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L'ASSOCIATION DES INDUSTRIES SOLAIRES DU CANADA
CANADIAN SOLAR INDUSTRIES ASSOCIATION

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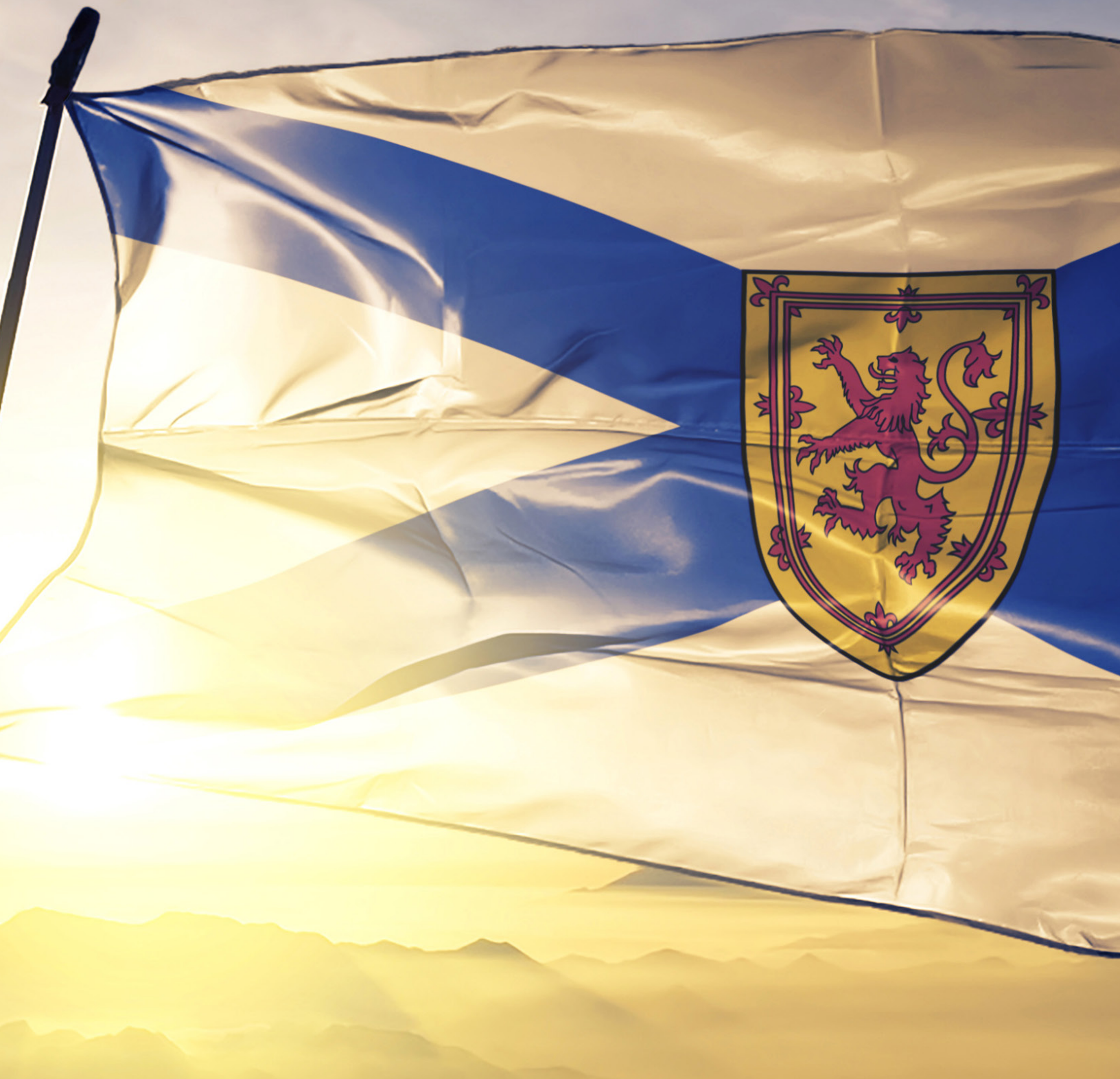

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** Cover by Solar Ascent*

INTRODUCTION

We have great news to share – it has never been easier nor cheaper in Nova Scotia for a homeowner to install a solar photovoltaic (PV) system! Solar technology continues to improve, and costs continue to decline, so it's no surprise to see solar being installed more frequently on homes and commercial spaces across the country. In Nova Scotia, the solar sector has rapidly grown within the last five years thanks in part to programs that support homeowners to invest in sustainable and renewable energy.

Nova Scotia's geography makes solar energy an excellent choice whether a homeowner chooses to install solar PV system, solar hot water, or a solar hot air system. In fact, Nova Scotia gets more annual hours of sunshine than Germany, which is one of the world leaders of solar electricity production.

In addition to the environmental benefits of going solar, generating your own electricity with solar PV saves money on your electricity bills — a big benefit for Nova Scotians, who face among the highest electricity rates in Canada. On average, a solar PV system can save homeowners in the province about $1,300 per year. There has never been a better time to harness the power of the sun!

Created specifically for Nova Scotians, this guide is designed to:

- Help you understand the economic and environmental benefits of generating your own electricity with solar PV.
- Provide information on solar programs and services available in Nova Scotia and how to use these programs to reduce the cost of your system.
- Explain the solar PV installation process from start to finish, with guidance on choosing an appropriately sized system, selecting a qualified solar installer, assessing system costs, estimating system performance, and reducing risk.

Whether you want to take control of your electricity bill or reduce your home's environmental impact, solar PV can help you power your home in a more energy efficient and sustainable manner.

A solar system is an investment in your future. But as with any significant decision, you need to consider your options carefully and understand what's involved before making a commitment.

WHO WE ARE

About CanSIA

The Canadian Solar Industries Association (CanSIA) is a national trade association that has advocated on behalf of the solar energy industry in Canada since 1992. We proudly represent manufacturers, installers, developers, builders, owners, engineers, consultants, and other companies and stakeholders who want to see solar energy grow in Canada. On behalf of our members, CanSIA promotes the unique economic, environmental and technological benefits of solar energy in Canada. We believe that our role as an industry association is not only to represent our members on current issues, but to position the industry for sustainable growth for years to come.

About Nova Scotia Department of Energy and Mines

The Nova Scotia Department of Energy and Mines manages and promotes energy and mineral resources to achieve optimum economic, social, and environmental value from these sectors. The Sustainable and Renewable Energy Branch within the Department is working towards a cleaner, more secure, sustainable energy future. The Department's Solar Team has been laying the foundation for an effective, safe, and vibrant solar industry in Nova Scotia. The team supports the development and design of new solar policies and programs in the Province.

About Efficiency Nova Scotia

Efficiency Nova Scotia (ENS) is Canada's first energy efficiency utility founded in 2010. It is an independent non-profit organization operated by EfficiencyOne and regulated by the Nova Scotia Utility and Review Board (UARB). Working with more than 150 local partners, ENS has helped 400,000 program participants complete energy efficiency projects, saving Nova Scotians $180 million in annual energy savings while offsetting 1 million tonnes of CO^2 equivalent annually.

ENS offers programs and services to reduce electrical and non-electrical energy and has three funding streams:

- Revenues from supplying electricity efficiency and conservation activities to Nova Scotia Power, which helps the utility meet the province's renewable electricity regulations;
- Provincial revenues that provide services to save on non-electrical energy; and
- Revenues from the Government of Canada through its Low Carbon Economy Fund.

NOVA SCOTIA'S UNTAPPED SOLAR POTENTIAL

Despite Nova Scotia's solar potential, less than 1% of Nova Scotia's electricity is currently being produced from solar energy. At the same time, electricity generation is responsible for 42% of the province's greenhouse gas (GHG) emissions. This provides incredible opportunities for solar to further decrease Nova Scotia's GHG emissions from coal-fired electrical generating facilities and other non-renewable resources.

In fact, the future for solar energy in Nova Scotia's residential sector is extremely bright. The province has seen a significant increase in residential solar installations as a result of Efficiency Nova Scotia's SolarHomes Program, which provides rebates on newly installed solar photovoltaic systems. It's becoming easier for Nova Scotians to install solar as a renewable energy source for their home, while supporting the province's shift toward clean energy sources.

Progress towards a more renewable energy portfolio is already underway. By 2020, up to 50% of Nova Scotia's electricity will come from renewable sources — mainly hydro and wind. Solar is expected to play an increasing role in helping the province phase out coal as Nova Scotia transitions to a clean grid over time.

HOW SOLAR ENERGY WORKS

All solar systems capture light from the sun and convert it into forms of energy that we can use in our homes, such as electricity and heat. Two methods of energy generation are commonly seen on homes and commercial buildings: solar PV and solar thermal. Both methods use the sun's energy to create usable energy, but solar PV systems use the energy to generate electricity, whereas solar thermal systems use the energy to heat air or water. This guide is focused on solar PV systems for generating electricity.

Solar Photovoltaics (PV)

Solar PV systems are the most commonly used solar technology. Solar panels are affixed to rooftops using racking equipment or installed directly on the ground with a ground mount. During the day, PV panels produce direct current (DC) power, which is fed through an inverter to create alternating current (AC) power, which is the type of electrical current most commonly used in our homes.

Grid-Tied Solar PV

The vast majority of solar PV systems being installed currently are grid-tied, meaning electricity flows to the home's electrical panel where it is used up by the home's electrical equipment, with any surplus electricity being exported back to the electrical grid. A typical grid-tied solar PV system is made up of the solar panels themselves, racking equipment to affix it to a roof or a ground mount, one or more inverters to convert the electricity into its more usable AC form, and any other piece of electrical equipment necessary to connect an approved system to the home and/or the grid. These "balance of system" components are in most cases required by the Canadian Electrical Code, and include things like appropriately sized wiring, disconnection devices, junction boxes and breakers, along with

** Photo by Solar Ascent*

** Photo by SKYLIT*

a bi-directional utility meter and optional system monitoring equipment.

When considering a solar PV system for your home, one of the key decisions you will need to make is which type of inverter to install. After the panels themselves, inverters are the most important equipment in your solar PV system.

There are three main types of inverters currently available for your grid-tied solar PV system: string inverters, microinverters, and power optimizers (also known as string inverters with power optimizers or DC optimizers).

Here are some key things to note regarding the different types of grid-tied inverters:

- String inverters typically are less expensive than other inverter types.
- String inverters should only be used if your roof is not shaded at any point during the day and does not face in multiple directions. Since one unit controls a large number of panels in a string, if one gets shaded then the production of the entire string is reduced.
- Microinverters are rapidly gaining in popularity, particularly for residential solar systems. While they tend to be more expensive than string inverters or power optimizers, their costs are falling as they become more popular.
- Microinverters and power optimizers are best for installations where one or more panels may be shaded at any point during the day, or where panels are facing different directions. Each unit controls the output of each individual panel, which means when one panel is shaded the rest continue to produce energy.
- Microinverters and power optimizers allow you to monitor the power production of each individual panel.
- Power optimizers offer many of the same benefits as microinverters, but tend to be slightly less expensive. Power optimizers are often considered a mix between more expensive micro-inverters and the standard string inverter.
- A system that uses microinverters or power optimizers will produce slightly more power than a similar system with a string inverter.

Solar Myth: Solar panels are not worth it.

Fact: The cost of solar PV has decreased significantly in the last 5 years. With the cost of solar at an all time low, with a supportive net metering policy, with decent solar yield, and with some of the highest electricity prices in Canada, now is the best time to install solar PV in Nova Scotia!

Solar + Storage

As a safety measure, conventional grid-tied solar systems require power to operate, and do not power the home at times of power outages. However, it is possible that a solar PV system designed in conjunction with a battery bank can produce energy and power your home with or without power from the grid. A solar PV system used in conjunction with an off-grid or hybrid inverter, associated electrical modifications (which may include transfer and DC disconnect switches, and/or electrical panel upgrades), and a battery bank can enable a grid-tied home the ability to maintain power during outages or go completely off-grid.

There are two main types of solar + storage: AC-coupled, and DC-coupled solar plus storage systems. AC- or DC-coupling refers to the way in which solar panels are coupled with and interact with a battery system.

AC-coupled systems require two inverters: a standard grid-tied solar inverter which converts DC power from solar panels to AC power used in the home, and a battery-based inverter which converts DC power from the battery bank to AC power used in the home. These systems are slightly less efficient than DC-coupled systems because there are small losses in power when the electricity is inverted each time. However, they are easier to design and install in a home because the solar and battery systems do not have to be tied in to one another. And, because AC-coupled systems can utilize standard grid-tied solar inverters, they are the natural choice for retrofitting an existing grid-tied solar system.

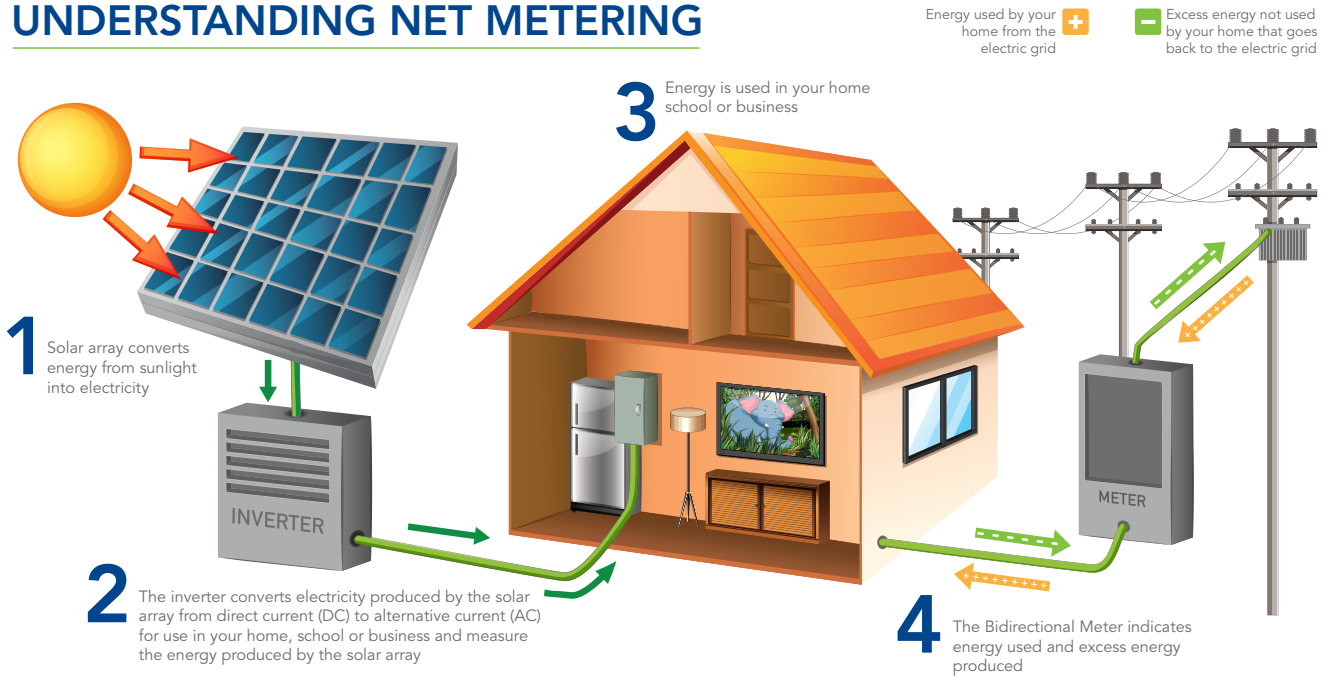
Solar Myth: Solar Panels Don't Work on Cloudy Days.

Fact: The simple answer is that solar panels do work on cloudy days – they just do not perform as well as they would on a bright sunny day. Though estimates range, solar panels will generate about 10 – 25% of their normal power output on a cloudy day. It would be accurate to say that solar panels do not work as well in rainy or cloudy weather.

DC-coupled systems utilize one inverter which plays both roles of charging batteries and converting DC power to AC power used in the home. Because the solar panels' DC power can be used to charge batteries in DC, there are fewer inverter losses so these systems are slightly more efficient than AC-coupled systems. However, they may be more complex to design and install.

Hybrid inverters are only slightly more costly than grid-tied inverters, so if you think you might want to install a battery system some time in the future, investing in a hybrid inverter with your grid-tied solar system may be an option worth considering, making your transition to a solar + storage solution in the future more straightforward and cost-effective with a DC-coupled system. However, grid-tied solar systems can still be retrofitted using an AC-coupled battery storage system. Regardless of the direction you choose, the option to expand to battery storage in the future will always be available.

UNDERSTANDING NET METERING



Like other solar components, the cost and performance of battery systems are improving. However, off-grid or hybrid solar systems that have battery storage are considerably more expensive than grid-tied solar systems. Due to higher costs, if you are already connected to a reliable grid, from a financial perspective adding batteries to your solar system does not currently make sense. However, if your area suffers from frequent and long duration power outages, the increased cost may be something worth considering to attain energy independence. As you consider a solar system for your home, talk to your solar installer about whether this option makes sense for you.

Solar Thermal

While this guide is focused on Solar PV, it is worth mentioning another technology which uses energy from the sun. Solar thermal technology captures light from the sun for space or water heating. Solar thermal installations consist of either flat plate or evacuated tube collectors. In both thermal technologies, heat from the sun is absorbed by a working fluid (typically glycol) and used to help heat the water used for washing dishes, running a bath, or rinsing off the dog after a muddy run – it can also be used to heat your pool or your home, if you have a hydronic heating system.

If you're interested in learning more about solar thermal visit www.efficiencyns.ca or call 1-877-999-6035.

NOVA SCOTIA POWER'S ENHANCED NET METERING PROGRAM

How Net Metering Works

Net metering allows homeowners to benefit from generating their own electricity while still being connected to the provincial power grid. If your solar PV system generates more electricity than your home is using at any given time, the extra electricity flows into the local grid for others to use. On the other hand, if your system isn't producing as much as your home needs, it still draws electricity from the grid to power your home.

As a net metering customer, Nova Scotia Power Inc. (NSPI) will install a bi-directional electricity meter to record the flow of electricity to and from your home. At the end of the billing period, if you produced more energy than you've used, you will receive a credit on your next bill. At the end of a year, if you still produced more electricity than you used, NSPI will give you a cash payment based on the current residential rate for any surplus energy that has not already been credited to your power bill. It is important to note that net metering customers will continue to pay a monthly base charge.

In addition to the SolarHomes Program, the Enhanced Net Metering Program is one of the key drivers for solar PV deployment in Nova Scotia. The current program is considered a best practice among net metering programs as excess electricity exported to the grid receives the same value as electricity bought from the grid. Without this rule, financial payback times would be longer and less favourable for customers.

Requirements for Net Metering Customers

Residential solar PV systems must be appropriately sized to meet your electricity consumption. This means that the amount of electricity your solar PV system produces must be comparable to the amount of electricity used by your home. As an example: Nova Scotian homes use an average of 10,000 kWh per year. Where a well-designed solar PV system generates around 1,150kWh/kW of electricity per year in Nova Scotia, then a solar PV system that is 8.7 kW would be sized to meet approximately 100% of its annual energy use.

Under the Enhanced Net Metering Program, all grid-tied solar PV systems require that an Interconnection Request and Equipment Information Form be submitted to and approved by NSPI. Before you have a solar system installed, your solar installer will typically complete this form on your behalf.

For more information about the Enhanced Net Metering Program, including how to apply, visit NSPI's website www.nspower.ca

INCENTIVE PROGRAMS IN NOVA SCOTIA

Many people are concerned about the cost of installing a solar system. The good news is that solar is becoming increasingly affordable, especially with assistance from rebate and financing programs.

SolarHomes Program

In 2018, Efficiency Nova Scotia launched the SolarHomes Program which offers rebates to Nova Scotia homeowners for installing eligible solar PV systems.

The program is funded through the Federal Government's Low Carbon Economy Fund and the Nova Scotia Department of Energy and Mines. As of February 2019, the program provides rebates of $0.60 per watt for solar photovoltaic systems that meet the program criteria, up to 25% of eligible project costs or $6000, whichever is less. The rebate amount is subject to change over time. For current rebate rates, please visit the Efficiency Nova Scotia website via the link below.

Solar Myth: Nova Scotia does not get enough sun to produce significant solar energy.

Fact: Nova Scotia gets more annual sun hours than Germany which is one of the world leaders in solar. In fact, Halifax alone gets an average of 290 days of sun each year. The average annual solar yield in Nova Scotia is 1,100 kWh for every kW of solar panels, this is comparable to several major cities across Canada. For example, a system in Halifax produces at least 90% of what a system produces in Toronto, Quebec, Fredericton, Charlottetown, and Victoria.

To be eligible for rebates, approval is required from Efficiency Nova Scotia, and the system must be installed by companies approved for the purpose of the program, otherwise known as SolarHomes approved installers. You can find the list of SolarHomes approved installers at: www.efficiencyns.ca/residential/services-rebates/solarhomes

Applications are processed on a first-come, first-serve basis. Receiving approval from Efficiency Nova Scotia provides participants with assurance that a specific rebate amount will be offered within the timeline indicated in their approval.

How it works

Step 1: After reviewing the SolarHomes program website, we recommend that you contact at least three approved solar installers for quotes. This would also be a good time to assess the condition of your roof. Generally, if your roof is at least 12 years old, it may be worthwhile contacting a professional roofing company to inspect it. This is also the best time to contact your home insurance provider to see if you would require any changes to your policy or coverage.

Step 2: Once you decide to move forward with your solar installation, your solar installer can submit the SolarHomes Approval application to Efficiency Nova Scotia, along with any necessary supporting documents. This is the best time to ensure that you obtain any necessary permits and that your system complies with any municipal building code and electrical code requirements.

Step 3: Wait to receive confirmation from Efficiency Nova Scotia for approval for your rebate. Once the application is approved, you can purchase the equipment and have it installed. After approval has been granted, the installation must be completed within the required timeline in order to receive your rebate.

Step 4: Once the installation and final electrical inspection is completed, you or your solar installer submit the SolarHomes Rebate Application and supporting documents. Your rebate cheque will arrive in the mail six to eight weeks after Efficiency Nova Scotia receives your completed rebate application.

For more information on the program including how to apply visit: www.efficiencyns.ca/residential/services-rebates/solarhomes

FINANCING OPTIONS

In addition to rebate programs, there are also several financing options that allow homeowners to amortize the cost of installing a solar system, including programs offered by municipal governments and private lending institutions.

Municipal Financing Programs

In Nova Scotia, several municipalities have Property Assessed Clean Energy (PACE) programs that offer homeowners long-term financing for renewable energy and energy efficiency upgrades. If you are concerned about the costs of installation, a PACE financing program could help.

PACE programs are designed to help homeowners pay for their upgrades with the money they save on heating, cooling and electricity costs, by allowing you to repay a low-cost loan over time either through your property tax bill or a local improvement charge.

If you live in participating municipalities, you may be able to fund cleaner energy for your home through special financing programs that let you pay for the upgrades. Please note that program details vary per municipality.

The following sections provide information on several PACE programs. Please note that not all PACE programs support solar. Contact your local municipality to find out whether municipal financing for solar PV is available in your area.

Halifax Solar City

The Halifax Solar City program offers property owners living within the Halifax Regional Municipality the opportunity to install three types of solar systems — solar PV, solar hot air, and solar hot water — through an innovative financing option to avoid the large, upfront cost of solar energy installations. Eligible applicants include residential property owners, non-profit organizations, places of worship, co-operatives, and charities. The program involves a voluntary financing application, where the property owner enters into an agreement with the municipality to access funds that offset the capital costs of installing solar energy systems on their property.

The municipality places a voluntary Local Improvement Charge (LIC) on the property after the solar contractor is paid at the end of the project. The LIC is an additional annual charge separate from the property owner's annual property tax bill. The LIC payments are made over a period of 10 years at a fixed interest rate of 4.75% with the option for the property owner to pay the balance in full and remove the lien at any time without penalty.

Residential property owners participating in Solar City are also eligible to apply for the provincial rebate under Efficiency Nova Scotia's SolarHomes Program. For more information, contact Solar City at (902) 490-6821 or at solarcity@halifax.ca or visit www.halifax.ca/home-property/solar-projects

Clean Energy Financing Program

The Clean Foundation offers a Clean Energy Financing Program for individuals interested in making their home more energy efficient.

As of February 2020, there are five municipalities participating in this program: The Town of Bridgewater, and the Districts of Barrington, Digby, Lunenburg, and Yarmouth.

To learn more, visit www.CleanEnergyFinancing.ca or call toll-free 1 (844) 727-7818.

Municipality of Guysborough - My Energy Improvement Plan

Efficiency Nova Scotia has partnered with the Municipality of Guysborough to offer residents PACE financing toward energy efficiency and clean energy upgrades. This PACE program allows residents to borrow up to $10,000 at a low interest rate of prime + 1%. To find out more, call toll-free 1-877-999- 6035.

Solar Colchester

Solar Colchester has a PACE program offered by the Municipality of the County of Colchester that allows eligible property owners to install solar PV and receive up to $20,000 in financing assistance from the municipality. The program is available to homes in Colchester with a single, owner-occupied dwelling unit and up to one rental unit. It is also available to certain non-profit institutions. Property owners must pay an upfront deposit of $1000 and then repay the remaining cost of the project over 10 years at a fixed interest rate of Prime + 0.75%. To find out more, visit www.mysolarcolchester.ca

Private Financing Programs

Credit Union Atlantic Energy Efficient Financing

Credit Union Atlantic (CUA) is an official financing partner of Efficiency Nova Scotia. They offer financing options for green energy installations and upgrades, including solar PV. Financing rates start from 4.49%. CUA recommends that you undertake a Home Energy Assessment before beginning your home energy efficiency project. For more information, visit: www.cua.com/Home/ProductsAndServices/MortgagesandLoans/GoGreen

Other financing options may be offered by solar installation companies in Nova Scotia. Talk to your solar installer to find out if they provide financing.

GETTING STARTED WITH SOLAR

Once you're confident about your financing options, it's time to assess whether a solar PV system would work effectively on your property and how big the system should be.

Deciding if a solar system is right for you takes a trained eye. How much usable roof area is available? What is your sun exposure? How much electricity do you use? What size system can your electrical panel support? The best way to answer these questions is to speak with an approved solar installer.

An approved installer should guide you through these questions and provide an honest assessment of a property's potential, but it's helpful to understand the main factors that influence the decision. This section provides an overview of the key considerations when selecting a solar PV system and hiring an approved installer.

** Photo by Solar Ascent*

Understanding Your Solar Potential

How much energy your system can generate depends on several factors. Your installer will look at several considerations, including:

- Roof orientation: the orientation of each roof face including its compass heading and slope
  - The optimal orientation for solar in Nova Scotia is facing due south with a roof slope of around 40 degrees. That being said, most roofs that face anywhere from W-SW-S-SE-E and have roof slopes anywhere from 0 to 45 degrees will still produce desirable numbers.
- Shading: including but not limited to trees, obstructions, and nearby buildings
  - Shading can have a huge impact on the suitability for solar at any given location. This can be caused by existing and future obstructions, such as trees or nearby new construction.
- Electrical service: the size of your electrical service and busbar rating
  - The Canadian Electrical Code dictates how much solar PV can be tied into a home's electrical system. Depending on your electrical service, whether 100 amp, 125 amp, 200 amp, etc., and the bus bar rating on your electrical panel, your home may only be able to accommodate a limited amount of solar generated electricity.
  - It is important to note that a 100 amp service will typically allow you to have a maximum solar system size of around 4.25kW. Homes with a 200 amp service can support a system size of up to 12kW, which would cover most residential installations.
  - Roof condition: the size and condition of your roof
  - Size plays an important role for how many panels can fit on the roof and therefore how big of a system can be accommodated. Roof condition is important in deciding whether it makes more financial sense to re-do a roof that's at the end of its useful life before committing to a solar install. If the roof requires replacement within the life of system, cost of removal should be included within the overall cost so that financial analysis can be accurate.
  - There also needs to be adequate structural/roof support for the solar system. The installer, or an affiliate structural engineer, may advise on making structural enhancements before approving an installation.

Solar Myth: Solar panels won't work in winter.

Fact: While shorter days means less sun, your solar PV system will still produce electricity in the winter. In fact, like other pieces of technology, solar panels actually work better in cooler weather. The steeper the solar panels are mounted, the quicker they are to shed accumulated snow and ice. Those living in snowier regions with solar panels mounted flatter will see a decrease in efficiency due to snow cover. Despite this, a 5-year study led by Northern Alberta Institute of Technology in Edmonton found that the impact of snowfall only results in a three percent loss of solar power.

As the weather varies throughout the year, so will production from your solar system. Some months may be sunnier than average, while others may have more clouds, fog or snow. Generally, solar electricity production estimates can be surprisingly accurate to within a few percentage points. Your installer should be able to provide you with the amount of energy your proposed solar design will produce in its first year. The amount of electricity that your system can generate in a year is impacted by the orientation, slope and shading of the solar array; as such, a site review is critical to ensure that all parties have a good understanding about the expected performance of the system over time.

A well-designed solar system should produce around 1,150 kWh for every kW of solar capacity. In addition, your solar system should produce electricity for at least 25 years, so you will need to take into account any future obstructions or plans that might impact your system. Will that tree hover over your solar panels a decade from now? Are your neighbours planning an addition that will shade

your roof? It's a good idea to discuss your solar plans with your neighbours before you get started.

Finally, you will also need to take into account panel degradation. Although solar panels typically last up to 25 years, it is worth noting that their energy production will degrade over time and from panel to panel. Typically, panels degrade at a rate of around 0.5% each year and may only be producing around 80% of what it produced in its first year at the end of its lifespan.

Site selection

The site of the solar system itself, including the orientation of the roof and shading, is the most significant factor that will affect how much electricity (kWh) your solar PV system will generate over time.

Your solar installer should undertake detailed performance modelling to help determine the best location for an installation on your property. This process will include measurements and analysis to help the installer identify structural or natural features that could affect system performance because of shading, both now and in the future.

Ideally, your system should be unshaded for the life of the contract. As mentioned earlier, it is a good idea to speak with neighbours about plans that could affect one another's use of the land (e.g., removal or addition of trees, home renovations etc.). That being said, some homeowners are reluctant to remove trees which add to the beauty and value of the property. In some cases, depending on the location of the tree relative to the solar system, the overall impact on your solar efficiency may not be as bad as you think. You should discuss this issue with your installer in order to make an informed decision.

The orientation of the planned system is also important. The slope and compass direction of the roof will impact how much sunlight in your area hits the panels.

The direction that your roof faces, also referred to as the azimuth angle, is the primary factor determining how much direct sunlight will hit your solar panels. Solar panels are most effective when installed on south-facing roofs. An easy way to determine the direction that your roof faces is to use Google Maps. Look up your property and use the grid to find true south, then compare your roof.

In general, solar panels oriented directly east or west will produce about 20% less electricity than if they were facing south. Even with this decrease in performance, solar panels can produce enough electricity to save you hundreds of dollars a year.

Figure 1: Performance factor of a solar system in Halifax, NS as a function of orientation and slope

Azimuth (Compass Heading) in degrees, where 0 is North and 180 is South

Roof Slope (degrees)	North			Northeast			East			Southeast			South			Southwest			West			Northwest		
	0	15	30	45	60	75	90	105	120	135	150	165	180	195	210	225	240	255	270	285	300	315	330	345
0	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%	83%
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30	55%	55%	57%	61%	66%	72%	78%	83%	88%	92%	96%	98%	99%	99%	97%	94%	90%	86%	80%	74%	68%	63%	58%	56%
35	50%	51%	53%	58%	64%	70%	76%	82%	88%	92%	96%	99%	100%	100%	98%	94%	90%	85%	79%	72%	66%	60%	55%	51%
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45	42%	43%	46%	51%	58%	65%	73%	79%	86%	91%	95%	98%	100%	99%	97%	93%	88%	82%	76%	68%	61%	53%	47%	44%
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55	35%	36%	40%	46%	53%	61%	69%	76%	82%	88%	92%	95%	97%	97%	94%	90%	85%	79%	72%	64%	56%	48%	42%	37%
60	32%	33%	38%	44%	51%	59%	66%	74%	80%	86%	90%	93%	95%	94%	92%	88%	83%	77%	70%	62%	54%	46%	39%	34%
65	30%	31%	36%	42%	49%	56%	64%	71%	78%	83%	88%	91%	92%	92%	90%	86%	81%	75%	67%	60%	51%	44%	37%	32%
70	28%	30%	34%	40%	47%	54%	62%	69%	75%	80%	85%	87%	89%	89%	87%	83%	78%	72%	65%	57%	49%	42%	35%	30%
75	27%	29%	33%	38%	45%	52%	59%	66%	72%	77%	81%	84%	85%	85%	83%	80%	75%	69%	62%	55%	47%	40%	34%	29%
80	26%	28%	31%	36%	43%	50%	56%	63%	69%	73%	77%	80%	81%	81%	79%	76%	72%	66%	60%	52%	45%	38%	32%	28%
85	26%	27%	30%	35%	41%	47%	54%	60%	65%	70%	73%	75%	76%	76%	75%	72%	68%	63%	57%	50%	43%	36%	31%	27%
90	25%	26%	29%	33%	39%	45%	51%	57%	62%	66%	68%	70%	71%	71%	70%	68%	64%	60%	54%	47%	41%	35%	30%	26%

Note: This is a representative example system modeled using PVWatts, located in Halifax Nova Scotia, with a DC to AC ratio of 1.2 and default losses

While it is technically possible to install solar panels on the north side of your roof, it is not recommended for any roofs with significant pitch. This results in paying more than you should for a solar system that generates less than it could. A knowledgeable installer will be aware of this and should recommend a system that produces at least 70% of a system with optimal orientation.

Myth: Solar panels require too much maintenance.

Fact: Since there are no moving parts, solar panels generally require very little maintenance. The panels should be inspected a few times a year for dirt and debris that can be easily cleaned using a garden hose.

Under optimal conditions, a well-sited solar array in Nova Scotia – a south facing roof at around 40 degrees – produces approximately 1150 kWh annually for every installed kW of solar capacity. The amount of energy that a solar array collects is directly impacted by its geographical location – the angle in which the panels are mounted and the orientation (azimuth) of the installation. Figure 1 illustrates how the performance of the array decreases as the orientation and tilt move further away from the optimal siting. In Nova Scotia, ground-mounted installations are often mounted at an angle of about 40 degrees and oriented at 180 degrees to ensure capture of the maximum amount of available energy. Roof-mounted installations are ideally installed on south facing roofs; however, east or west facing solar systems are commonly installed with reasonable levels of performance above 70% of optimal.

Assessing household needs

Residents with grid-connected homes need to keep in mind that a solar PV system must be sized to meet the annual electricity usage of your home, and not beyond it. You will need to keep in mind any other updates to your home that you plan on doing that may impact your electricity usage in the future. Additions such as an electric vehicle or HVAC system will increase your usage. You might also be taking measures to reduce your usage by switching to energy efficient appliances, upgrading your heating system, or adding extra insulation in the attic. It is recommended that you undertake any energy efficient measures first to reduce energy usage prior to installing your PV system. It is generally accepted that it is more cost effective for you to increase your home's energy efficiency first; that way, you don't need as large a solar PV system to meet you annual electricity usage.

A solar PV system should produce electricity for at least 25 years. It's important to think ahead so you can design a system that fits your long-term needs.

In addition to helping you select an appropriately sized solar PV system, your solar PV installer can check municipal regulations or homeowners' association bylaws that could impact your installation, and they can also identify any required permits.

Choosing a Solar PV Installer

To be confident in the advice you receive, it's important to request estimates from at least three different installers. This will help ensure that you receive the best value for your investment and provide the best opportunity to learn what is necessary for a successful installation. Sometimes an installer will prepare a project estimate using available satellite and street imagery, but to prepare an accurate quote, the installer will need to visit the site to assess the conditions and surrounding area.

When evaluating potential installers, it is important to find out if the company you're considering has experience installing solar PV systems. Ask questions, such as:

- Do their employees or contractors have any specialized solar training?
- If they are not solar specialists, what experience do they have successfully completing solar projects?
- Are they familiar with rebate and financing programs available in your municipality?
- Do they have a portfolio of similar solar PV installations they can share?

- If their main experience is unrelated to solar, how do their skills and experience relate to the solar business?
- What do they offer for workmanship warranty?

Don't be shy with your questions! You need to be able to count on the company to competently manage your installation from design and permitting, to installation, to flicking on the switch - in other words, a complete, turn-key installation.

The following section provides additional information to help you select a solar PV installer that's right for you.

Checking references

Before you choose an installer, it is recommended that you seek references and reviews from past customers and obtain independent feedback whenever possible. While a reputable installer will aim for a smooth, problem-free installation, it is possible that your installation may require additional follow-up. Ask past customers about how the installer addressed any issues that came up.

You can also check with groups like the Better Business Bureau to see if the installer you are considering is listed on their website, if they have a history of complaints against them, and how they worked to resolve those issues.

After your consultation, ask yourself if the company representative leaves you with confidence that the company will be around long-term to deliver on warranty coverage and services that will support the optimum performance of your system. If you have any doubts, don't be afraid to ask more questions.

Hiring an installer under the SolarHomes Program

If you are applying for a rebate under the SolarHomes Program, you will need to hire an Approved Installer listed on the Efficiency Trade Network (ETN). These installers must also offer you a minimum of a 1-year workmanship warranty. They should also be able to provide you with proof of $1 million in general liability insurance coverage.

A link to the list of ETN members can be found on the SolarHomes webpage under "Step 1": www.efficiencyns.ca/residential/services-rebates/solarhomes

* *Photo by Appleseed*

To be listed as a SolarHomes Approved Installer, installers need to demonstrate the following:

- Experience installing solar PV systems or comprehensive hands-on training for solar PV design and installation, including electrical fundamentals, solar energy principles, PV modules, inverters, racking and installation.
- Proof of completing and maintaining relevant safety courses and certifications including WHMIS (Workplace Hazardous Management Information Systems), OHS (Nova Scotia Occupational Health & Safety Act), Standard First Aid / CPR, Introduction to Lock-out / Tag-out, Introduction to Hazard Identification and Certified Fall Arrest and Protection.

Solar Myth: Solar panels will damage my roof.

Fact: The solar PV cells attached to rooftops use modern materials engineered specifically for the task. Holes need to be drilled into a roof truss to attach solar panels, but your roof can still be protected. Reputable solar panel installation companies follow industry best practices, like using quality flashed mounts to waterproof roof penetrations.

Getting a quote

It is important to understand what products and services are included in the cost of your solar PV system. When you request a quote, ask for a written account of the costs and responsibilities that are covered in the total, including all components and installation. Make sure that the estimate clearly indicates what costs, if any, you will be responsible for, in addition to the installer's quote.

During the process of getting a quote, there are a number of questions you should ask the installer:

- Will they help you with all incentive and/or net metering related paperwork? Does the total cost estimate include a complete turnkey installation including all permits, equipment, costs and related tasks?
- Is the company able to provide you with a quote to temporarily remove the panels if your roof needs repair or replacement?
- When you review the estimate, check to see if it includes the following items:
  - The costs of permitting and/or associated fees (for example, a building permit may require a stamped engineering drawing).
  - Warranty support and maintenance after your system is installed.
  - Monitoring equipment for your system that will help you monitor and track its performance.

Be sure to fully understand what warranty coverage your system will have and who will be responsible for honouring that warranty (i.e., the manufacturer or installer). Also ensure that any subcontractors the installer may use have the proper qualifications and insurance needed to properly complete the work. Remember, all electrical work must be inspected. Additional inspectors may be required for building safety.

Your solar installer should also help you understand what to expect from your solar PV system in the long term. Several factors are used to calculate the projected performance of your solar installation. Ensure that each estimate you obtain includes the following:

- An estimate of the on-going costs for the system, including regularly scheduled system maintenance and service.
- The approximate lifespan of the system and its expected output over this lifespan. This should align with the manufacturer's performance guarantee and equipment warranty period. Most solar panel and inverter manufacturer warranties are 10 years, while most solar panel performance warranties are 25 years.
- Any potentially significant costs for replacement parts, such as panels, inverters, and/or control systems.
- A reliable assessment of the energy production at the site, including an assessment of shading impacts.
- If a lifetime financial analysis is included, make sure all assumptions are listed and that you agree

with the calculations.

- Is the installer providing reasonable projections for electricity rates? Electricity costs have risen around 3% per year on average over the last 10 years in Nova Scotia.
- Is inflation being accounted for? The value of money today is not the same as the value of money 25 years from now.
- Is panel degradation being accounted for? Solar panel output decreases around 0.5% each year.
- Is ongoing maintenance and operating costs being accounted for? For example, if the inverter has a 10-year manufacturer warranty, it is reasonable to assume it will need to be replaced around year 10.

Ensure payment terms are clearly explained within the terms and conditions of the agreement. If a deposit is being requested upfront, make sure payment and refund terms are included. It is important that customers have these open discussions with their installer before signing on the dotted line.

Understanding the full picture up front will help avoid surprises and will give you more confidence in your investment.

Financial Analysis of a Solar PV System

Purchasing a solar PV system is a big investment, and it is important to consider whether the decision is financially viable for you. The average installed cost for grid-tied solar PV systems in Nova Scotia is $2.50 per Watt before HST, before rebate.

If you are working with a solar professional, they might include a cashflow analysis and attempt to quantify the total financial benefits over the entire lifetime of the system. When performing a financial analysis, a number of factors should be taken into account. For example, panels are known to slowly degrade in performance each year, electricity costs may not be the same today as they are in the future, and even the value of money changes over time. A comprehensive financial analysis may include the following factors:

- Panel degradation rate: 0.5%/year
  - All solar panels degrade very slowly over time. The degradation rate varies between models.
- Project lifetime: 25 years
  - Grid-tied solar PV systems have very few moving parts and may last for a long time. However, 25 years matches what the typical performance warranty is on solar panels, and it matches the term on a standard Enhanced Net Metering interconnection agreement.
- Estimated cost escalation rate of electricity: 3%
  - The cost of electricity historically rises, and that rate averages around 3% for the last 10 years in Nova Scotia. This is just an estimate and the cost of electricity in the future may vary.
- Estimated inflation rate: 2%
  - Inflation is estimated to be 2% for the next 25 years, per a recent OECD long-term forecast report. This is just an estimate and inflation may vary.
- Assumed discount rate: 2.5%
  - Discount rate refers to the rate of return used to discount future cash flows back to their present value. Conceptually, if you were to invest this money instead of installing a solar system, it would be expected to produce a rate of return, so this should be taken into account when evaluating the financial benefits of investing your money in a solar system instead of the stock market. 2.5% is a default discount rate commonly used in Nova Scotia. Your discount rate may vary.
- Estimated operation & maintenance (O&M) cost: $25/kW/year
  - O&M costs are estimated by the National Renewable Energy Laboratory (NREL), a branch of the U.S. federal government, and are estimated and reflect the most up to date best judgement of their PV O&M working group. Details can be found in their latest NREL U.S. Solar Photovoltaic System Cost Benchmark. Costs include preventative maintenance, and corrective maintenance to replace components, and include the replacement cost plus labour cost, multiplied by the probability that a failure will occur each year.

- It is recognized that some solar panel manufacturers are beginning to offer 25-year manufacturer warranties, and some inverter manufacturers offer extended warranties on their inverters to 25 years. In cases where both the solar panels and inverters have 25-year manufacturer warranties this number would be significantly lower, but many systems have 10-year manufacturer warranties on both, and the majority of this O&M estimate refers to the cost of replacing faulty equipment outside of the warranty period.
- If your solar panel manufacturer or inverter manufacturer warranties are greater than 10 years, a reduced O&M annual cost assumption can be used in the financial modeling of your system.

Please note, it is recognized that solar + battery storage projects have additional costs as compared to grid-tied systems. A financial analysis can still be performed to provide information on the value of the solar system as a function of its up-front cost and anticipated energy production, but does not attempt to quantify any other costs or benefits related to supplying power during outages.

A well-designed solar system produces a solar yield of around 1,150 kWh/kW in Nova Scotia. That means that every kW of solar PV capacity generates around 1,150 kWh of energy in one year. At the current residential electricity rate of $0.15603/kWh, that means each kW of solar produces around $180.00 worth of energy savings each year.

Reducing Risks and Solving Problems

Even after doing all that homework, making a final decision can still feel daunting. There are some additional steps you can take to minimize the risks associated with your installation.

Determine the installation services that your solar installer offers in-house. Some providers subcontract these services. For example, a licensed electrician or plumber may be required to take out a permit and be responsible for all electrical connections on site. If your installer contracts out that work, find out who they use and ask if that company or person is experienced with, or certified in, the installation of solar technology.

To reduce risk and protect all parties, you may decide to select an installer based on their training and experience in solar technologies. All approved installers under the SolarHomes program will have already provided proof of insurance with the Worker's Compensation Board of Nova Scotia. Other related solar certification organizations, such as the North American Board of Certified Energy Practitioners (NABCEP), provide optional certification for Canadian contractors dedicated to improving solar development and applicable standards.

If a concern arises during or after the installation of your solar PV system, don't be afraid to raise the issue with your installer. Reputable businesses will

always be keen to address any problems. This is why it's important to select a reputable and experienced installer from the outset. If you are not satisfied with the installer's response, look at the remedies available to you under your contract or warranty.

As a SolarHomes approved installer, companies are enrolled in Efficiency Nova Scotia's Trade Network. If your contractor is a SolarHomes approved installer, and you have concerns regarding your solar PV installation, you are welcome to notify Efficiency Nova Scotia. They will do their best to mediate between you and your installer to find a successful resolution to your concerns wherever possible. Companies with repeated issues, whether related to workmanship or customer service, may be removed from the Efficiency Trade Network as a result.

If your contractor is a CanSIA Member you can also be assured that they must abide by CanSIA's Consumer Protection Program. If something goes wrong and you are having difficulties correcting the issue with the member company, you can take advantage of CanSIA's complaint resolution process and submit a complaint form. Submitted complaints get reviewed by CanSIA's Ethics Committee, where the Committee chair will assist in finding a resolution that both sides are happy with. You can find a list of CanSIA members by going online at www.CanSIA.ca/gosolar

Plumbing Vents

If you have a plumbing vent on the side of your roof where the solar PV system will be installed, it may affect the number of panels you can install on your rooftop. Your installer, through a licensed plumber, may be able to relocate the vent for an additional fee. This will enable you to install additional panels to your system. It is not advisable to cut the plumbing vent in order to place a solar panel over it. Section 2.5.6.5.5 of the National Plumbing Code of Canada 2015 states that: Where a vent pipe passes through a roof, it shall: a) Be terminated high enough to prevent the entry of roof drainage but not less then 150 mm above the roof or above the surface of storm water, which could pond on the roof.

FINAL CHECKLIST AND KEY QUESTIONS TO ASK BEFORE SIGNING AN AGREEMENT

Congratulations on preparing to go solar! Here is a quick reference of the key points to remember before you sign on the dotted line.

Laying the Groundwork

- ☐ Have you spoken with your neighbours and insurance company to identify any potential issues (current or future) that would impact your system?
- ☐ Is your installer taking care of your net metering application with Nova Scotia Power on your behalf and have you checked your electricity rate and understand the rules for banking credits?
- ☐ Have you identified a financial rebate and financing option and reviewed the necessary paperwork (including approvals, where needed)?

Choosing a Solar PV Installer

- ☐ Have you checked references and qualifications for the installer you have chosen?
- ☐ Do you have a copy of the warranty or guarantee for equipment and workmanship?

Doing Your Math Homework

- ☐ Is your system sized appropriately for your average annual consumption level? Remember, you will not be able to hold on to credits for more than 12 months, so oversized systems will not be economic, nor are they permitted when applying for the net metering program.
- ☐ Have you factored in any financing costs (including leasing costs) in calculating your system costs and savings?

Preparing for Installation

- ☐ Have you checked your roof condition to ensure that it will hold up for the next 25 years?
- ☐ How will the contractor access your roof? Do you need to make any special arrangements to allow access?

- ☐ Have you and your installer assessed and addressed any potential shading issues, now or in the future, that may affect power production?
- ☐ Have you completed any other upgrades to your home that may impact your home's electricity usage?
- ☐ Are there any other structural or electrical conditions you need to address before installation?
- ☐ Who will take care of any necessary building or electrical inspections?

Doing the Paperwork

- ☐ Who will apply for the SolarHomes rebate and what are the eligibility criteria for the rebate?
- ☐ Are there any municipal permits required? If so, will the contractor take care of these?
- ☐ Do you have a copy of a detailed invoice or a list of model and serial numbers for equipment should there be a warranty issue?
- ☐ Have you checked what your contract does and does not cover?

CONCLUSION: NOW IS THE TIME TO GO SOLAR!

CanSIA and Efficiency Nova Scotia are committed to helping create and support a renewable and sustainable Canada. The time has never been better for Nova Scotians to reduce their greenhouse gas emissions and save money by embracing solar energy.

While a solar PV system may seem out of reach to many, there are financial programs to help minimize the cost, as well as experts who are ready to help you power your home with solar energy.

But don't just stop at your property's border. Talk to your neighbours and friends about how they can help contribute towards Nova Scotia's clean energy future. Together, we can achieve a brighter tomorrow!

ADDITIONAL RESOURCES

CanSIA Member Directory

You can easily search for a CanSIA Member near you using CanSIA's Member Directory. Search by name, location, or other attributes to find the right member for you. CanSIA members are bound by CanSIA's Consumer Protection Program. To learn more about the program, visit: www.cansia.ca/consumer-protection

Solar Nova Scotia

Solar Nova Scotia is a volunteer-based registered not-for-profit society formed in 1980 whose vision is a Nova Scotia that relies 100% on sustainable renewable energy. As a community-driven organization, they have approximately 2,000 members representing private citizens and solar energy companies. Solar Nova Scotia's mission is to promote and facilitate the adoption of solar energy in Nova Scotia in a way that is supportive of other jurisdictions, all sources of sustainable renewable energy, and conservation and efficiency.

Solar Nova Scotia recently partnered with the Nova Scotia Department of Energy and Mines and the Atlantic Canada Opportunities Agency to produce three reports under the heading of the Atlantic Solar Study. The organization continues to fulfill its mission by producing and sharing information on solar technologies, their value as an energy source and best practices for ensuring a smooth transition to a more sustainable future. For more information visit www.solarns.ca

SolarAssist.ca

SolarAssist.ca is a free, interactive online tool to help Nova Scotians assess their home solar potential, and to calculate how much they'd save by installing solar panels. Input some details about your home and power consumption, and the web platform gives you information to determine whether your home may be a good candidate for solar PV. SolarAssist.ca estimates your solar system size, what it might cost, the amount of money you might save, and provides information on programs available to help you go solar.
Visit www.SolarAssist.ca to learn more.

NOTES

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* Photo by Solar Ascent