Rhode Island's

Residential Guide to Going Solar

TABLE OF CONTENTS

Acknowledgements

The Rhode Island Residential Guide to Going Solar was developed by the Rhode Island Office of Energy Resources (OER). This guide was created to help Rhode Island residents considering an investment in solar PV navigate the process of going solar.

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Massachusetts Residential Guide to Solar Power (MassCEC)
http://files.masscec.com/solar-loan/SolarElectricityResidentialGuide.pdf

A Homeowner's Guide to Solar Financing Leases, Loans, and PPAs (CESA)
https://www.cesa.org/assets/2015-Files/Homeowners-Guide-to-Solar-Financing.pdf

A Guide to Community Solar: Utility, Private, and Non-profit Project Development (National Renewable Energy Lab)
https://www.nrel.gov/docs/fy11osti/49930.pdf

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*Photo credit for cover photo – Newport Solar, Portsmouth

Introduction

Our sun contains limitless amounts of clean, renewable energy that can be utilized for the production of electricity without emissions of greenhouse gases and particles that pollute our environment. Solar photovoltaic, also known as solar PV, systems are one way we are able to harness this energy and convert sunlight directly into electricity, which can be used to power your home or small business. Solar energy will be an essential part of our future as it will be critical in remediating economic, environmental, and social concerns that arise from the production of fossil fuels. Residents who have already installed solar PV cite many reasons for going solar including: financial benefits, concern about pollution and the environment, and a desire for energy independence. Regardless of the reason, many homeowners find that installing a solar PV system is an investment that converts free sunlight to electricity, reduces air pollution, reduces monthly electricity bills, and contributes to the local economy by creating local jobs and supporting local businesses.

About This Guide

The purpose of this guide is to assist Rhode Island residents who are considering solar energy to generate electricity in their homes. This guide will help determine whether a solar PV system is right for you. It reviews solar PV technology, the installation process and provides resources on finding an installer as well as available incentives. This guide focuses on solar systems interconnected to the utility distribution system. While this guide is intended primarily for homeowners, many of the issues discussed apply to small scale installations in general and may apply to businesses considering solar PV.[1]

Why Go Solar?

In 2018, Rhode Island was the 8th most expensive state for electricity in the country.[2] In that year, natural gas fueled over half of the electric power sector and nearly all in-state electricity generation[3]. Solar can help reduce reliance on natural gas and cheapen the cost of electricity.

Rhode Islanders who have already installed solar PV systems are enjoying the benefits. A few of them have stated:

- *"I am really glad that we made the investment in the solar program. Our electric bills have been dramatically lower, so it's been even better than we expected."*
- *"Working great, saving lots of money."*
- *"Was able to achieve near carbon neutral position from solar with $0 out of pocket expense."*

[1] Some of the regulations and incentives discussed in this guide may not apply to certain customers in the Block Island and Pascoag Utility districts. Customers of those utilities should contact the utility directly for information on net-metering and interconnection requirements related to small scale solar projects.

[2] https://www.eia.gov/state/rankings/?sid=RI#series/31 - as of July 2018

[3] U.S Energy Information Administration, 2017

About Office of Energy Resources

The Office of Energy Resources (OER) works closely with private and public stakeholders to increase the reliability and security of our energy supply, reduce energy costs and mitigate against price volatility, and improve environmental quality. Rhode Islanders spend over $3 billion per year on energy to light their homes, keep the heat on, and fuel their vehicles. Fossil fuels such as natural gas, fuel oil, and gasoline supply the vast majority of these energy needs. By recommending and implementing smart energy policies, such as those that promote energy efficiency and renewable energy, OER helps reduce Rhode Island's dependence on these out-of-state fuels, advancing our state as a national leader in the new clean energy economy.

Solar PV System Components

What is Solar PV?

Solar PV systems allow for sunlight to be converted directly into electrical energy that is used to power your home or business in a more sustainable, economical way. You have probably seen PV systems in your neighborhood on a rooftop. When the sun shines onto a solar panel, photons from sunlight are absorbed by the cells in the panel, which creates an electric field across the layers of silicone atoms generating a flow of electricity. Panels are wired together and connected to a home's distribution network to provide electricity with a clean, renewable source of energy.

Solar PV Cells & Array

A single PV device is known as a cell that consists of semiconductor materials that absorb the sunlight and convert it into electricity. The more intense the sunlight striking the cell, the greater the amount of electricity produced. An individual PV cell is usually small, typically producing about 1 or 2 watts of power. To boost the power output of PV cells, they are connected together in chains to form larger units known as modules or panels. Modules can be used individually, or several can be connected to form arrays. One or more arrays are

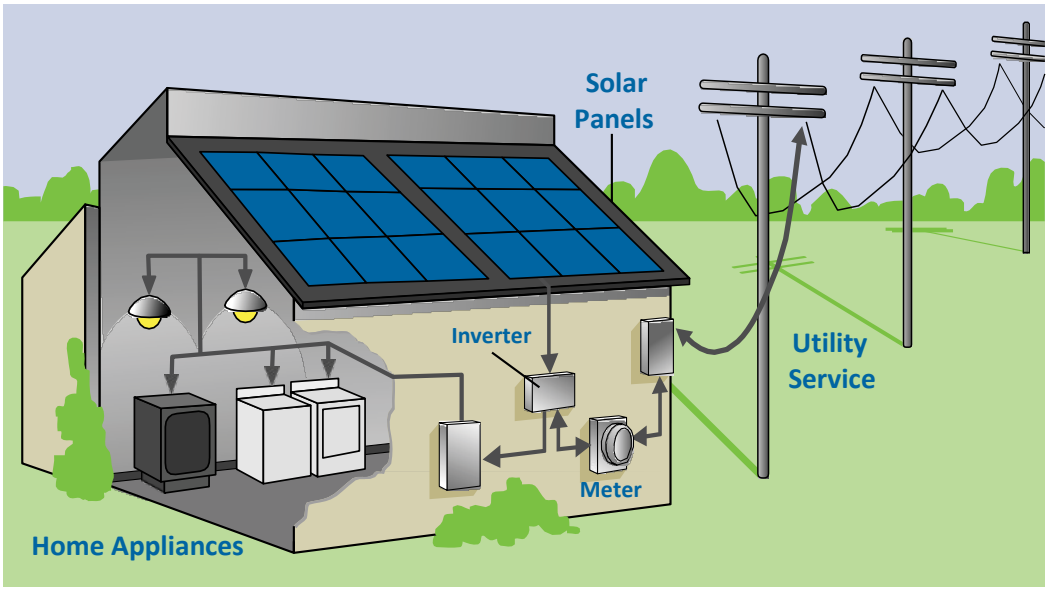

Figure 1: The Flow of Electricity from Rooftop Solar

then connected to the electrical grid as part of a complete PV system. Due to this modular structure, PV systems can be built to achieve the desired system, capacity or power producing capability.

Inverters

Solar PV panels produce direct current (DC) power that must be converted to alternating current (AC) power which is supplied by electric utilities in the United States to generate usable electricity. This is accomplished by an inverter. Typically, the inverter is located near where the electric service from the local utility enters the house (close to the electrical panel). Inverters are designed so that if power from the utility goes down, the solar PV system will shut down as well. This is an important safety precaution for utility workers who often work on power lines to restore power during an outage.

String Inverter vs. Micro-Inverter vs. Power Optimizers

There are three different inverter types commonly used by installers in Rhode Island:

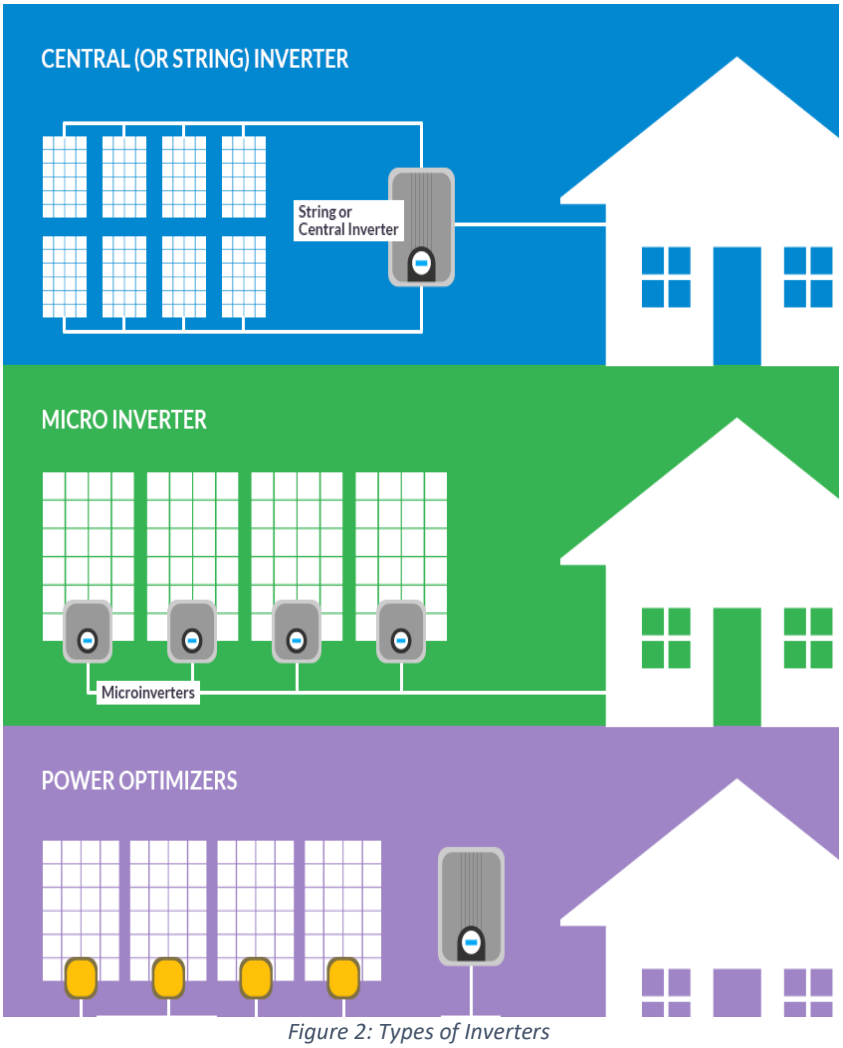

Figure 2: Types of Inverters

String inverters convert direct current (DC) to alternating current (AC) power by arranging multiple solar panels into groups connected by "strings." Each string of panels is connected to a single inverter.

Micro-inverters are installed on each individual solar panel and convert direct current (DC) to alternating current (AC) power. One of the advantages with micro-inverters is that they cancel out the negative impacts from shading that string inverters cannot do. Therefore, one panel's poor production does not decrease the maximum production of all the panels. Each individual panel is able to be monitored for performance measures. Micro-inverters tend to be more expensive than string inverters, but their costs are falling as they become more popular.

Power optimizers are installed on each individual solar panel similar to micro-inverters. They allow PV panels to maximize their power production, therefore increasing the efficiency of the system. Since they are installed individually, they also reduce the impacts from shading and can be

monitored to pinpoint any issues and correct them to obtain the optimal energy production from the system.

External Shut-Off

National Electric Code requires solar PV systems to have an external shut off, often called a "disconnect, so the utility can shut down the system when workers are repairing nearby power lines or in other necessary situations. This prevents possible injury to utility line workers who expect nearby electricity lines to be deenergized during an outage. It is important to know where the external shut off is on your PV system and it should be clearly labeled.

Batteries

Most solar PV systems installed in Rhode Island do not have a battery. Batteries add to the cost of a system, often by hundreds of dollars. Due to the benefits of net metering, owners of solar PV in Rhode Island do not need a battery to balance their load (the process of matching generation to consumption). However, without a battery backup, grid-tied solar PV systems will not operate when the power grid is down. New battery technologies are emerging regularly which, as they are deployed across the country, will result in reduced costs. Rhode Island regulations allow for a small battery to be installed on residential homes with a net metered solar PV system less than 25kW. If you are interested in learning more about the benefits of solar and batteries, there are some additional resources on this topic that can be found in the Appendix – Additional Resources.

Solar PV can be wired in a home with an existing or future generator. It is important to make sure that your generator is on a different circuit than the PV system. Make sure to inform your selected solar PV installer if you have a generator or if you plan on purchasing a generator in the near term.

Interconnection Types

In Rhode Island, a residential solar customer has two options for incentives. The incentive programs are discussed in more detail later in the guide. However, the incentive programs dictate the type of interconnection configuration that must be used. Customers can choose from either a net metered system or a Renewable Energy Growth program interconnection.

To utilize net metering, homeowners must have a special net meter installed, which spins backwards when the solar PV system is producing more electricity than is being consumed on site. Net metering is a solar incentive that allows consumers to "net out" charges on their electric bills by sending the excess power produced by their solar panels back to the grid. When the homeowner's electricity use is greater than the solar PV system's production, then the homeowner can obtain power bought from the grid.

The Renewable Energy Growth program interconnection is slightly different as a second "tenant" meter is required to be installed. The second meter captures the production from the solar PV system. The two meters are read together monthly, and the bill credits generated from the solar PV system are shown on the electric bill in the form of a line item reduction. If excess production is generated, above what a homeowner uses in their home during a month, National Grid provides Production Based Incentive (PBI) in the form of check[4].

Solar PV System Life

Solar PV systems are passive, have no moving parts, and are designed to last at least 20 years. Many systems installed in the New England region in the 1980s continue to produce power today. Solar panels are typically guaranteed by manufacturer warranties for 20 or 25 years. While the life span of most string inverters is shorter

[4] https://www9.nationalgridus.com/narragansett/non_html/2018%20Small-Scale%20Solar%20Rules%204-2-18.pdf

than the panel life, manufacturing improvements have extended the inverter life to 15 years or more for some equipment with warranties averaging around 10 years. Installers may provide an extended warranty option for string inverters. If you opt for a string inverter, make sure to ask your installer about both the manufacturer's warranty length and if they offer an extended inverter warranty.

Energy Efficiency – a Critical Step

Energy efficiency is generally considered to be the "low hanging fruit" when it comes to making fiscally sound, environmentally friendly choices about a home's energy use, and it is the most cost-effective way to reduce a home's total electricity use and cost. The advantage of adopting energy efficiency measures is that some require no change in behavior, meaning you could save energy without having to sacrifice comfort. For example, LED light bulbs use 10% of the energy required to power an incandescent light bulb. Therefore, by changing your light bulbs you can save energy, money and become one step closer to being more energy efficient.

By adding some measures that require changes in certain behaviors, further energy can be conserved in your home. Some things your can do that can add up to significant savings on your electricity bill include turning off lights, unplugging appliances that are not regularly used, and installing a programable thermostat. For more energy saving measures, the US Department of Energy has a list of actions you can take.[5] Furthermore, by reducing your overall energy usage, you can reduce the size of your solar PV system potentially saving you more money on upfront costs.

Figure 3: A thermographic representation to detect air leaks and insulation gaps

[5] https://www.energy.gov/eere/femp/home-energy-checklist

Rhode Island is a nationally recognized leader in energy efficiency and has consistently ranked in the top three most energy efficient states in the country.[6] Rhode Island offers a number of incentives and loan opportunities through the state's energy efficiency programs for homes, businesses, and municipalities. The energy efficiency programs are supported by a surcharge on electric and gas customers' bills and most of these programs are run by National Grid. The Office of Energy Resources and the Energy Efficiency Resource Management Council monitor and assist National Grid with the implementation and development of the annual energy efficiency programs.[7]

Saving energy through efficiency reduces the need to use non-renewable fuels, thereby preventing greenhouse gas emissions. Rhode Island's goal is to reduce greenhouse gas emissions by 80% below 1990 levels by 2050. To do so, Rhode Island prioritizes investments in energy efficiency measures (with no greenhouse gas emissions) that cost less than purchasing additional energy supplies (that do emit greenhouse gases).

Figure 4: The Energy Star Label Indicates Energy Efficient Appliances

To schedule a no-cost home energy assessment for your home please call 1-888-633-7947. An energy auditor will come to your home, complete an attic-to-basement evaluation, and provide a custom home energy report outlining recommended energy efficiency improvements. They will even install a few no-cost energy saving products. These may include ENERGY STAR® certified LED light bulbs, 7-day programmable thermostats, faucet aerators or low-flow showerheads. Based on your assessment, you may be eligible for rebates, a 0% interest HEAT loan, and thousands in savings towards a new insulation installation.

[6] http://aceee.org/state-policy/scorecard
[7] http://www.energy.ri.gov/energy-efficiency/residents/

How Much Solar Do You Need?

It is critical that you understand your electricity usage for a solar PV system to be appropriately sized. The PV system size is the first factor in determining the cost of a solar generation system. Monthly utility bills include a summary of how much power a homeowner has used each month for the past year. The installer will want a copy of a recent bill to determine an appropriate system size based on the property sites characteristics, power needs, and your budget.

Residential electric utility bills charge customers for actual consumption, measured in kilowatt-hours (kWh) of electricity consumed. Although the average residential system size in Rhode Island is about 6 kW, the optimal system size for you and your savings depends on several factors some of which include your 36-month prior electricity usage, desired bill and energy offset, electricity rates, available space for the system, roof location and orientation, and available financing options. These will have an impact on the size of the system you should choose.

The average Rhode Island household can use between 6,833 to 11,388 kWh per year, though both higher and lower levels of consumption are common. As a rule of thumb, you will need approximately 100 square feet of roof space for each kW installed. For reference, 1 kW will produce about 1,500 to 1,800 kWh per year; however, actual production may vary. Something to consider when sizing your system is whether you seek to offset your entire electrical use or simply reduce it. [8]

Figure 5: RGS Energy Solar Installation

[8] http://www.ripuc.org/eventsactions/docket/2515-NGrid-Q2-2017.pdf

Where Should I Put It?

For most homeowners in Rhode Island, rooftop installations are the most common, the easiest, and the most practical way to use solar PV to power their homes. Rooftops provide a readily available location for solar PV arrays and are unlikely to have competing uses. Roofs in New England are usually tilted to shed water and snow, which helps keep solar PV modules clear from debris. Roof-mounted systems also allow for a simple interconnection to a home's existing wiring, and a roof's elevation decreases the likelihood of shade falling on the array. Rhode Island homeowners with open land on their property may choose to install a ground-mounted solar PV system. The advantage of a ground-mounted system is that it can be oriented to the optimal south-facing direction and at the ideal tilt to maximize electricity production, without the limitations of a roof's exposure or slant. However, ground-mounted systems typically have a higher cost than similar roof-mounted systems due to the expense of the ground-based structure the panels are mounted to and the need for underground trenching to accommodate the electrical wires which connect the PV system to the building with the electrical meter. Also, ground-mounted systems have a higher potential for existing and future vegetation to cast shadows on a system.

Figure 6: Newport Renewables Zero Energy Home, Jamestown

Orientation

Solar panels achieve the maximum production possible when they are oriented as due south as possible. When a direct southern exposure is not feasible because of the roof orientation or aesthetics, facing 45 degrees west or east of true south reduces energy output by less than 5 percent. Facing 90 degrees from true south reduces annual energy output by only 10-20 percent. Therefore, a roof that faces south, southeast or southwest is feasible and a roof facing east or west may be acceptable, depending on your expectations for the system

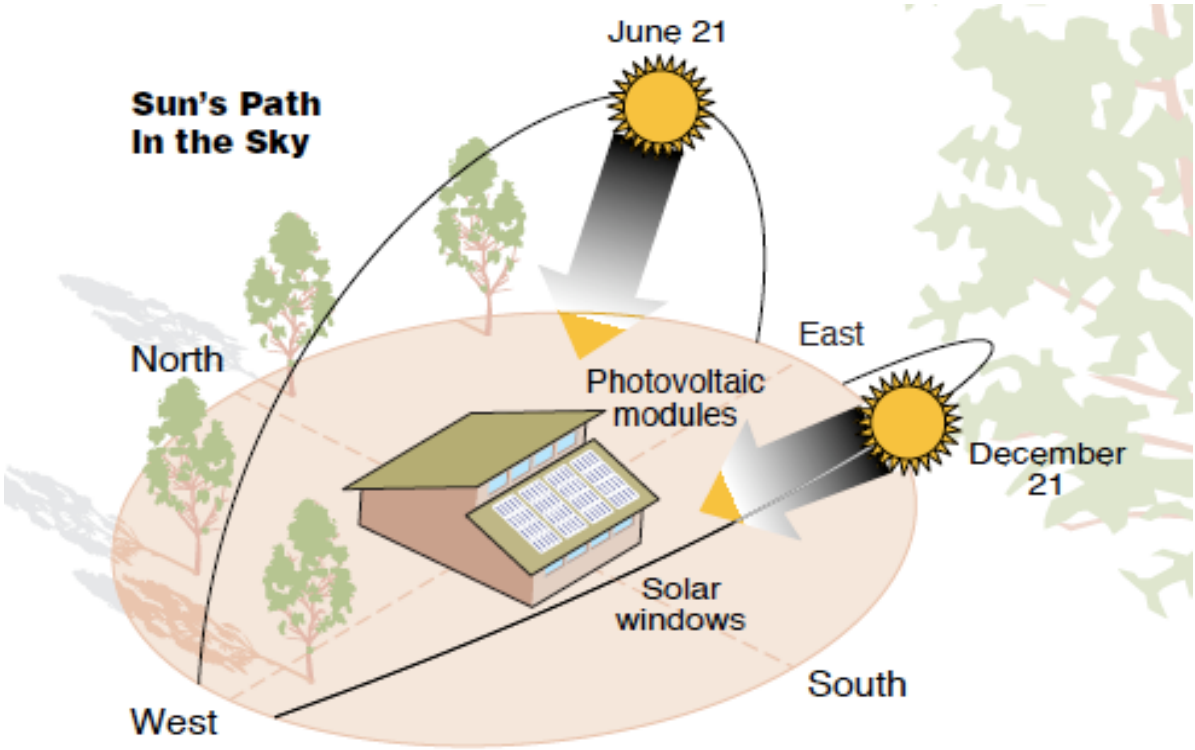

Figure 7: The Path of the Sun in New England

It is important to note that a north facing system, or a system that is not ideally sited in a primarily southern facing location, will not produce as much electricity as a system facing south. Make sure to carefully review the production estimates provided to you by your selected installer.

Roof Condition

Since it is both time-consuming and costly to remove a system once it is in place, homeowners should evaluate the structural condition of their roof and shingles before a system is installed to ensure that roof repairs or replacement will not be necessary in the near future. Consider making any necessary roof repairs before a solar PV system is put in place. Most installers recommend replacement if the roof has a remaining lifetime of eight years or less.

Cyclical Fluctuations

As a result of the sun moving across the sky at varying heights from sunrise to sunset and from season to season, the amount of electricity generated by a module varies during the daylight hours and over the course of the year. Residential solar PV installations are typically stationary, meaning they do not follow the track of the sun

over the course of the day and are generally fixed. They are not adjusted to account for changes in sun angle from season to season. Therefore, to maximize the production of electricity, the design of individual solar PV systems must optimize module tilt, orientation, and shading.

Tilt

A critical factor in performance is the tilt or slope since performance output rises with the increase of exposure from direct sunlight. A recent study in 2018 revealed that the optimal fixed tilt for the United States is approximately 28 to 32 degrees, but an exact tilt is not crucial.[9] A 15-degree variation to suit a roof's pitch makes almost no difference in power output. While it may not provide optimal capture of solar rays, most rooftop solar panels are mounted parallel to the roof for the sake of simplicity and aesthetics.

Shading

Shading can severely affect the performance of a solar PV system therefore effecting the payback period of your PV system. Depending on the type of system, shade on 25 percent of an array could result in a 50 percent or greater drop in output. It is important to examine shading across the sun's path – not only in a day, but also over a year since the angle of the sun is lower in winter. You should make sure your neighbor's house and trees will not shade your solar array in winter. Also, consider what might create shade in the future, such as growing trees or new buildings. It is a good idea to ask your neighbors if they have future remodeling or landscaping plans that could shade your solar panel location. Many solar professionals use a tool called a solar pathfinder to find optimal placement at a location[10]. If seasonal shade is an issue, a microinverter system may be recommended by your installer since only the shaded panels are affected.

Zoning

If you are planning on going solar in a historic district, contact your community's planning department. Solar panels are considered a minor alteration to a home so it should be a simple process if the changes meet their guidelines. Most Rhode Island communities do not have restrictions on residentially zoned properties for rooftop solar PV projects.

Property Taxes

Homeowners with a solar PV system may be eligible for a property tax exemption on the value added by the system. Homeowners are encouraged to discuss this with their installer and the local tax assessor's office.[11] It also recommended that homeowners speak with their property insurance company to inform them of the existence of a solar PV system.

[9] https://web.stanford.edu/group/efmh/jacobson/Articles/I/TiltAngles.pdf
[10] www.solarpathfinder.com
[11] http://webserver.rilin.state.ri.us/Statutes/TITLE44/44-3/44-3-3.HTM

Available Incentives

Net Metering

Net-metering projects export electricity to the grid and generate net-metering credits that can be used to offset your electricity bill. Most Rhode Island homes with solar systems are able to interconnect with the electrical grid, allowing the homeowner to purchase power from the electric distribution company when the PV system is not producing as much electricity as the homeowner is using. Utilities may require a special inspection prior to interconnection to ensure that the solar electric system complies with established technical, performance, and safety requirements.

Renewable Energy Fund

The Renewable Energy Fund (REF) administered by the Rhode Island Commerce Corporation is dedicated to increasing the role of renewable energy throughout the state. The REF provides grants for renewable energy projects with the potential to make electricity in a cleaner, more sustainable manner, while stimulating job growth in the green technology and energy sectors of Rhode Island's economy. Programmatic funds come from the "system benefit charge" on electric bills, Alternative Compliance Payments, and the Regional Greenhouse Gas Initiative.

Homeowners are eligible for the Small Scale solar program. This grant can be used with a net metered solar PV system. Blocks of funding are available on a first come, first serve basis. Your selected solar installer will apply to the REF on your behalf. After the solar PV system is installed, the grant will go directly to the installer after the completion paperwork is processed and a quality assurance evaluation of the system is complete.

If using the REF Small Scale program, make sure the turnkey contract with your installer clearly shows how much the grant is for and includes a clause with an option for cancellation in case the grant program becomes fully subscribed. This is a popular program with a limited annual amount of funding.

Renewable Energy Growth Program

The Rhode Island Renewable Energy Growth Program (REG) is administered by National Grid, has a Small-Scale program that is available to eligible homeowners. It allows customers to sell their generation output under long-term tariffs at fixed prices. Payments are available for 15 or 20 years for residential customers, or 20 years for non-residential customers. Depending on the term, project size, and other factors, National Grid will pay a fixed kilowatt-hour rate for solar generation in a Performance Based Incentive (PBI).

This incentive is separate from net metering and cannot be used in addition with the Renewable Energy Fund programs. Homeowners can choose one incentive, but not both. Your solar installer will select either a net metered solar system or a REG project on the interconnection application with National Grid. Only National Grid customers are eligible for this program.

It is important to note that National Grid will request a W-9 from a homeowner participating in the REG program. There may be a tax liability associated with the income generated from the PBI payments. More information about National Grid's tax policy can be found in the Additional Resources Appendix.

Federal Tax Credit

The Federal solar tax credit or as some know it as the investment tax credit (ITC), allows you to deduct 30 percent of the cost of installing a solar energy system from your federal taxes. The ITC for residential and commercial solar has generated annual solar installations by over 1,600 percent since the start of the federal policy in 2006. The ITC can be leveraged with state incentives to decrease the cost of a solar energy system installation. For example, if coupled with the REF grant, a homeowner could save anywhere from 50%-55% on the original cost of a system.

The federal ITC which was created by the Energy Policy Act of 2005 has been extended for a multi-year extension for residential and commercial projects completed by the end of 2023.[12] The tax credit is a dollar-for-dollar reduction in the income taxes that a person or company claiming the credit would otherwise pay the federal government. It is based on the amount of investment on a solar PV project. Both the residential and commercial ITC are equal to 30 percent of the basis that is invested in eligible property which have commence construction through 2019. The ITC then steps down to 26 percent for projects that begin construction in 2020 and 22 percent for projects that begin in 2021. After 2021, the residential credit will drop to zero while the commercial and utility credit will drop to a permanent 10 percent.

Rhode Island Sales Tax Exemption

Equipment purchased for a residential solar electric system in Rhode Island is usually exempt from state sales tax.[13]

Make sure to discuss all incentives and potential tax liability associated with participation in various programs with your tax advisor.

Economics of Solar PV

Even with the myriad of environmental benefits that solar creates, the economics are often the single most important factor in the decision to go solar. Without the economic feasibility, solar PV would not be viable option for most homeowners. Purchasing a solar PV system often requires upfront installation and equipment costs, but there are significant economic benefits that are realized over time. The financial return on a solar PV system in Rhode Island can be very favorable for homeowners with a suitable site. The average pay-back period is between five to eight years. The PV systems will continue to produce financial returns long after the system is paid off due to a significantly reduced electricity bill for the life of the system. The average life of a solar PV system is around twenty-five years so many homeowners find that going solar is a smart investment for energy savings and independence.

Avoided Electricity Costs

The most fundamental benefit a homeowner will receive from a solar PV system is the electricity generated which directly displaces electricity that the homeowner would otherwise purchase from an electric distribution utility. Fuel cost increases, rising demand for fuel or electricity, and fuel supply constraints can all cause the cost of purchasing electricity from an electric distribution utility to increase. Purchasing a solar PV system is the

[12] https://www.seia.org/sites/default/files/inline-files/SEIA-ITC-101-Factsheet-2018-June.pdf
[13] http://webserver.rilin.state.ri.us/Statutes/TITLE44/44-18/44-18-30.HTM

equivalent to paying for many years of electricity use in advance at a fixed and stable price. Homeowners can get an accurate projection of the cost of power a solar PV system produces now and in the future because the fuel price is stable (sunlight will always be free), the solar resource in Rhode Island (days of sunlight per year in a given region) is generally predictable, and there is little system maintenance required.

Home Value Appreciation

Market conditions and the interests of particular buyers will ultimately determine the sale price of a home. However, recent research suggests a solar electric system can increase a home's market value if prospective buyers understand the financial benefits that the system creates. A 2014 study by the Lawrence Berkley National Lab, called Selling to the Sun,[14] found that prospective home buyers in California and other states in the U.S. were willing to pay more for a property with a resident-owned solar electric system. The average premium across various states, housing markets, electric markets, and home types was $4 per watt. This equated to a premium of about $15,000 for a typical electric system.

Figure 8: Trinity Solar, Cranston

System Maintenance

As is the case with any appliance, solar PV systems require some maintenance over their lifetime. This generally includes making sure the solar panels are clean, ensuring the panels are receiving unobstructed sunlight, and replacing the inverter generally once during the life of the solar PV system, which should be at least 20 years. Installers should provide a minimum five-year labor warranty to protect the equipment against defective workmanship, component breakdown, or significant degradation in electrical output. In addition, the solar PV

[14] http://emp.lbl.gov/sites/all/files/selling-into-the-sun-jan12.pdf

equipment should have appropriate manufacturer's warranties. See the "Quality Assurance" section of this guide for more information on warranties.

Buying or Leasing?

Since a home solar power system can cost anywhere from $5,000 to $50,000, how you pay for it is a big deal! There are many considerations and different costs and benefits of buying versus leasing a home solar system. Local and state incentives and how they apply to a purchase versus leasing should be factored into your decision. When purchasing a home solar system, you own it. The main expense is upfront, so you may need to get a loan to finance it and you are responsible for its maintenance. Most residential solar PV projects in Rhode Island are owned directly by the homeowner.

A big advantage of ownership is that once your electric bill savings recoup the initial cost, the remaining electric bill savings are all "profit" (return on your investment). There also may be incentives for purchasing that are not available when leasing.

When leasing a system installed on your home, the leasing company owns it. Typically, there is little or no upfront cost and a homeowner could start saving some money right from the start – as long as the energy produced results in utility bill savings that are greater than the monthly lease payment.

Since the leasing company owns the solar system, the company gets whatever tax credits, rebates and other incentives that are available. These financial benefits and other factors typically enable the company to set your initial monthly payments lower than your initial utility bill savings and still make a profit.

The leasing company monitors and is responsible for maintaining and repairing the solar system. Some provide the homeowner a means to monitor energy production, savings, and carbon emissions avoided, etc. Some leasing companies sell their leases to third-party investment groups, so it is wise to ask who the future owner of your solar system could be. Make sure to verify that they have the expertise and capacity to fulfill the maintenance and other responsibilities under the lease agreement.

Purchasing a Home Solar Power System

Unlike leasing your solar power system, you can take advantage of Rhode Island's available incentives and programs that aim to reduce the cost of going solar if you purchase the system yourself. Be sure to examine the limits and details of incentives. It can be helpful to consult your tax adviser – to determine your capacity to use tax credits, as well as whether or not you will owe taxes from receiving incentives.

If you plan to finance the purchase, there are several financing companies that can assist offer low-rate or zero-down-payment incentive loans that can apply to home solar purchases. However, be sure to research the financing company and the terms of the loan. Many solar installers partner with financing companies to offer a complete package of incentives and financing. Your relationship with the financing company will continue long after the solar installation is complete, so make sure you are comfortable with the amount of the loan and the monthly payment.

Another financing option is a home equity loan or second mortgage. Such loans obligate your home as collateral, but they have lower interest rates than other types of financing, and the interest may be tax deductible, further

reducing your finance cost. Federal Housing Agency, or FHA; Veterans Affairs, or VA; U.S. Department of Agriculture, or USDA; and other lending agencies may offer specialized loan programs with favorable terms for renewable energy.

Figure 9: Sol Power, Wakefield

Selecting an Installer

If you are buying a home solar PV system, you choose your installer. If you are leasing a solar PV system, the third-party company might choose the installer. Either way, it is crucial to choose carefully as to ensure a quality installation that will perform properly and not cause damage to your home or the equipment. Note that bids and site assessments typically are free, so consider getting multiple quotes. Investigate every company you are considering as there are several websites to read reviews. Some of these include solarreviews.com, Yelp, and the Better Business Bureau. Keep in mind that extreme and outlying reviews may not be reliable. One of the best ways to learn about a company to hear from other people who went solar with that installation company. Ask for references and call them. Often people who have gone solar are willing to share their experience.

Figure 10: Newport Solar, Providence

Look for reputable, professional PV system installers who have documented training and field experience installing residential PV systems. Solar PV system installers who are certified by the North American Board of Certified Energy Practitioners have passed a rigorous exam and demonstrated a high level of training and experience.[15]

Verify the license or credentials of the installer you are considering. Rhode Island requires that solar installation companies have a General Contractor's Registration[16]. In addition, electricians installing solar PV must have a Rhode Island electrical license[17]. Check the Secretary of State's office to ensure that they are registered to do business in the state.

Rhode Island Renewable Energy Professional Certificate

The Renewable Energy Professional (REP) is a certificate created by the General Assembly in 2014. It updated the electrical and plumbing licensing laws and created a new designation, the REP. The new rules create a limited license that allows REP certificate holders to perform certain renewable energy system installation work without holding an electrical or plumbing license. The Electrical Contractor's License already includes the work allowed by the REP limited license. Only contractors or individuals without an electrical license are required to obtain the REP limited license to perform ancillary non-electrical work on renewable energy systems. To learn

[15] www.nabcep.org
[16] http://www.crb.ri.gov/search.php
[17] https://dltweb.dlt.ri.gov/profregsonline/LicenseSearch

who in the state holds a Rhode Island Renewable Energy Professional certificate and what the qualifications are for installers to earn the certificate, please visit www.energy.ri.gov/renewable/REP.

Contact at least three solar installers and set up a meeting and get written proposals from them, with clear specifications, costs and estimated annual energy production (and how it was derived). Ask questions and get details in writing. Ask for customer references and talk to them. Never let a vendor rush or pressure you into a quick decision!

Environmental Benefits of Solar PV

Use of solar PV systems to generate electricity dramatically reduces the environmental impact of the myriad of personal, industrial, and commercial processes which rely on electricity. Solar PV modules do not emit greenhouse gases or other pollutants, and do not require intensive mining operations to provide fuel.

Compared to the mix of fossil fuel power sources typically used to produce power for New England consumers, every 1,000 kWh generated by a solar PV system avoids sending 2.03 pounds of sulfur dioxide, 0.54 pounds of nitrogen oxides, and 1,102 pounds of carbon dioxide emissions into the atmosphere. In addition, solar PV systems reduce the production of particulates that contribute to respiratory problems and can prevent unnecessary health care costs associated with those problems.

The U.S. Environmental Protection Agency (EPA) reports that electricity generation is currently the largest industrial source of air emissions in the United States. Fossil fuel-fired power plants are responsible for 40 percent of man-made carbon dioxide (CO2) emissions, 23 percent of the nation's nitrogen oxide (NOX) emissions, and 67 percent of sulfur dioxide (SO2) emissions. These emissions contribute to the formation of smog and haze, and are associated with a wide range of health problems.

The Solar Energy Technologies Office quantified the environmental benefits of going solar and announced that water consumption will drop in 36 states that will be equivalent to hydrating 1.3 million households, solar PV can prevent $17 billion in health and environmental damages, can help mitigate climate change and can increase the health amongst citizens.[18] Clean, renewable energy produced by a rooftop array on your home can help preserve our natural resources and protect our environment from further damage.

Post Installation

What happens after the PV system is installed?

After your solar installer completes the installation there are a few next steps. First, the installer should test the equipment to confirm that it is operating properly. You should also ensure that the installer provides copies of

[18] https://www.energy.gov/eere/solar/downloads/environmental-and-public-health-benefits-achieving-high-penetration-solar

any technical equipment manuals and warranties. In addition, you should be familiar with the components of the installed system, most importantly the location of the external disconnect. You need to know how to shut the system off in an emergency. In addition, you should learn how to read the information displayed on the inverter and have contact information, including a phone number and email address, in case the system needs service. Many installers will provide a copy of commissioning test results to the owner and register the warranties, but if not ask for them to do so.

Many inverter manufacturers offer websites and phone applications to help customers monitor PV system production. The software can provide alerts to homeowners if something goes wrong with an individual panel or the entire system. Make sure to ask your installer if the inverter manufacturer offers system monitoring. Your solar salesperson should be able to help you download and set up this software.

Next, the installer will schedule an inspection with the local electrical inspector to sign off on the installation and provide signatures on the solar permit. Feel free to ask for a copy of the signed solar permit after this inspection.

Lastly, your utility will come out and interconnect the solar system. The interconnection of your system will depend on which program you have chosen. A net meter will be installed if you have opted for a net metered system. If you have chosen the REG program with National Grid, a second meter will be installed. After physical interconnection, you will receive an email from the utility allowing you to turn your system on.

If you have opted for either a Renewable Energy Fund grant or a REG tariff, your project may be inspected by a third party after interconnection. These inspections ensure that the investment made by ratepayers result in a high quality and safe solar installation.

Warranties

Your installer should provide copies of all warranties. Read them carefully and ask questions. Often this language can be found in the contract you signed with your installer. Make sure that both equipment and workmanship warranty language is mentioned. Solar panels typically come with a 20 to 25-year warranty however, their productive lifespan can exceed that. Also, check the warranty information on the string inverters or microinverters. String inverter warranties may be less than the warranty of the panels and may need to be replaced during the lifetime use of the system. If you have a string inverter you may want to consider an extended warranty if offered. Other system components such as disconnects, racking, and wires may come with relatively short warranties or no warranties at all. Homeowners may want to purchase an extended warranty to cover replacement or repair of these components or the risk that a panel manufacturer will have undergone bankruptcy by the time a homeowner pursues a manufacturer's warranty claim.

Workmanship warranties vary in length from between 3 to 15 years. These warranties cover the installation by the solar company. At a minimum, you should have a three-year workmanship warranty as many of the issues that could arise related to workmanship may occur during the first three years after installation. Roof leaks, improper wiring, or a system failure are things that should be covered under a workmanship warranty.

Talk to your friends and neighbors

Solar is still a word-of-mouth industry. Because solar systems last so long, it is not a repeat customer business. If you are happy with your solar installation consider posting a positive review of your experience, talking to your neighbors, or offering to host an open house with a community or church group you may be affiliated with.

Dispute Resolution

Most home owners are very happy with their decision to go solar. Occasionally a homeowner may need to look for resources to help resolve a complaint with their solar installer. There are several ways a complaint can be resolved. First, you should identify whether the issue is with the installer or the utility. If the dispute is with your installer, go back and read through the contract you signed with the company. Is the issue covered under the workmanship warranty or otherwise mentioned?

Here are some helpful links and tips:

1. If the complaint is regarding the workmanship or quality of the work related directly to the structure (non-electrical) you may be able to file a claim with the General Contractor's Registration Board - http://www.crb.ri.gov/claimfiling/index.php
2. If the complaint is about anything else related to workmanship consider filing a claim with the Rhode Island Attorney General's office - http://www.riag.ri.gov/ConsumerProtection/About.php
3. If the complaint is related to National Grid, email the complaint to distributed.generation@nationalgrid.com and make sure to include your account number, address, and the nature of the issue.

Glossary

Alternating Current or AC

AC is the form of electricity that is delivered to your home or business by an electric utility. Solar PV systems produce DC, which must be converted to AC by an inverter.

Array

Any number of electrically connected PV panels providing a single electrical output.

Capacity Rating

The rating given to a PV system by its manufacturer denoting the load the system is able to meet or supply when operating at full capacity in direct sunlight with no shade.

CEC-AC Rating

The calculation that provides a total estimated energy output of a solar generation system, factoring in the efficiency of the panels and inverter.

Conversion Efficiency

The amount of the sun's energy that a solar cell can convert into electricity; the balance is lost as heat or reflected light.

Direct Current or DC

Solar PV systems produce electricity in DC, which is defined as the continuous flow of electricity through a conductor. DC power is converted to AC by an inverter to power homes and businesses.

Greenhouse Gas or GHG

The gases responsible for trapping heat from the sun within Earth's atmosphere (i.e., water vapor, carbon dioxide, methane, ozone, chlorofluorocarbons and nitrogen oxides). GHGs are released from many sources, including industrial processes such as power generation from fossil fuels.

Grid

A network of power stations, transmission circuits and substations that conduct electricity and provide it to homes and businesses

Grid-Connected or Grid-Tied PV System

A PV system in which the PV array is wired into buildings or residences that are connected to the utility grid. This allows customers to feed excess electricity into and pull needed electricity from the grid.

Interconnection Agreement

A legal document between the customer and their electric utility authorizing the connection of the customer's solar generation system to the utility's grid. This agreement is required prior to the utility granting permission to operate.

Inverter

A device that converts DC electricity produced by a solar generation system into AC electricity that can be used in a home or business. Some energy is lost when this conversion takes place (see CEC-AC rating).

Inverter Efficiency

The AC power output of the inverter divided by the DC power input. Inverter efficiency is lowest when operating at low loads; thus, it is important to select inverters of the proper size relative to the PV array.

Kilowatt or kW

A unit of electrical power equal to 1,000 W, which constitutes the basic unit of electrical demand. The watt is a metric measurement of power (not energy) and is the rate (not the duration) at which electricity is used. 1,000 kW is equal to one megawatt (MW).

Kilowatt-Hour or kWh

A unit of electrical energy, equivalent to the use of one kW of electricity for one full hour. Utilities measure customers' electric energy usage based on kWh, and electricity rates are most commonly expressed in cents per kWh.

Load

The amount of power consumed by an electric customer at a specific time. Base load is the minimum constant level of electricity required by utility customers; peak load is the amount of electricity required at the time of greatest demand.

Megawatt or MW

Unit of electric power equal to 1,000 kW or 1 million watts.

Meter

A device used to measure and record the amount of electricity used and/or generated by a consumer.

Modules

A module is the smallest protected assembly of interconnected PV cells. Modules are rated typically from 40 to 300 watts.

Orientation

A term used to describe the direction that a solar module faces. The two components of orientation are the tilt angle (the angle of inclination a module makes from the horizontal) and the azimuth (the compass angle that the module faces, with north equal to 0 degrees and south equal to 180 degrees).

Photovoltaic or PV

The technology that uses a semiconductor (such as silicon) to convert sunlight directly into electricity.

Renewable Energy Credits or RECs

Also known as green certificates, green tags or tradable renewable certificates, RECs represent the environmental attributes of the power produced from renewable energy projects. By installing a renewable energy system (such as solar), you become the owner of these environmental attributes.

System Size

System size is the electricity generating capacity of a given photovoltaic system based on CEC-AC rating standards. The system size should be limited to no greater than the amount of total electricity consumed at a site during the prior 12 months.

Time-of-Use or TOU Rates

An electricity pricing plan in which the cost of electricity varies depending on the time period in which the energy is consumed or produced. In a TOU rate structure, higher prices are charged during utility peak-load times. Such rates can provide an incentive for consumers to curb power use during peak times. Solar PV panels tend to produce power during peak times, so they have higher value when used in conjunction with TOU rates.

Tracker or Tracking Array

A number of PV modules mounted such that they track the movement of the sun across the sky to maximize energy production, either with a single- axis or dual-axis mechanism.

Watt or W

A unit of measurement of electric power, named after physics pioneer James Watt.

Additional Resources

Energy Efficiency Resources

Energy Efficiency Programs available to Rhode Island customers - http://www.energy.ri.gov/energy-efficiency/residents/

Renewable Energy Growth Program Links

REG Program Page - http://www.ngrid.com/REGrowth

REG Program Tax Policy - https://www9.nationalgridus.com/narragansett/non_html/RE_Growth_Tax_Policy_2017.pdf

Renewable Energy Fund Links

Renewable Energy Fund program page - https://commerceri.com/financing/renewable-energy-fund/

Investment Tax Credit Links

Solar Energy Industry Association ITC Factsheet - https://www.seia.org/sites/default/files/inline-files/SEIA-ITC-101-Factsheet-2018-June.pdf

Video Resources

Video – "Rooftop Solar Financing 101" - https://www.cesa.org/projects/sustainable-solar/resources/resource/rooftop-solar-financing-101-video

Video – "Choosing a Solar Installer" - https://www.cesa.org/projects/sustainable-solar/resources/resource/choosing-a-solar-installer-video

Video – "Will Solar Save You Money" - https://www.cesa.org/projects/sustainable-solar/resources/resource/will-solar-panels-save-you-money-video

Miscellaneous Resources

United Solar Neighbor's Guide, "Battery Storage for Homeowners" - https://www.solarunitedneighbors.org/wp-content/uploads/2018/11/Solar-United-Neighbors-Battery-Guide.pdf

Clean Energy State's Alliance - Homeowner's Guide to Solar Financing - https://www.cesa.org/assets/2015-Files/Homeowners-Guide-to-Solar-Financing.pdf

EnergySage – a solar marketplace website - https://www.energysage.com/

Solar Checklist
For Rhode Island Homeowners

Preliminary Questions

1. How much electricity is currently consumed on your property and how much does it cost, monthly and yearly?
2. Do you have a south-facing roof? If not, do you have property with open space that might accommodate a ground-mounted solar PV system?
3. Do you know where there is shading on the roof or elsewhere on the property during different times of the day and at different times of the year?
4. Do you want to purchase and own the solar PV system or do you want to work with a third-party company and either buy the electricity generation through a power purchase agreement or pay a monthly lease payment?
5. Have you gotten at least 3 quotes from solar companies?

Purchasing and Contracting

1. Are you comfortable with the installer's knowledge and experience?
2. Is the installer registered with the RI Secretary of State, holds a General Contractor's license and a Renewable Energy Professional Certificate?
3. Does the installer have credible references and are they willing to provide them?
4. Is the installer adequately insured to protect you as well as the company's employees and subcontractors?

STATE OF RHODE ISLAND
OFFICE OF ENERGY RESOURCES

5. Is the electrician performing the work subcontracted or an employee of the installation company?
6. What is the length of the workmanship warranty in the contract?
7. Does the contract include performance specifications for the system being installed, including an estimate of the amount of electricity the system will produce?
8. Does the contract clearly lay out what is included and what is not included in the total project costs?
9. Were you presented with options for RI specific incentives such as the Renewable Energy Growth and Renewable Energy Fund programs?
10. Were you presented information regarding the 30% Federal Investment Tax Credit?
11. Does the proposed payment schedule protect you by allowing payment to be withheld until the system: 1) passes local code inspections, 2) receives utility interconnection approval, and 3) is shown to be operating properly?

Post Installation

1. Has the installer left descriptive materials and equipment operating manuals as reference materials?
2. Has the installer tested and activated the system?
3. Have all necessary inspections occurred?

Typical Solar Installation Steps

Steps	Role
Research contractors and compare bids	Customer
Design system (site visit and usage evaluation to determine size)	Installer
Sign contract	Customer
Apply for interconnection; submit application(s) to National Grid	Installer
Apply for a Solar Permit with the City/Town	Installer
Apply for RI State Incentives	Installer
Install the solar PV system	Installer
Town/City onsite system inspection; submit approval to utility	Installer
Utility onsite interconnection/meter inspection	National Grid
Turn system on upon written approval from utility	Customer
Receive first utility bill post-installation	Customer

Additional Resources

1. Video – "Rooftop Solar Financing 101" - https://www.cesa.org/projects/sustainable-solar/resources/resource/rooftop-solar-financing-101-video
2. Video – "Choosing a Solar Installer" - https://www.cesa.org/projects/sustainable-solar/resources/resource/choosing-a-solar-installer-video
3. Video – "Will Solar Save You Money" - https://www.cesa.org/projects/sustainable-solar/resources/resource/will-solar-panels-save-you-money-video

For more information, visit www.energy.ri.gov

IREC's Clean Energy Consumer Bill of Rights

Our future depends on clean, renewable energy and our ability to access and enjoy that energy efficiently. The Interstate Renewable Energy Council (IREC) works to make this a reality for more Americans.

IREC's Clean Energy Consumer Bill of Rights addresses important consumer issues, including safety, contractual transparency, warranties, advertising, privacy and other protective measures related to solar and other renewable energy and energy efficiency technologies. This information empowers consumers to engage in the rapidly evolving clean energy industries with greater confidence. It enables a positive consumer experience with products, technologies, service providers, marketers, sellers, and other market players, including their utility.

The Clean Energy Consumer Bill of Rights covers consumer relationships with utilities, third-party providers and sellers, access to the utility grid, and access to electricity consumption data.

Section I: Consumer interaction with Companies, Contractors, and/or Subcontractors

General

- Companies, contractors and/or subcontractors must confirm compliance with all applicable federal, state and local laws.

Safety

- Companies, contractors and/or subcontractors shall provide proof of the following:
- Health and safety practices and procedures are followed;
- Licensing, bonding, and insurance requirements are met;
- Permitting and inspection requirements are met;
- Workers are trained to industry standards and supervised; and
- Industry-recognized credentials in good standing shall be explained and displayed.

Contracts

- Contracts and contract terms shall be transparent, easy to understand and prominent.
- All costs and financing terms, including those that may be dependent on price or retail rate escalation assumptions, shall be made clear, easy to understand, and explained thoroughly.
- All prices and costs shall be transparent throughout the life of the transaction.
- Contracts shall avoid underestimating costs and overestimating performance.
- Ownership terms shall be clearly defined.

- Contracts shall clearly describe the duration, nature, and potential impacts to the buyer of any restrictions, liens, fixture filings, or other security interests that may encumber the consumer's ability to transfer or modify his property or gain access to credit as a result of such terms.
- Termination and removal terms shall be clear especially in cases of third-party ownership.
- Contracts shall include discussion of who is responsible for the proper disposal of the product at the end of its life.
- Performance calculations shall specify and include all relevant factors.
- If installation and/or equipment will be monitored, the consumer shall be told what kind of data is being collected, who has ownership and access to the data, and if the data will be sold to others.
- Contracts shall include a reasonable period for rescinding contracts.
- Contracts shall include remediation terms regarding damage to property from work.
- Contracts shall include start and end dates if applicable.

Warranties & Protection

- Equipment and labor warranties shall be clearly defined and easily understood, with responsible parties identified.
- Any performance labels shall be clear and verifiable.
- Upon completion, operating manuals shall be provided if applicable.
- Contact information for follow up shall be provided and kept updated including if the company or product manufacturer ceases operations.
- Any long-term maintenance plan shall be made available in writing and explained.
- An adequate dispute resolution process shall be available in writing and explained.

Advertising

- Claims shall be accurate, factual and substantiated.
- Claims shall avoid underestimating costs, overestimating performance and overvaluing financial and incentive benefits.
- Endorsements shall be genuine and verifiable.
- Renewable Energy Certificates or Renewable Energy Credits (RECs):
  - Providers must educate their clean energy customers about RECs.
  - Providers must be clear and transparent in the role of RECs and their disposition in the clean energy offering, and clearly communicate the customer's rights to make clean energy claims.
  - All statements or claims about renewable energy use must be supported by appropriate REC ownership.
- Companies must follow applicable telephone marketing laws, such as the National Do Not Call Registry rules, which require companies to keep their own "no call" lists, and that telemarketers promptly identify a sales call, among other requirements.
- Companies must follow applicable email and commercial electronic message laws (e.g., the CAN-SPAM Act). These rules require such commercial messages be clearly identified as advertisements, prohibit advertising emails that contain false or misleading header information or deceptive subject lines, and require such messages to have an unsubscribe option, among other requirements.

Respect & Privacy

- Consumers shall be treated fairly and honestly.
- Confidentiality of consumer personal information must be maintained, unless a consumer has actively consented to having that information shared, as permitted by relevant laws.
- Customers should have to give express written permission to have any information shared.
- Consumer data shall be secure and handled responsibly.
- Any conflict of interest or an appearance of impropriety by the provider shall be disclosed.

Section II. Consumer interaction with their utility company

Access

- Consumers shall have fair and non-discriminatory access to the grid provided that safety and reliability requirements are followed.
- The price paid for customer resources shall reflect the full and fair market value of those resources.
- A simple, transparent and efficient process shall be defined for customer resources to connect to the grid.
- Utility rate information shall be clearly available to customers and shall be transparent and easy to understand.
- Consumers using and/or owning distributed resources connected to the grid shall only be responsible for costs directly attributable to their connection and shall not be burdened with unfair or unreasonable charges.
- Consumers shall have access to their own consumption and generation data and be able to share it with third parties.
- Consumers shall know which other entities have access to their data, how the data will be used and if any personal information will be identified with the data.
- Individual consumer energy information provided to third parties for commercial purposes not related to the services provided by the utility shall be prohibited (or fully disclosed with an opt-out clause).