, individuals who purchase collectors as part of a large group have historically paid approximately 4%-14% less per system than an individual would for his or her own project.	**Volunteer Inexperience:** In new Bulk Purchase organizations, there is likely little industry expertise on the action committee. Organizers are volunteers who have an interest in the technology, but often no working experience.
Cost Efficiency: Bulk purchasing lowers the cost of operation; the process of bulk purchasing is meant to achieve the lowest price possible, and the organizers are usually volunteers, keeping costs down.	**Low Transfer of Expertise:** Given the voluntary nature of the action committee, there may be high participant turnover, resulting in loss of their experience, knowledge and continuity. The ongoing creation of organizational and operational manuals by the action committee may mitigate this loss and ensure the transfer of knowledge.
"Hands Off": Bulk purchasing removes much of the responsibility of neighbourhood individuals to research, find and negotiate appropriate and best-cost systems. This advantage does not apply to Action committee participants.	**Price/Participation Fluctuation:** With no initial obligation to commit by homeowners, some may withdraw from the purchase at various points in the project, affecting the cost of systems for others.
Security: Responses to RFP's will likely highlight inexperienced or inappropriate manufacturers and installers, making these installers easier and less time consuming to eliminate from the selection process.	

5.3.3 Forming a Bulk Purchase Group

There is little published information currently available for communities wishing to implement organized bulk Solar PV purchases, however a number of groups are currently conducting cost-benefit analyses for Solar PV technology, developing a standard RFP and lists of more prominent and reliable installers, as well as developing standard materials and processes for groups across the country.

In Ontario, a non-profit organization, OurPower, has been acting as a resource sharing mechanism for solar bulk-purchase groups across the province. OurPower is currently host to a variety of bulk-purchase groups, including four Toronto groups; the Riverdale Initiative for Solar Energy (RISE), the West Toronto Initiative for Solar Energy (WISE), the Downtown West Solar Energy Project (DWSEP), the Valley Initiative for Solar Energy (VISE), and other Ontario groups such as the Guelph Residents Advocating for Solar Power (GRASP), and Community Renewable Energy Waterloo (CREW). OurPower has recently partnered with the Toronto Renewable Energy Co-op

(TREC), to better develop and offer resources to new groups across the Province.

The general process of initiating a neighbourhood-based Bulk-Purchase is as follows:

1. A group of interested residents form a neighbourhood solar energy action committee.
2. Members of the action committee research required materials and expertise for the project, financial modeling and RFP or RFQ parameters.
3. The action committee reaches out to the community to assess and bolster support for a neighbourhood bulk-buy, and to begin developing a database of interested homeowners and/or small business owners.
4. Based on the amount of community interest, the action committee develops and finalizes an RFP/RFQ, including a no-risk/no-obligation site assessment, and submits the RFP/RFQ to selected manufacturers and installers.
5. The action committee reviews project tenders to select the best proposal based on pre-determined criteria and parameters.
6. The action committee organizes and holds a major community meeting inviting all individuals in the database to date, as well as marketing the meeting using the media, local politicians, and other methods of advertising.
7. At the final public meeting, the selected vendor (or vendors in the case of a Solar PV / Solar Thermal RFP/RFQ) should be asked to participate and respond to questions about their system. Interested individuals will be requested to leave their contact information, to be visited by the vendors for a free no-obligation home assessment.
8. At this point the action committee's duties are complete. Each individual homeowner then has the choice to accept or reject the proposal(s) at the time of site inspection, and enter into a contract directly with the installer.
9. A final count of total systems installed will result in a quantity discount applicable to all system purchasers, as outlined in the successful vendor's bid.

The RFP/RFQ process is further explored in Section 7.8, and a sample RFQ can be found in Appendix D, and Toronto's WISE or DWSEP's RFPs can be requested from their organizing committees through OurPower.

Not listed in the disadvantages above, is a potential disadvantage for the country's local solar energy sector, arising from adoption of the bulk purchase model. The residential solar PV industry is still relatively small, currently comprised of a number of smaller

installation companies. A Bulk-Purchase in a neighbourhood or community will essentially allocate all of the potential early adopters of solar PV systems to a single installer, resulting in that installer reaching and potentially far surpassing their capacity to install systems, leaving no business for other installation companies. This can potentially result in erratic or unsustainable industry growth, in that at any point in time, installation companies may have either too much business to handle, or none at all.

That being said, the Bulk-Purchase model does have a variety of advantages for the industry, in that much of the education and marketing of Solar PV systems will be done on a volunteer basis by the community. This will almost certainly result in faster, but potentially erratic, demand growth. There are also ways to address this concern; using an RFQ as opposed to an RFP (Section 7.8) and selecting two or more preferred vendors as opposed to one, is one way of addressing this concern.

Case Example: West Toronto Initiative for Solar Energy (WISE)

Background:

In the late spring of 2006, a dynamic community-led solar energy project was created in Ward 21 of Toronto, The West Toronto Initiative for Solar Energy (WISE). In just one year it went from a concept to signed contracts and systems installed; a good example of how pooling community resources can bring about change towards a more sustainable future.

Useful Experience:

Project Organization

Understanding how the project will be organized and what group will lead the initiative is important. Having selected an informal association of volunteers, WISE felt it would have been valuable to have a more formal organizational structure. It would have also been useful to ask participants to purchase a membership because it helps to sustain a commitment; it creates buy-in; and, it provides operating funds. Incorporation should have been considered, since Incorporating allows the project to be eligible for more grant money and it helps to minimize liability. Finally, the more people involved the better. Creating a community solar power project takes a lot of time and many people are needed for all the tasks involved.

Residence Associations

Working with residence associations is very useful because they can help to organize and provide support when connecting with the municipality. It is also important to bring in local politicians (the Mayor, Councillors). If they believe the project brings value to the community, their support will be very helpful.

Vendor Selection and Project Management

It is necessary to develop a successful project/vendor relationship. It will also reduce the overall cost of the project if you select a vendor who is eligible for government grants. The WISE organizing committee also helped their participants when contracts with vendors are signed and when installation and connections occur. The WISE project incorporated both Solar PV and Solar Thermal technologies, and there were some conflicts between vendors when roof space needed to be shared.

Connections and Building Permits

Connection to the grid can be difficult, thus the organizing committee should proactively meet with the local utility to set-up the connection process. WISE met with the permitting department early on to address costs and barriers. Each installation is unique and project participants need to deal with their own insurance company.

Results:

Over 300 people became involved with WISE. Of these, 162 people requested an evaluation of solar potential on their homes and 44% purchased systems. WISE currently has commitments of 60 Solar Hot Water heaters and 26 Solar PV systems. This represents a value of more that $720,000 being invested in the community and local distributors of solar technology. If you would like more information about this project please visit www.ourpower.ca or contact one of the leading organizers ken.traynor@gmail.com.

5.4 Co-operative Ownership

5.4.1 Applications of Co-operatives

Co-operatives are either a for-profit or non-profit business owned by members who wish to cooperate to satisfy common goals. The most common co-operative model denotes incorporating all of the investment and individual interests into a single remotely-sited, collectively-owned, large-scale project, requiring only one installation, site assessment, and set of system components. Combining capital resources allows the aggregate cost (per person) of a project to be greatly reduced, in order to achieve greater economic benefit and a shorter payback. Additionally, it allows members to invest in solar systems regardless of whether they rent or own and live in an apartment or detached home.

Co-operatively owned Solar PV systems are very different from those purchased through a Bulk-Purchase Organization. The Co-operative model is able to take full advantage of economies of scale, achieving the lowest possible installed cost per kilowatt of Solar PV. Pooling enough equity, single remote systems can reach an enormous size.

Canadian Co-operatives operate under the Canada Cooperatives Act (1998, c.1). They are fundamentally different than other incorporated businesses. As opposed to making decisions by way of a proportional vote among shareholders, co-operatives operate democratically so each member has an equal vote in decisions made by the co-operative. Typically major decisions are made, and board members are chosen, at the annual general meeting where members cast one vote for each issue. Although members each share an equal vote, co-operative profits are dispersed based on the size of individual investment, thus a member with twice the investment in the co-operative is entitled to twice the profit. For a detailed guide with more information on Canadian cooperatives, consult the Federal Government's Canada Business Cooperative Info-Guide[23], or visit the Canadian Co-operative Association[24].

There are some inter-provincial differences in co-operative regulations. In Ontario and Quebec, co-operatives must conduct at least 50% of their business activity with their members, a condition with strong implications for energy co-operatives that needs consideration for large remotely-situated Solar PV co-operatives in those provinces. This will be further described in the following section.

[23] Government of Canada 'Canada Business' Website: Main: canadabusiness.gc.ca
To access Cooperatives Info-Guide; search text 'Cooperatives Info-Guide' on main page.

[24] Canadian Co-operatives Association; www.coopscanada.coop

The Canadian Co-operative Association has a contact list for all provincial associations. Consult your Provincial co-operative association for Province-specific considerations.

5.4.2 Forming a Renewable Energy Co-operative

The primary consideration for the development of any co-operative is finding an appropriate array of founding members who share similar visions and goals. Research regarding the start-up of a cooperative is essential, and the Canada Business Cooperative Info-Guide is a good place to begin as it outlines a clear process for the creation of co-operatives, and provides a number of related, helpful resources. Other co-operatives similar to a potential Solar PV co-operative may be able to provide insight, and can be researched in the lists of your Provincial co-operative association's members. Once a collection of founding members has been established, scheduling routine meetings where founding members are assigned tasks can accelerate the start-up. During this 'fact-finding' portion of the process, participants will investigate whether a Solar PV co-operative is economically feasible and socially viable in the local community. Before incorporating as a co-operative, contact your provincial co-operative association for any additional information you may need.

Once incorporated, the co-operative must solidify the exact type of project to be developed and establish all of the specifics relating to the Solar PV installation. Once this is known, the co-operative must develop a business plan, an offering document and a membership agreement, which will allow them to begin searching for members to invest in the project. For this, an Offering Statement is required. Provincial financial service providers will have information regarding these processes; in Ontario, the Financial Services Commission of Ontario (FSCO) has an online resource for co-operatives.

Although registering an Offering Statement for a renewable energy co-op in Ontario or Quebec costs significantly less than an Initial Public Offering, there has been difficulty establishing a link between the energy that is produced by the project, and the respective members (energy link theory). In these Provinces, 50% of the co-operative's business must be conducted with members. The electricity created is very difficult to associate with individual members because the electricity generated by a remote PV panel goes into the grid and gets 'pooled', members of the Co-op do not receive their project's solar-generated electrons directly into their homes or businesses. Provisions must be made in the Offering Statement to link the energy usage with individual members. A Solar Energy Co-operative in Toronto, SolarShare, is currently attempting to establish this link to facilitate the creation of energy co-ops in Ontario. Please see Appendix B for the proposed methodology for addressing the business-with-members rule, developed by OSEA and the Ontario Co-op Association, for Offering Documents submitted to FSCO.

5.4.3 Advantages and Disadvantages

Advantages	Disadvantages
Lower Installed Cost: By forming a single large installation, a number of costs can be avoided and significantly reduced, decreasing the average cost per unit of generation capacity of the project. In addition to this, co-operatives can take advantage of significantly reduced costs of approval of a share offering by the Provincial Financial Services Commission.	**Diversity of Investment:** Members with a larger financial stake in the co-operative may come into conflict with other members with a lesser financial stake in the organization. Setting a minimum and maximum investment limit is one way of avoiding this potential conflict.
Democratic: The organization is owned and controlled by its members. All decisions are made internally and democratically.	**Timeliness:** There may be long time periods required for decision-making, as most decisions must be made by the co-operative's Board of Directors, and some major decisions have to occur at the annual general meeting.
Community-Building: Co-operatives tend to foster a strong sense of community, and present the opportunity for members to associate in pursuit of shared goals.	**Low Growth:** As profits are paid out regularly to members, there may be little incentive for the co-operative to grow through reinvesting profits into new projects.
Limited Liability: Contrary to previously listed organizational structures, a co-operative has limited liability; members are not individually legally responsible for debts, contracts and other obligations or losses the co-op may endure in the future.	
Access to Profit: Co-operatives are organized so that profits are distributed to members on a regular basis, usually quarterly or annually in the form of cash or shares in the co-operative.	
RRSP Eligibility: Co-operative shares or bonds may be RRSP-eligible, likely within a self-directed RRSP account.	

Case Example: SolarShare

SolarShare, a project initiated by the Toronto Renewable Energy Co-operative, is a large scale, community-owned PV project. It is still in the development phase; however, the project management committee has already completed a complete financial analysis of a 1MW rooftop Solar PV installation. The ***SolarShare Financial Analysis***[27] is based on a project situated in Ontario, and selling electricity through the RESOP. It is publicly available, and is an excellent tool for any new Solar PV Co-operatives.

[27] SolarShare Financial Analysis (xls; 0.4MB); www.trec.on.ca/documents/SolarShare%202007-Oct.-11.xls

6. Financing & Financial Analysis

When considering the financial aspects of installing a Solar PV system, there are two primary considerations that need to be addressed. Due to the capital-intensive nature of solar projects, the primary consideration for anyone considering a new system is the manner of financing the project. The second consideration is the financial analysis of the project itself, to ensure that a reasonable return and payback period can be expected over the project's lifetime.

6.1 Financial Assessment

There are a number of ways to evaluate which structure would create the greatest economic benefit for your specific situation.

Important considerations include:

- Overall Value of the Project
- Capital Cost Obligation
- Monthly or Annual Cash Flows

Overall Value

The financing structure that optimizes the overall value (Net Present Value, or NPV) of the project consists of maximizing the contributions of grants or subsidies, thus reducing the remaining balance to be financed through private or shared equity. The process of maximizing NPV must also avoid debt as much as possible, which carries the obligation to pay interest and erodes the long-term cost-savings or revenue of the installation.

Capital Cost

Reducing the capital cost obligation, or the initial payment required, of the project requires taking on debt. The nature of debt is that it charges the borrower interest for the ability to spread the financial demands of the project over time, and decreases the capital cost obligation. Most project planners assume a certain amount of debt and account the interest as a reasonable expense for the increased ability to spread out project costs. Increasing the amount of debt directly increases the amount of interest paid over the course of the project, decreasing the NPV.

Cash Flows

A monthly or annual cash flow is the combined value of the loan repayment amount and the cost savings generated by the system during the specified time period. The term of the debt selected will affect both the NPV and the variability of monthly or annual cash flows. Maintenance and operational costs will also affect the monthly cash flow.

6.1.1 Net Present Value

Net Present Value (NPV) is an important concept when considering any project, especially projects with large capital costs and long project lifetimes such as any Solar PV project. The NPV calculation can be used to determine whether long-term projects are in fact profitable.

Future cash flows do not have the same value as currency today. NPV is equal to a future sum of money, after accounting for inflation, and after forecasting future interest rates that today's investment would have been expected to earn if it had been invested. The application of NPV in Solar PV project valuation is useful, since it may be difficult to recognize a profitable project when it is tied to significant initial cost. Though Solar PV technology is inherently very capital-intensive, it realizes savings or earns revenue over a long period of time. A positive NPV indicates that regardless of large capital cost, the project is in fact profitable overall; the larger the NPV, the higher the value of the project.

For those same reasons, the cost savings, or revenue earned in future decades from the Solar PV installation are different than the value of those savings or earnings today. NPV will illustrate all the future energy savings to today's dollars.

6.1.2 Return on Investment (ROI)

A project's ROI is a measurement of the profit generated by an investment. It measures the amount of cash flow or income stream from the investment to the investor. In the case of solar PV projects, the projected ROI should be determined to attract investment or justify the debt/equity ratio of a project. If investors are able to achieve a better return by investing in other projects it may be difficult to attract that investment. In the case of debt, the ROI must be larger than the debt interest payments in order to justify any amount of debt, otherwise the debt will continue to grow over time.

6.2 Financing a Project or System

Several financial mechanisms are available to raise capital for Solar PV projects. These include:

- Private or Shared Equity
- Grants, Charitable Donations, Subsidies or other Government incentives
- Debt Financing
- Financial Intermediaries

6.2.1 Private or Shared Equity

Equity in (ownership of) a Solar PV project refers to funds allocated to capital costs of the project. Private Equity is money that an individual or business allocates toward a project. Shared Equity is money from a variety of investors for the purpose of developing a Solar PV project, such as aggregated investment from members in a partnership or co-operative.

6.2.2 Government Grants, Subsidies & Programs

There are some federal and provincial programs designed to financially aid Solar PV projects. Government programs and subsidies may be discontinued at any time, which should be considered a risk during the planning process for Solar PV projects.

Federal Funding:

Currently, the only federal incentive available is the *ecoENERGY* for Renewable Power Program, and it is only available for systems of one megawatt or more. *ecoENERGY* for Renewable Power will provide an incentive of 1¢/kWh to businesses, municipalities, institutions and organizations for up to 10 years for eligible low-impact, renewable electricity projects constructed between April 1, 2007 to March 31, 2011. Please note that projects applying under the RESOP in Ontario will be required to return 50% of this federal incentive to the Provincial Government, effectively reducing the projects federal incentive income to 0.5¢/kWh over 10 years. For more information on the Federal Government's *ecoENERGY* for Renewable Power Program, please visit their website at: http://ecoaction.gc.ca/ecoenergy-ecoenergie/power-electricite/index-eng.cfm

There are also favourable business and personal income tax and accounting incentives available federally, investigated further in Section 6.3.6.

Provincial and Regional Funding:

CanSIA[28] as well as Environment Canada's website detailing Incentives and Rebates[29] both have a continually updated list of provincially and regionally available subsidies and grants. Those that currently directly apply to Solar PV systems are listed here.

Ontario:

Renewable Energy Standard Offer Program: Described in Section 3.3.2.2 of this manual, Ontario RESOP offers a premium price for solar electricity of 42¢/kWh. For more information, visit the OPA website at www.powerauthority.on.ca/sop

Provincial Sales Tax (PST) exemption: System owners may apply for an 8% rebate off the total cost of all new residential Solar PV systems. This program was recently extended in the 2007 budget to cover installations made up to January 1st, 2010. For more information, please visit the Ontario Government Website at: www.rev.gov.on.ca/english/refund/sesr

Toronto Atmospheric Fund: A municipal fund organized to provide loans and grants to new projects that contribute to cleaner air quality in the Greater Toronto Area. Specifics of the program can be researched at www.toronto.ca/taf. Note that generally, these grants fund only project development costs, not system costs.

[28] CanSIA; Government Incentives Website: www.cansia.ca/government.asp

[29] Environment Canada's Incentives & Rebates: www.incentivesandrebates.ca/gc_fi_search.asp

Net Metering: Ontario has a Net Metering program for generators 500kW or less. Information can be found on the Government of Ontario Website at: www.energy.gov.on.ca/index.cfm?fuseaction=renewable.netmetering

Internal Energy Generation Program: The Northern Ontario Heritage Fund has a support program for on-site energy generation for small businesses in Northern Ontario as part of their Small Business Energy Conservation Program. The program covers a wide variety of applications including PV for northern tourist camps, among other technologies. More details can be found on the NOHF website at:www.mndm.gov.on.ca/nohfc/Default_e.asp

Ontario's renewable energy website can be used to identify new incentives or rebates as they become available.[30]

Prince Edward Island:

Provincial Sales Tax (PST) exemption: This effectively takes 10% off the final price of all new residential renewable energy applications, including solar thermal and solar PV energy collection systems. Specifics of the program can be researched at the PEI Environment, Energy and Forestry website: www.gov.pe.ca/envengfor/index.php3?number=1012183&lang=E

British Columbia:

Provincial Sales Tax (PST) exemption: This effectively takes 7% off the final price of all new wind-powered generating equipment, solar PV panels, solar thermal collector panels, and micro-hydro turbines and generators rated up to 150 kilowatts. Specifics of the program can be researched at the BC Ministry of Small Business and Revenue website: www.sbr.gov.bc.ca/individuals/Consumer_Taxes/Provincial_Sales_Tax/energy_conservation_exemptions.htm

Innovative Clean Energy Fund: The $25 million Innovative Clean Energy Fund was established in the recently released BC Energy Plan. The fund will support the development of clean power and energy efficiency technologies in the electricity, alternative energy, transportation, and oil and gas sectors. Among a variety of project types to be considered for funding were renewable resources, including biomass, ocean/hydro, solar, wind, geothermal. Specifics on the program can be found on the BC Government website at: www.gov.bc.ca/empr/popt/innovative_clean_energy_fund.html

Standing Offer Program: Currently in draft form, BC is considering the implementation of a Feed-In Tariff for projects 50kW to 10,000kW.[31]

Net Metering: BC has a Net Metering Program for generators 50kW or less. For more information on this program, see BC Hydro's website at: www.bchydro.com/info/ipp/ipp51323.html

[30] Government of Ontario Renewable Energy Website: www.energy.gov.on.ca/index.cfm?fuseaction=english.renewable

[31] BC Hydro Standing Offer Program Website: www.bchydro.com/info/ipp/ipp51323.html

6.2.3 Debt Financing

Debt financing is one way to address the upfront capital cost requirements of a Solar PV project. There are many types and sources for loans available. Major considerations when borrowing money include the amount and term of the loan, and interest rate. Because interest paid servicing the debt causes NPV to decrease, a higher ratio of debt to equity used to finance a Solar PV project will result in a lower the NPV. Individuals and organizations should research what types of loans are available for their project by speaking with regional banks, credit unions and other loaning institutions.

Non-specific loans:

Nonspecific loans are available to most individuals and businesses. The most common non-specific loans include Lines of Credit or Secured Loans. These loans carry short terms and high interest rates; generally commanding an interest rate of prime plus 3%. By securing a loan against the property in which the system is being installed, it may be possible to get a lower interest rate.

Renewable energy loans:

Because of the nature of the loan, some government organizations and financial institutions may finance solar projects at a preferred rate due to the long-term nature of the investment, and an institutional commitment to promote renewable energy technologies. However, this type of loan is not widely available, and availability may vary over time.

6.2.4 Renewable Energy Service Companies

Renewable Energy Service Companies (RESCo's) are organizations with the funding capital necessary to install medium and large-scale projects. Upon a request by a building owner to install a Solar PV system, the RESCo will assume all the responsibility of installing the system, including selecting an installer and maintaining the system. Through a PPA with the building owner (Described in Section 3.3.2.1), the RESCo will install an electricity meter, and bill the owner for the electricity produced by the system at a pre-determined price. That host organization will then be able to use the solar electricity to offset its regular electricity use.

Regardless of the fact that the system will be incorporated in the structure of a building, the building owner does not own the system; ownership of the system remains in the hands of the RESCo.

The price of electricity is usually set at a set price for 20 years. This finance and ownership structure is gaining popularity in North America, due to the capital-intensive nature of commercial-scale Solar PV installation.

6.3 Financial Analysis & Payback

The financial analysis of potential projects is dependent on a number of factors. There are currently free financial software tools available to calculate the payback of Solar PV projects.

The main factors affecting the economics of any Solar PV project include:

- The cost of Solar PV Systems
- The cost of electricity that the solar PV system is offsetting (Net Metering only), or the price offered under Provincial Feed-In Tariffs (Standard Offer Program) or Commercial PPA
- The efficiency/performance of the system
- Selected financing methods
- Operational costs and required maintenance
- Applicability of federal tax and accounting-based incentives
- Trading Carbon credits or Renewable Energy Certificates

In the following section each one of these factors will be discussed briefly.

6.3.1 Cost of Solar PV Systems

The prices of Solar PV systems are somewhat variable. They are primarily based on the total size of the system, the selection of a Grid-Tie versus Grid-Interactive system, and the type and complexity of installation required. Also, since the Canadian Solar PV industry is still developing, there is a variety in pricing among installers due to different system components used, installation methods, and company sizes. Due to the nature of the industry, it is important to note that many installers are pricing systems using 'cost-based pricing'[32], as opposed to a 'competition-based pricing',[33] since a generally accepted market price for various systems has yet to be established.

Listed in the chart below is a range of prices for Solar PV systems based on preliminary research conducted by OSEA on the cost of residential systems across Ontario. It is assumed that the prices will remain generally the same across Canada.

Assumptions used in OSEA research into Pricing of PV Systems:

- Simple Grid-Tie PV system
- Single-storey home
- Wiring is run along the exterior of the home
- Inverter located in the basement in close proximity to breaker panel / meter
- All initial costs included: electrical & building permits, connection, inspections, complete installation and commissioning
- Taxes, ongoing generator fees (if applicable) and operation and maintenance have not been included

[32] Cost-based pricing is setting the price of a good or services equal to the total cost of all the components combined, including a markup to cover staff time, overhead, business development and other expenses.

[33] Competition-based pricing is typically set relatively equal to the generally accepted market price for a given good or service, in order to be competitive in the industry

System Size	Description	Flush Roof Mounted (43-48°)	Flat Roof Mounted (including frame)
1kW	Installed Cost, roof-mounted PV array	$12,500 – $16,750	$13,000 – $18,500
2kW	Installed Cost, roof-mounted PV array	$21,750 – $23,000	$22,500 – $24,250
3kW	Installed Cost, roof-mounted PV array	$27,500 – $32,500	$30,000 – $33,500

Table 5:
Estimated Costing of Grid Tie Solar PV

The cost figures in the table above should be used as a guide only, as actual costs will vary.

Community Bulk-Purchasing:

An approach that has had some success in Ontario in achieving lower pricing for systems has been through a community-organized bulk-purchase group (Section 5.3). Typically, discounts have ranged from 4% to 14% from the prices listed above.

Grid-Interactive Solar PV Costing:

There are additional variables in Grid-Interactive systems, making prices much more varied depending on system owner preferences. For use as a rough approximation, higher prices in the range of 15% to 30% more can be expected from those listed above.

6.3.2 Cost of Electricity

The financial viability of a Solar PV project is largely dependent on the cost of grid-supplied electricity offset (in the case of Net Metering) or the price received for electricity generated (in the case of a PPA or Feed-In Tariff). In any case, the target price should be set such that over a 20-25 year project life, a system owner will be able to recoup their initial capital cost investment and account for inflation and the time-value of money during the project life. However, a lower price is often acceptable to individuals and businesses due to additional benefits associated with a Solar PV system that cannot be quantified (i.e. reduced greenhouse gasses, reduced air pollution and added power dependability, etc.).

As described in Section 3.3.1, the cost of electricity offset under Net Metering is project-specific. The price of electricity is different in each Province, and there is likely a graded pricing scheme and other distribution or service charges incorporated in the total cost of electricity offset. It is possible to determine the current price offset from taking an average of the previous year's electricity bills, however the price will likely vary over the lifetime of the project. It is possible to factor in a price escalation rate into a financial analysis, however small variations in the escalation rate has major impacts on the financial viability of a system, and it is impossible to predict the future price of electricity to any accuracy.

Power Purchase Agreements (PPAs) are much better able to reduce a project's financial risk (from price variability), since PPAs offer a set price in a legal contract. Commercial PPAs are set such that system owners are able to recoup their initial investment and make a

return over the life of a project, and feed-in tariff pricing is typically set such that it will help encourage early PV adoption, by making installations more financially attractive. Ontario's Renewable Energy Standard Offer Program offers a price of 42¢/kWh for 20 years; the highest price to-date in North America. This price was set to enable system owners to recoup approximately half of their initial capital cost investment during that time.[34]

For further information, OSEA's document *Renewables Without Limits* investigates other financial incentives and PPA pricing world-wide for Solar PV electricity.[35]

6.3.3 System Efficiency/Performance

Dependent on the type of solar modules selected, panel efficiency will range. As expected, higher-cost panels have higher efficiency. It is important to note that selecting the highest efficiency modules will result in the most electricity generation, but not necessarily the best payback. Tools like RETScreen[36] can use the efficiency to calculate the total amount of electricity generated over the life of the project, and multiply it by the price received or offset. It can then calculate the payback based on the total installed cost.

Solar modules lose efficiency over their lifetime, and typically at a very predictable rate. Most warrantees on panels themselves will guarantee an efficiency of 80% of their rated capacity after 20 years. Panels will however lose much of this efficiency early in the project life, due mostly to discolouration and aging of the protective tempered glass. Other system components such as the inverter losses or keeping a battery bank charged will result in some additional efficiency loss.

6.3.4 Method of Financing

Section 6.1 describes the effect on a project's overall value as system owners select various methods of financing a project. However, if new system owners finance a project wholly or partly with debt, it is important to structure the debt for desired cash flows.

Solar PV projects have proven to generate fairly constant annual revenue or cost savings over long time periods of 25 to 30 years. With long-term loans, it is much easier to balance monthly cash flows over the life of the loan. It is important to determine the appropriate debt structure to ensure that monthly savings are greater than monthly interest payments as early as possible in the project's lifetime.

The monthly and annual cash flow generated by a Solar PV project consists of the cost savings or revenue generated by the system during the given time period, offset by the loan repayment amount. An illustration of this concept can be found in Appendix C.

[34] RESOP Presentation; 2007 CanSIA Annual Conference; Ontario Power Authority (OPA)

[35] Renewables Without Limits: www.ontario-sea.org/pdf/RenewablesWithoutLimits.pdf

[36] RETScreen International Website: www.retscreen.net/ang/home.php

Longer-term loans are accompanied by lower annual payments. If less is spent servicing or repaying a loan on a monthly basis, it will be easier to balance that amount with the energy savings and avoid negative cash flow situations in the early years of a Solar PV project. Unfortunately, longer term loans cost more over the life of the loan than shorter term loans.

Notice from the example in Appendix C that although the long-term loan generates more positive annual cash flows during the first 10 years, the shorter-term loan generates a higher NPV. Finding an appropriate balance between interest rate and term is specific to each individual situation and project.

6.3.5 Operational and Maintenance Costs

Grid-Tie Solar systems require virtually no maintenance. Leafs or other debris may occasionally need to be removed from around flush-mounted systems, but solar panels are installed in Canada to be 'self-cleaning'. The angle allows snow to melt and fall off, and rain washes away any silt or dirt. Since solar systems have such long project life-times, inverters may need replacement, and roof repairs may require the panels to be removed, which could be an additional expense.

Grid-Interactive systems incorporate batteries, which will need replacement typically every 6 to 15 years, depending on the type of battery, how it is used and how it is maintained. They also require periodic inspection, and possibly maintenance such as cleaning battery terminals and in the case of flooded lead acid batteries, topping up the fluid levels with distilled water several times per year.

6.3.6 Federal Tax and Accounting-Based Incentives

There are two income tax and accounting-related considerations for new Solar PV projects that may be applicable, and can possibly affect the financial vaibility of projects. Both considerations relate to the method of depreciating or expensing the capital or development costs of a project, and counting it against profit for the purpose of reducing tax. In some Solar PV projects this can be a key consideration due to the ability to rapidly depreciate the assets, counting them as expenses much earlier in the project and taking advantage of the tax benefits earlier than other types of capital investments.

A complete overview of these considerations can be found on the Government of Canada's Finance Department website.[37]

This section should be used as a general overview only, and use of these mechanisms in a financial analysis or any dependence on them requires the advice of a qualified accountant. In addition, this section should not be considered tax advice in any way; for advice on the use of these mechanisms the reader should contact the Canadian Income Tax Ruling Directorate[38].

[37] Department of Finance Canada: CRCE & Class 43.1, 43.1; www.fin.gc.ca/news96/96-046_2e.html

[38] Canadian Income Tax Ruling Directorate; 613-957-8953

6.3.6.1 Canadian Renewable and Conservation Expense (CRCE)

The Canadian Renewable and Conservation Expense, or CRCE, deals with the ability to use the vast majority of renewable energy project development costs (not including the capital cost of the project itself) as expenses against profit for tax purposes, in the year they are incurred. Typically, project owners/developers are able to do this anyway, as with any other development expense; however, CRCE allows these expenses to be flowed-through to other investors.

Using 'Flow-Through' shares, the total development costs of a project can be counted as an expense against the investment income or profits from any outside person or organization who has purchased shares in the project. Since many project developers will not have an income large enough to take full advantage of these tax benefits in their first year, the benefits have value on the market for their tax related benefits, thus being able to draw in early-stage investment at a much lower cost. In essence, flow-through shares are a means of selling to investors the ability to pay lower taxes.

6.3.6.2 Class 43.1 & 43.2

Class 43.1 & 43.2 of the Canadian Income Tax Regulations is known as the Accelerated Capital Cost Allowance (Accelerated CCA), and deals with the ability for a project developer to depreciate as an expense the capital cost of a renewable energy project at a much faster rate than other capital expenses.

50% of the total capital cost of a Solar PV project may be depreciated each year, using a declining balance, and depreciating only 25% in the first year. This means that after 4 years, over 90% of the capital cost of a 20-year Solar PV project is available to be counted as expenses against income tax. This has enormous financial implications, in that if an organization has profits large enough to take full advantage of this rapid depreciation, and meet certain criteria described below, they are able to reduce their total amount of tax paid much earlier in the project, largely increasing NPV (Section 6.6.1).

These accelerated expenses are not able to flow-through to outside investors, and therefore the developer must have profits large enough to take full advantage of the tax benefits for Class 43.1 & 43.2 to have a financial impact on the project's NPV. In addition, Regulation 1100 Sec. 24 stipulates that organizations may only deduct an amount equal to or less than the income generated from the renewable energy project itself during that year. Some types of energy, mining and manufacturing companies are exempt from this stipulation, in order to promote the adoption of more environmentally friendly business practices.

6.3.7 Carbon Credits and Renewable Energy Certificates

When Solar PV systems are metered separately, it may be possible to take advantage of carbon credit or Renewable Energy Certificate (REC) markets. Systems that wish to take advantage of these additional revenue streams need to show that the reductions are real and accurate and must be verifiable. It is also important to note that the system owner typically retains the rights to the environmental benefits associated with the system. Note that system owners connecting through Ontario's RESOP do not own the associated RECs for their projects, the Government of Ontario gains ownership of any associated quantifiable environmental or economic benefit through the PPA.

Currently a number of voluntary Carbon Credit markets exist including the Chicago Climate Exchange (www.chicagoclimatex.com), and a variety of carbon neutral programs. Renewable energy certificates can be traded through a number of brokers across North America or potentially sold to renewable energy retailers. The price of a REC or carbon credit can vary widely.

6.3.8 RETScreen Financial Analysis Software

An excellent resource for the financial modeling and analysis of renewable energy projects is the program RETScreen, on the Natural Resources website[39]. RETScreen is a tool developed by industry professionals to aid in financial project analysis. RETScreen should only be used in conjunction with the RETScreen manual to avoid errors that may significantly alter the financial outcome of a project. For large projects, a project specific financial analysis should be developed for an appropriate level of accuracy.

7. Installation & Planning

7.1 Installation Process

Research and planning are essential during the selection and installation of a Grid-Tie or Grid-Interactive solar PV system.

The Canadian solar industry is quickly moving from a fairly unregulated industry, to one with more clearly defined guidelines and procedures. CanSIA has been continually developing a code of ethics under which to govern its members, as well as providing installer training and certification; although new solar enthusiasts should maintain a "Buyer Beware" approach. Most installations are performed by way of a single contract with one service provider, and an individual, business, group or organization typically enters into an agreement with a single installation company. The installers generally secure the solar modules and other system components themselves, install the project and typically provide future maintenance. There are other means of having a system installed; for example, it

[39] RETScreen International Website: www.retscreen.net/ang/home.php

is possible to purchase system components directly and contract only the installation, but this is rare for small installations. An excellent source for finding solar installers is the CanSIA Members Directory, found at www.cansia.ca/directory.

There is a risk minimizing process to follow that limits the possibility of making major mistakes during the planning of a project. The following considerations highlight this process.

7.2 Considerations for a New System

There are four main considerations during the planning process. They include:

1. The criteria for making the selection; including for example:
   a. Cost of system;
   b. Level of Desire for Backup Power;
   c. Size;
   d. PPA vs. Net Metering; and
   e. Acceptable Financial Return.
2. Selecting an Appropriate Ownership Structure
3. Hiring a Reliable and Reputable Installer
4. Securing an Appropriate Service Contract

7.3 Criteria for Making Selection

A large variety in system types, applications, sizes and metering options make the selection process complicated. It is recommended that if questions remain after reviewing the information in this manual, the reader either contact OSEA for more information, or review other Solar PV information resources, such as CanREN[40], books such as the Renewable Energy Handbook, by William Kemp[41], or workshops and seminars such as those offered by The Kortright Centre.[42]

7.4 Selecting an Appropriate Ownership Structure

Determining which ownership structure is best suited is an important part of the installation process. Structures are examined in Section 5.

7.5 Hiring a Reliable and Reputable Installer

Currently, there is no federal or provincial Solar PV installer certification process officially recognized by the Canadian Government. There is however a certification process offered by CanSIA that is designed to certify existing installers. A Solar PV Technician Program is currently offered for those individuals wishing to become Solar PV system installers, and classes are listed on the CanSIA website (www.cansia.ca/education.asp).

[40] Government of Canada's Renewable Energy Network: www.canren.gc.ca/default_en.asp

[41] Aztext Press, Available at: www.aztext.com

[42] Renewable Energy Workshops, The Kortright Centre; www.kortright.org

The following considerations will increase the chance of selecting a reliable contractor.

- Investigate installers who are members in good standing with the Canadian Solar Industries Association; preferably select installers who are certified as PV Technicians by CanSIA. A list of their members can be found on the CanSIA website.[43]
- For individual residential homeowners, investigate whether there are any Bulk-Purchase groups currently organizing a project in your region. If there is not, consider speaking to people in your community to investigate starting one.
- Research installers that have already installed projects in the community. Speak to homeowners or business clients directly and ask about their experience. For those companies that have not installed projects in your community, ask for references, and check them. Referrals from neighbours are excellent ways to locate trusted installers.
- Select an installer who has industry experience, and has been installing Solar PV technology for a minimum of three years.
- If pursuing an individual contract, ensure that all possible details have been fully explained and consider having the document reviewed by legal council. Make sure the contract stipulates all costs associated with the installation including future guarantee or maintenance costs, warranties on the hardware, and complete and thorough descriptions of installation requirements for the collectors and system.
- Ensure the installation company is a licensed electrical contractor[44]; this can be verified with the ESA[45]. Licensed electrical contractors are required to have a minimum of $2 million in liability insurance.
- Ensure that solar modules, inverters, and other equipment are CSA approved.
- Request proof of insurance, and copies of all related permits required, as described in Section 4.2.

[43] CanSIA Members Directory: www.cansia.ca/directory

[44] Contractor Licensing, www.esaecra.info/site/index.php

[45] ESA Licensed Contractors, www.pluginsafely.ca

7.6 Servicing: Maintenance and Warrantee

Most system installers also perform maintenance work, or can provide system inspections. As stated in Section 6.3.5 however, there is very little ongoing operational or maintenance cost associated with Grid-Tie Solar PV systems. For this reason, there is no need to enter into a long-term service agreement with your installer or a maintenance service provider.

Solar modules carry warrantees of typically 20 years, guaranteeing usually 80% of their initial capacity at this point. Since modules will have very low yearly efficiency losses beyond 20 years, their expected useful life can be estimated at between 40-60 years. Inverters typically carry warrantees of between 5 and 10 years, and batteries will typically have warrantees of only 1 to 2 years.

Possibly the most important warrantee to consider is that which the installer will offer on the installation itself. This should be a minimum of one year, and it is recommended to request a longer warrantee. It should also explicitly include coverage for any roof leaks resulting from the mounting of panels. Prior to the warrantee expiring, it is recommended that the system owner inspect the entire system, including wiring, connections and performance, and report any issues to the installer to ensure repairs or corrections will be covered.

7.7 System Connection Process

During system installation, the LDC must be informed that a Grid-Connected Solar PV system will need to be connected shortly. At this time it, is required that a decision be made on the method of connection (described in Section 3.3). In the case of residential systems, unless the system is situated in Ontario, this method will very likely be through Net Metering. In Ontario, it is likely the system will be connected through the RESOP. At this time, the LDC may require that the system owner enter into an embedded generation agreement, or connection agreement.

Upon final installation, an electrical inspector will be required to inspect the system to ensure it meets electrical code requirements. Upon approval, connection authorization will be sent to the LDC. The LDC will install a new Net Meter (in the case of Net Metering), or a new separate meter (in the case of a PPA), and connect the system to the electricity grid.

7.8 Individual Contract or RFP/RFQ Process

A Request for Proposal (RFP) is a written invitation for suppliers or service providers to bid on a specific product of service. In the case of Solar PV, an RFP is sent to a select list of installers and each will return a proposed bid on the system described in the RFP. These bids are legal offers and once reviewed by a committee, one winning bid will be selected and homeowners will have a choice of entering, or not entering into the described contract with that installer.

A Request for Quote (RFQ) is a written invitation for installers to provide a quote for a proposed application based on a graded scale of quantity discount pricing. If for example a community group desires a number of Grid-Tie systems, the RFQ will invite installers to describe their proposed system, and provide a price estimate based on a reference home. Unlike an RFP, it is not a legal offer; the price of the installation may vary from the price quoted based on individual homeowner's system requirements. Also, unlike an RFP, there will be no 'winning bid'; any number of offers may be given to homeowners to make their own choice. The quantity discount achieved from the bid will only be realized if the quantity of bids accepted for a specific respondent's quote falls within a quantity-discount block.

An RFQ provides more flexibility to each individual homeowner to choose exactly which system will be appropriate for their home. However, since multiple installers will be selected, the same level of discount pricing achieved will likely be less than selecting only one installer under an RFP.

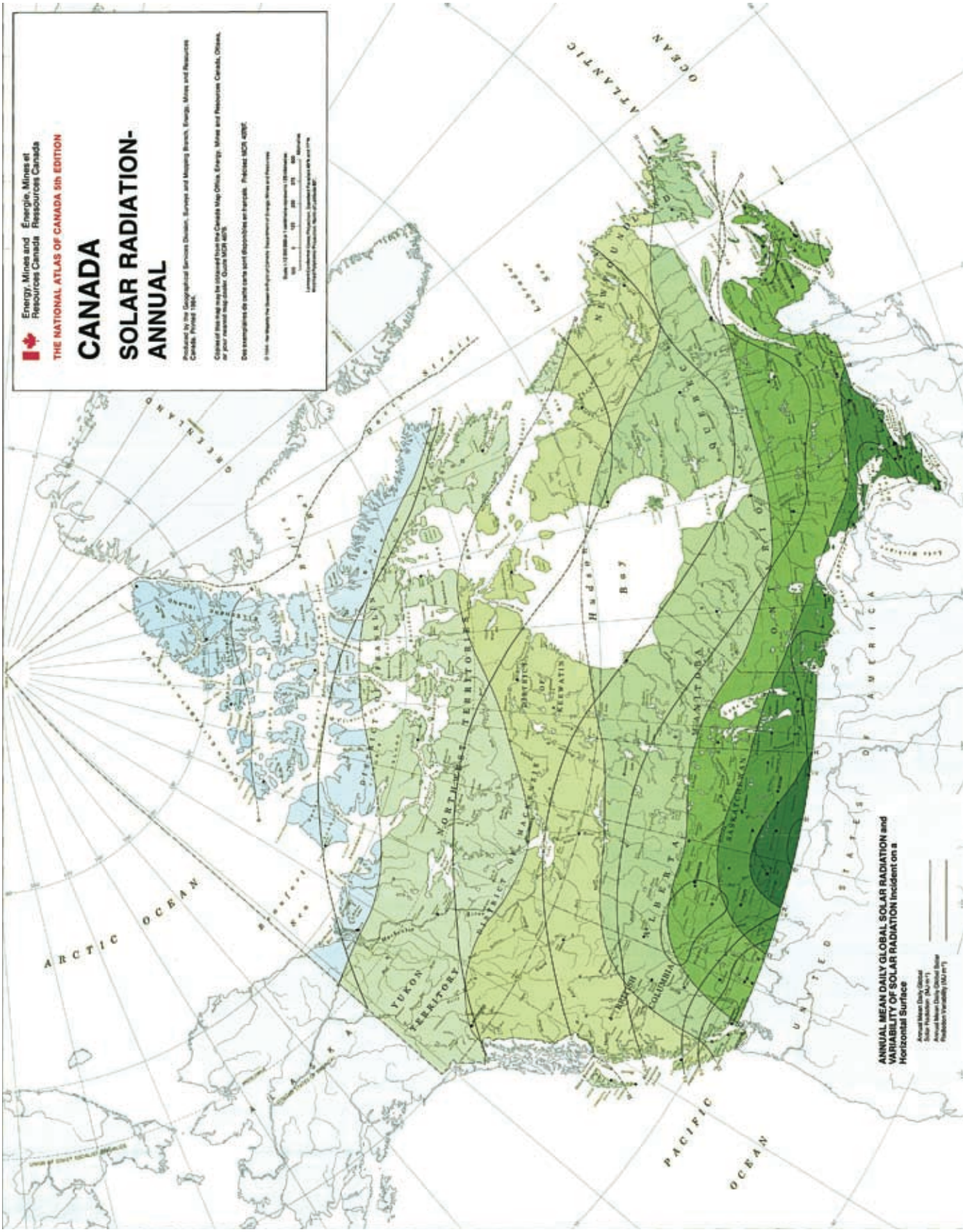
For single or small Solar PV installations, a formal request is not required. In this case, the individual or business will do a preliminary search for local installers, and select the best suited for the job based on the guidelines in Section 7.5. Once the company has been selected, a thorough and very specific contract is drafted for the project, and both parties enter into an installation and warranty agreement.

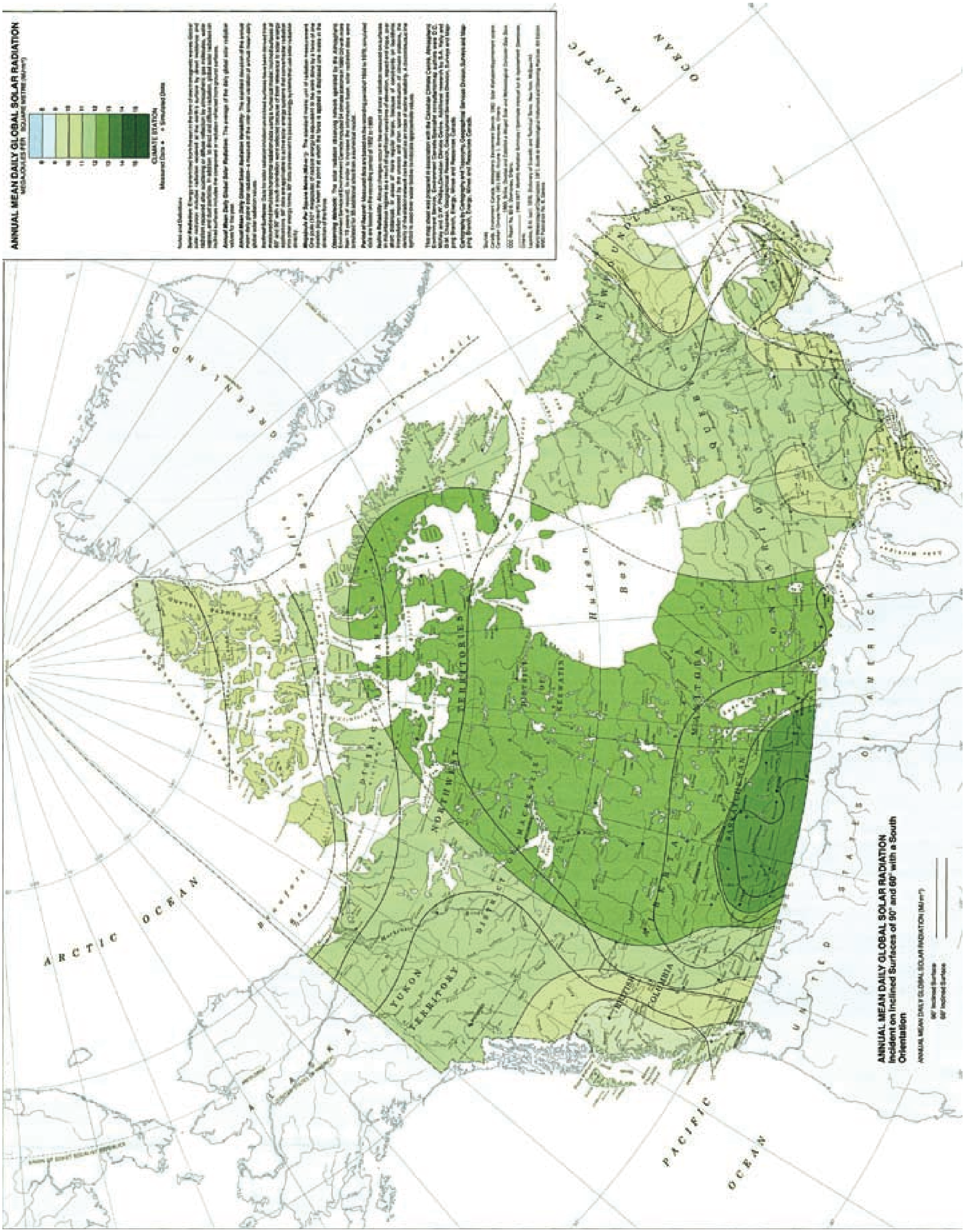
For large installations (for instance, a cooperatively-owned large remote system) or for Bulk-Purchases, an RFP or RFQ should be issued prior to entering into contracts. By issuing an RFP or RFQ, a larger project may achieve the best value by having a number of installation companies bid competitively on the specific project. Appendix D includes an example of an RFQ intended for use by a community bulk-purchase group. It is to be used only as a guide, and consulting legal council is recommended when designing an RFP or RFQ.

Sections of the RFP/RFQ to be developed include:

- Description of the project details and scale
- Which type of organizations the RFP targets
- Explanation of what specific deliverables are required by the installation
- Request for references and past projects
- Details of the final contract(s) and parties to the contract
- Other legal terms as determined by legal council

Appendix A: Solar Radiation Resource Map




ANNUAL MEAN DAILY GLOBAL SOLAR RADIATION
ANNUAL MEAN DAILY GLOBAL SOLAR RADIATION
Incident on Inclined Surfaces of 90° and 60° with a South Orientation
ARCTIC OCEAN
ATLANTIC OCEAN
PACIFIC OCEAN
Hudson Bay
YUKON TERRITORY
BRITISH COLUMBIA
NORTHWEST TERRITORIES
UNITED STATES OF AMERICA

Appendix B : Ontario Energy Co-operatives and Compliance with the "Business with Members Rule"

The original design for energy co-operatives contemplated a distribution of electrons (measured in kilowatt-hours) to co-op members in proportion to the amount of money invested in the co-op – essentially, a pre-purchase by the member of a proportionate share of the project's generation, for the life of the project.

This was to be accomplished by a credit to be given for the number of electrons generated for that member, on the member's utility bill, and an annual billing to members for their share of the costs of generation – maintenance, insurance, etc.

This approach was revised when it became apparent that, although the design of the open market for electricity did, in theory, provide for such delivery, in practice, such delivery was not feasible, or possible.

The original design was therefore modified to use money as the exchange medium, rather than the direct delivery of electrons – in return for their investment (or pre-purchase), members will be paid their proportionate share of the net revenue from the co-operative's sale of electrons into the electricity grid, which members would then apply to purchase equivalent electrons from the grid. This achieves the same result as the original design.

The volume of business, in an energy co-op, is the amount of energy "pre-purchased" through the financial investment – for practical purposes, by the purchase of a class of preference or membership shares designated for such purpose. To be effective, the maximum purchase of that designated class of shares should be linked, in a concrete way, to the value of the electricity consumed by the member.

Accordingly, a formula to establish the maximum permitted purchase of the designated class of shares should appear in the articles or bylaws, and the offering statement – a simple calculation of the present value of, say, 20 years' electricity costs to the member at today's rate of consumption.

Distribution on the basis of that pre-purchase is a distribution on the basis of patronage, even if done, for practical purposes, by way of dividends on shares.

For any questions regarding this requirement, please contact Brian Iler (biler@ilercampbell.com).

Appendix C: Possible Loan Structures

25 Year Loan At 7% Interest

Year	Loan Pmts.	Interest	Savings	Annual Cash Flow
1	-$200	-$350	$500.00	-$50.00
2	-$200	-$322	$495.00	-$27.00
3	-$200	-$308	$490.05	-$17.95
4	-$200	-$294	$485.15	-$8.85
5	-$200	-$280	$480.30	$0.30
6	-$200	-$266	$475.50	$9.50
7	-$200	-$252	$470.74	$18.74
8	-$200	-$238	$466.03	$28.03
9	-$200	-$224	$461.37	$37.37
10	-$200	-$210	$456.76	$46.76
11	-$200	-$196	$452.19	$56.19
12	-$200	-$182	$447.67	$65.67
13	-$200	-$168	$443.19	$75.19
14	-$200	-$154	$438.76	$84.76
15	-$200	-$140	$434.37	$94.37
16	-$200	-$126	$430.03	$104.03
17	-$200	-$112	$425.73	$113.73
18	-$200	-$98	$421.47	$123.47
19	-$200	-$84	$417.26	$133.26
20	-$200	-$70	$413.08	$143.08
21	-$200	-$56	$408.95	$152.95
22	-$200	-$42	$404.86	$162.86
23	-$200	-$28	$400.82	$172.82
24	-$200	-$14	$396.81	$182.81
25	-$200	$0	$392.84	$192.84
			NPV	$459.82

Loan	$5,000.00
Interest Rate	7%
Term	25 years
Capital Pmts.	-$200.00

10 Year Loan At 3.75% Interest

Year	Loan Pmts.	Interest	Savings	Annual Cash Flow
1	-$500	-$188	$500.00	-$187.50
2	-$500	-$150	$495.00	-$155.00
3	-$500	-$131	$490.05	-$141.20
4	-$500	-$113	$485.15	-$127.35
5	-$500	-$94	$480.30	-$113.45
6	-$500	-$75	$475.50	-$99.50
7	-$500	-$56	$470.74	-$85.51
8	-$500	-$38	$466.03	-$71.47
9	-$500	-$19	$461.37	-$57.38
10	-$500	$0	$456.76	-$43.24
11			$452.19	$452.19
12			$447.67	$447.67
13			$443.19	$443.19
14			$438.76	$438.76
15			$434.37	$434.37
16			$430.03	$430.03
17			$425.73	$425.73
18			$421.47	$421.47
19			$417.26	$417.26
20			$413.08	$413.08
21			$408.95	$408.95
22			$404.86	$404.86
23			$400.82	$400.82
24			$396.81	$396.81
25			$392.84	$392.84
			NPV	$1,027.32

Loan	$5,000.00
Interest Rate	3.75%
Term	10 years
Capital Pmts.	$500.00

Annual Savings	$500.00
Annual System Efficiency Loss	1%
Discount Rate for NPV calculation	7.5%

**** This model is to be used as an illustration only.**
Annual cash savings from actual projects will differ **

Appendix D: Sample RFQ for Bulk-Purchasing Organization

Request for Quotation (RFQ) for Bulk Purchasing of Solar Domestic Hot Water and Solar Air Heating Systems

[*Date*]

A. Background

[*Organisation*] is a local non-profit, community-based group helping residents and businesses in [location], and the surrounding region make more responsible choices in their use and supply of energy.

[*Organisation*] is staffed entirely by volunteers including professionals in the renewable energy field dedicated to reducing greenhouse gas (GHG) emissions by encouraging energy conservation and pursuing renewable energy projects in the [*location*] region.

As one of its priorities for [*year*], [*Organisation*] has launched the A Residential Solar Project, the goal of is to encourage residents of [location] and the surrounding region to consider a solar domestic hot water (SDHW) heater or solar air heating system for their home. The project will help to identify and overcome barriers to the adoption of SDHW and Solar Air heating systems through education and support to homeowners including product information, advice on buying and installing SDHW and Solar Air heating Systems and access to qualified professionals who can conduct a site analysis. We also will be registering up to 50 homeowners who wish to install either one or both of the systems during the project. An energy meter will be installed so that [*Organisation*] and the homeowner can record and monitor the energy output of the solar system installed.

A key element to the Solar project is to coordinate bulk purchasing arrangements with SDHW and Solar Air Heating System suppliers in order to secure the most cost-competitive price quotations. This information will be shared with the homeowner who wishes to install the unit(s).

B. Purpose and Scope of RFQ

The purpose and scope of this RFQ is to provide [*Organisation*] and the homeowners with information on local suppliers of SDHW systems who can provide "turnkey" residential solar domestic hot water and hot air systems. For the purposes of the RFQ, the term "turnkey" will include the following:

- **Final Site Assessment** ([*Organisation*], with the knowledge provided by the solar supplier, will conduct the preliminary site assessment to ensure the home has the correct orientation, roof slope and condition or South facing wall, space for the second hot water tank)
- **System Design**
- **System Purchase**
- **System Installation**
- **System Commissioning**
- **Warranties, After Sales Service and Maintenance Agreements**
- **Financing** (optional)
- **Future Upgrades** (optional)

In order to allow the [*Organisation*] and the homeowners to compare submissions on an equal basis, each supplier will submit a quote based on a reference house, the characteristics of which are provided in Annex 1.

The group recognizes that each installation is unique and actual quotes for each installation will be different, however the expectation of the group is that the "System Supplier" will be able to provide a very price competitive quote based on the fact that the "System Supplier" will have access to a large number of consumers interested in purchasing solar systems.

Companies responding to this RFQ will be considered the "System Supplier" and a principal point of contact for the group involved in the project.

Designation as a "System Supplier" does not reflect an endorsement of that company's product or service by [*Organisation*] or the homeowners, but merely reflects the fact that said company responded to the RFQ.

C. System Submission Requirements

C.1. Site Assessment

The "System Supplier" must demonstrate the ability to conduct or provide a site assessment to determine the appropriateness of solar systems for each site. Using the reference house as a base, each quote must clearly identify costs associated to travel to the site, final site assessments and a report estimating the potential savings using the RETScreen calculator.

C.2. System Design

Using the reference house as a base, the "System Supplier" must recommend a system that will provide optimal performance for the [*location*] market. Each submission must clearly describe specifications and cost of the recommended system including:

- solar collector
- pumps
- controller
- plumbing
- mixing valve
- expansion tanks
- storage tank (if necessary)
- heat exchangers
- controls including stagnation/over-heating strategies and freeze protection strategies
- roof and/or ground anchors
- all installation materials
- all other equipment and materials recommended by the "System Supplier"
- equipment features, options or considerations regarding hard water (or other water quality issues)

To provide the group with an appreciation of the implications on system design and cost for different family configurations, system design options should be provided for a low DHW load situation (family of 2 – working couple) and a high DHW load configuration (family of 4 with young children at home). The "System Supplier" is invited to provide any information that will help the group make an informed choice on the relationship between family size/DHW load and system costs.

The "System Supplier" will provide complete specifications for individual components and for the complete system. Performance data for the system will be provided (i.e. Bodycote tests or equivalent). The "System

Supplier" may recommend more than one system design or offer system designs with different components (i.e. different collectors).

Test data from actual field installations is highly desirable, particularly for the [location] area or similar climactic regions.

A RETScreen analysis will be provided using the system specifications and the Reference House description. A RETScreen analysis should be provided for each system design option. The RETScreen analysis should provide the solar fraction and the solar energy delivered (kWh/year) and a printout of the RETScreen sheets: "Energy Model" and "Solar Resource and Heating Load Calculation". The financial, cost and greenhouse gas calculations with RETScreen are not required but if they are available, it will add benificial information.

Regulatory Approvals and Permits

The "System Supplier" shall provide a description of how the turnkey solar hot water or air system conforms to relevant standards (CSA, UL, etc).

The "System Supplier" must include a statement on whether the system conforms with CAN/CSA-F379.1 as modified in 2004 by the CSA Technical Information Letter (TIL) "Interim Certification Requirements – Packaged Solar Domestic Hot Water Systems" or Solar Air Heating Systems.

For systems proposed by the "System Supplier", the group is interested in examples of municipalities where code enforcement officers have granted installation permits based on conformance to the TIL or equivalent standards. The "System Supplier" shall provide copies, where available, of the permits granted.

C.3. System Installation

Using the reference house as a base, the "System Supplier" will provide a clear description of tasks, time and costs to install the recommended system and clearly delineating optional features. The "System Supplier" should describe any additional costs or constraints that may need to be anticipated that are not reflected in the reference house example.

The "System Supplier" will also be responsible for securing all permits for the system and inspections as required.

The "System Supplier" will provide an estimate to install the system including final site assessment, system design, ordering time for the system, approvals and installation.

C.4. System Commissioning

Using the reference house as a base, the "System Supplier" will describe how each system will be commissioned.

C.5. Warranties, After Sales Service and Maintenance Agreements

The "System Supplier" will provide a complete description of applicable labour and parts warranties for both the system and individual components.

The "System Supplier" will also provide a description of how after sales service issues will be handled both during and after the warranty periods including labour costs, availability and accessibility of spare parts and recommissioning of the system, as required.

The "System Supplier" will also provide a description of optional system maintenance agreements and capability of offering extended warranty packages.

C.6. Financing (optional)

The "System Supplier" may wish to offer solutions to access alternative or innovative financing arrangements including:

- Preferred interest rates from a local financial institution
- Access to leasing arrangements for the system
- Access to rental arrangements for the system
- Other innovative financing options

C.7. Future Upgrades (optional)

The group recognizes that solar technology is evolving rapidly and new and more efficient components and systems will inevitably arrive on the market over the next 5 years. In addition the homeowners' situation may change (e.g. increased hot water loads, addition of a pool, desire to incorporate space heating, etc) creating the need or opportunity to increase or upgrade the system. Some members of the group may want such upgrades immediately.

To this end, the "System Supplier" may also wish to offer innovative solutions in concert with innovative financing options to enable homeowners to upgrade or modify their systems in the future.

Key features of interest to the group include:

- Future expansion of system capacity
- Integration of SDHW system with Space Heating
- Pool Heating
- Jacuzzi/Hot Tub heating
- Photovoltaic powered pumps
- Capability to work in a power outage (assume a capacity of 12 hours)

The "System Supplier" is encouraged to include in their submissions descriptions of how their system can meet these additional features.

C.8. Monitoring System (optional)

The group has indicated that it may want to monitor a number of installations to increase the confidence in the appropriateness of SHDW and Solar Air systems for the [*location*] market.

To this end the "System Supplier" is invited to offer solutions and cost estimates to provide and install monitoring equipment for their system that records solar energy collected and hot water used (i.e. Btu or kWh meters, flow meters, global radiation, etc).

D. Supplier Submission Requirements

The group insists on a turnkey installation where the "System Supplier" takes full responsibility for the design, installation and after sales service of the system. The "System Supplier" may sub-contract elements of the system but will still remain the single point of contact before, during and after installation of the system. The exception to this requirement could be issues related to financing of the system.

Each submission must provide as complete a description as possible of the "System Supplier" and sub-contractors and for each must address the following:

System Supplier

- Location of company
- # years in business
- # years in business of providing SDHW and Solar Air Systems systems
- Size of Company
- Credentials of key individuals of company
- # and examples of location of SDHW and Solar Air system supplied (include examples of designs of optional system features)
- description of liability insurance
- service area

Site Assessment Professional

- Location of company
- # years in business
- # years in business of providing site assessment
- Size of Company
- Credentials of key individuals of company
- # of site assessments conducted
- Description of liability insurance

System Designer

- Location of company
- # years in business
- # years in business of designing SDHW and Solar Air systems.
- Size of Company
- Credentials of key individuals of company
- # and examples of location of SDHW and Solar Air Heating systems designed (include examples of designs of optional system features)
- Description of liability insurance

System Installer

- Location of company
- # years in business
- # years in business of installing SDHW and Solar Air Heating systems.
- Size of Company
- Credentials of key individuals of company
- # and examples locations of systems installed (include examples of installation of optional system features)
- jurisdiction where installer is qualified to install systems (i.e. Ontario, Quebec)
- description of liability insurance

Manufacturers of System and Components

- Location of company
- # years in business
- # years in business of manufacturing SDHW and Solar Air Heating System products
- Size of Company
- Credentials of key individuals of company
- # of systems/components manufactured (include examples of installation of optional system features)
- Description of liability insurance

After Sales Service and Extended Warranty Suppliers

- Location of company
- # years in business
- # years in business of providing maintenance service and warranty repairs on SDHW and Solar Air Heating systems.
- Size of Company
- Credentials of key individuals of company
- # of systems serviced/warranted (include examples of installation of optional system features)

Financial Institutions (if applicable)

- Location of company
- # years in business
- # years in business of providing financing solutions
- Size of Company
- Credentials of key individuals of company
- # of systems financed (include examples of installation of optional system features)

The "System Supplier" should include information on all sub-contractors for optional features or elements of the system (i.e. space heating sub-contractors, pool heating sub-contractors), where applicable

[*Organisation*] and the Homeowners reserve the right to verify the financial integrity of the "System Supplier" or its sub-contractors. The "System Supplier" is encouraged to provide relevant information to allow the group to verify the integrity of the supplier and principal sub-contractors (i.e. St. Partick Street#, Better Business Bureau Reports).

E. Evaluation of System Suppliers and the Role of [*Organisation*]

A steering committee of the group will review and evaluate each submission against the requirements of this document. After all submissions have been reviewed, [Organisation] will host a meeting of the homeowners where the steering committee will present each submission and the degree to which they complied with the submission requirements.

[*Organisation*] and the steering committee WILL NOT select or recommend a preferred "System Supplier". Each consumer will negotiate their own contract or estimate with one or more of "System Suppliers" who responded to the RFQ. It is anticipated that the degree to which each RFQ complies with the submission requirements will significantly influence which "System Supplier" members of the group will prefer to contact regarding actual quotes.

[*Organisation*] makes no guarantees that any member of the group will purchase a solar system from companies responding to this RFQ.

[*Organisation*] will however make the results of this RFQ process available to all current and new members of the group and other interested homeowners. [Organisation] will continue to recruit new homeowners interested in installing SDHW and Solar Air Heating Systems.

Any contracts signed will be between the homeowner and the "System Supplier". [*Organisation*] will not be part of said contract.

F. Financial Submission Requirements

All prices to be in Canadian Dollars, PST included GST extra.

The "System Supplier" will provide a firm fixed price for this project based on the reference house and aforementioned specification conditions and constraints. All equipment and subcontractor costs (i.e. "turnkey") including but not limited to permits, liability insurance appropriate provincial workers compensation and all other regulatory issues are to be included in the quotation.

The "System Supplier" will provide quotes for a single system and volume discounts for bulk orders of 5 units, 10 units and 20 units. A "Pricing Template has been provided to help the "System Supplier" communicate the implications of system size on material and labour costs, discounts or bulk ordering cost reductions the "System Supplier" is prepared to offer, as well as other fixed and variable costs associated with a typical system supply and install contract.

The "Pricing Template" also provides an opportunity for the "System Supplier" to declare any terms and conditions for pricing. All submissions must clearly state terms and conditions for pricing.

It is the intent of the Consumer Group to present the results of this RFQ no later than [*date*] with the intent that systems would be installed commencing in [*date*] through to [*date*]. The "System Supplier" MUST clearly indicate the capacity of the "System Supplier" (i.e. # of units that can be installed per month) and any limitations (if any) regarding system installation (i.e. approximate date the last collector can be installed).

F. 1. Pricing Template

I. Materials and Labour

Provide a firm fixed price per household based on the requirements described above as they relate to the reference house in Annex A. Include all equipment supply and subcontractor costs (i.e. "turnkey"). Exclude costs for Site Assessment, Warranties, Maintenance Contracts and Energy Monitoring. Where the "System Supplier" wishes to provide quotes using alternative products please complete a separate Pricing Template for each system configuration or type.

Quantity Range (Units)		Family of 2	Family of 4
1-4	Materials	$	$
	Labour	$	$
	Total	$	$
5-9	Materials	$	$
	Labour	$	$
	Total	$	$
10-19	Materials	$	$
	Labour	$	$
	Total	$	$
20 plus	Materials	$	$
	Labour	$	$
	Total	$	$

Summary of System Specifications (major components) for each system type:

Collectors	
Plumbing	
Storage (if applicable)	
Controls	
Other Features	
Other Features	
Other Features	
Other Features	

II. Provide a separate identified price per household for the following items:

a) Final Solar Site Assessment	$
b) Plumbing or electircal Costs per m of run*.	$
b) Optional Annual Maintenance Contract (in warranty)	$
c) Optional Annual Maintenance Contract (out of warranty)	$
d) Extended Warranty per year. _____ years available	$
e) Optional Energy Monitor – installed and commissioned	$

* The purpose of this cost is to provide consumers with information to allow them to estimate plumbing costs for their own situation where plumbing distances are significantly greater or less than that of the reference house.

All of the above prices are valid until _____, 200__

Quote qualifiers

Travel Cost Policy:

_____

_____

_____

Labour Overtime Policy:

_____

_____

_____

Authorization

Company Name: _____

Authorized By: _____
(Print)

_____
(Signature)

Date: _____

G. Deadline for Submission

Five (5) hard copies of each submission and one electronic copy will be provided no later than [*date*] to:

[*Organisation*]
[*Mailing Address*]
[*Phone/Fax*]

H. Questions Regarding the RFQ

All questions regarding this RFQ must be submitted by E-mail. Phone calls or direct communications with any member of [*Organisation*] will not be accepted.

Questions can be submitted to [*email*]

Questions will be accepted up to [*date*]

All questions and answers will be promptly distributed to all companies who have expressed an interest in the RFQ

Reference House Description for System Design Options and RETScreen Estimates

Location

- [*location*] area

Roof Specifications

- Assume System is Flush Mount to Roof
- Assume Roof Slope is 4 in 12 (18 degrees)
- Assume orientation of Roof is Due South with No Shading
- Assume adequate Roof Area to install collector

House Specifications

- Assume 2 Story House with full basement
- Assume 10 m vertical height and 4 m horizontal length for glycol lines from collector to storage tank
- Assume gas-fired hot water tank with 55% efficiency

Occupant Specifications

- Assume two family configurations
  - Family of 2
- Working Couple; 155 litres/day at 55C
  - Family of 4
- 2 adults, 2 young children (home all day); 225 litres/day at 55C

Non-roof Mounted Systems

- Except for tracking collectors, assume the collector slope is 18 degrees from horizontal (for comparison with flush roof-mount)
- Except for tracking collectors, assume orientation of collectors is Due South
- Assume no solar shading

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