2019

Rhode Island Farm Energy Resource Guide

CREATED BY THE RHODE ISLAND OFFICE OF ENERGY RESOURCES

GUIDING FARMERS TOWARDS SUSTAINALBE, CLEAN FARM-ENERGY DEVELOPMENT

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STATE OF RHODE ISLAND
OFFICE OF
ENERGY RESOURCES

Acknowledgements

This resource guide was developed by the Rhode Island Office Of Energy Resources. It is intended to inform Rhode Island farmers about sustainable energy practices while encouraging the utilization of Farm-Energy incentive programs.

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The concept for this guide is based off of *Rhode Island's Residential Guide to Going Solar*, a similar guide created by the Office of Energy Resources. Specific information about solar PV system components are included from *Rhode Island's Residential Guide to Going Solar* to provide an all-inclusive document for farmers. Images and additional resources from *Rhode Island's Residential Guide to Going Solar* have also been included for reference if readers wish to learn more about solar PV.

Rhode Island's Residential Guide to Going Solar
http://www.energy.ri.gov/documents/solar/Guide-to-Going-Solar.pdf

We would also like to acknowledge the following RI farms for providing photographs and short testimonials about the success of Farm Energy programs:

Sweet & Salty Farm (Little Compton, RI)
Bedrock Tree Farm (Wakefield, RI)
Verde Vineyards (Johnston, RI)

Introduction

Purpose of This Guide

This Farm Energy Resource Guide aims to inform Rhode Island farmers and other interested agricultural producers about the environmental and financial benefits provided by renewable technologies and energy efficiency improvements. In addition, there are numerous financial incentive programs available to Rhode Island farmers that help reduce energy consumption, save money and lessen environmental impact. This guide outlines the scope of these programs to help farmers decide which opportunities and upgrades are must suitable for their properties. After reading this document, farmers will have a more well-rounded understanding of how clean farm-energy practices can simultaneously benefit their business and the environment.

Figure 1: Rooftop Solar array at Sweet & Salty Farm, Little Compton, RI
RIAgEP, REAP, and the Renewable Energy Fund were all used to fund this project

What is the Office of Energy Resources?

The Office of Energy Resources (OER) works closely with private and public stakeholders to increase the reliability and security of Rhode Island's 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 energy policies that promote energy efficiency and renewable

energy, OER helps reduce Rhode Island's dependence on these out-of-state fuels, advancing Rhode Island as a national leader in the clean energy economy.

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[1] 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.[2]

Energy Efficiency: What is it?

Energy efficiency is generally considered to be the "low hanging fruit" when it comes to making fiscally sound, environmentally friendly choices about your property's energy use, and it is the most cost-effective way to reduce total energy consumption. One advantage of adopting energy

Figure 2: A thermographic representation to detect air leaks and insulation gaps

efficiency measures is that some require no change in behavior, meaning energy is saved without sacrificing comfort or productivity. For example, LED light bulbs use 10% of the energy required to power an incandescent light bulb. Switching bulbs required no behavioral change, but saved energy while saving money, therefore improving overall efficiency. By adding some measures that require changes in certain behaviors, energy can be further conserved.

[1] http://aceee.org/state-policy/scorecard

[2] www.energy.ri.gov/energy-efficiency/residents/

Some easy activities that can add up to significant savings 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[3].

Why Should Farmers Manage Energy Use?

Sustainably managing energy use provides both financial and environmental benefits. Depending on the size of the operation, reducing (or even eliminating) energy costs can free up substantial funds that can be used for other projects. Those projects could be conventional upgrades such as machinery or infrastructure improvements, business expansion, or even further investment in more renewable/efficient developments that can help the farm completely offset their energy usage.

How do I know if I'm Considered a "Farm?"

A farm is defined as any Rhode Island location engaged in horticulture, floriculture, livestock-animal husbandry, aviculture, egg production, dairy production, apiculture, aquaculture, maple sugaring and/or viticulture for documented revenue. The various programs supported by OER offer free energy assessments and potential incentives for prescriptive electric, natural gas, and delivered fuel (oil and propane) energy efficiency measures.

Energy Audits – A Critical First Step

What is an Energy Audit?

Getting an energy audit done on your farm is the first step towards better understanding energy footprint. All financial incentive programs require auditing before proceeding with any installations or upgrades. An energy audit is an on-site evaluation of a property's energy usage. An energy specialist comes to the property and identifies energy efficiency improvements that can be made. By talking with the customer, looking over energy bills, and utilizing diagnostic tools, a report is compiled that identifies all the ways energy costs can be reduced.

The Audit Process

In an effort to promote sustainable energy development on RI farms, free audits are available for farmers trying to improve energy efficiency or who may be interested in renewable energy. **You can schedule your free audit by calling 1-800-332-3333**. Once your energy audit is scheduled, the specialist will meet you on your property before assessing your facility. They will often ask you if there are any specific concerns you'd like to address, or if there's any specific technology

[3] https://www.energy.com/eere/femp/home-energy-checklist

or infrastructure you're interested in. concerned about in terms of inefficient technology or infrastructure. From there, the specialist will go around the property and check for safety issues, identify areas in need of air sealing and insulation, evaluate your heating and cooling systems, look for lighting and appliance upgrade opportunities, and suggest tips to promote energy-saving behavior. The specialist also takes into account the local climate and energy rates to provide the most accurate estimate of your savings potential.

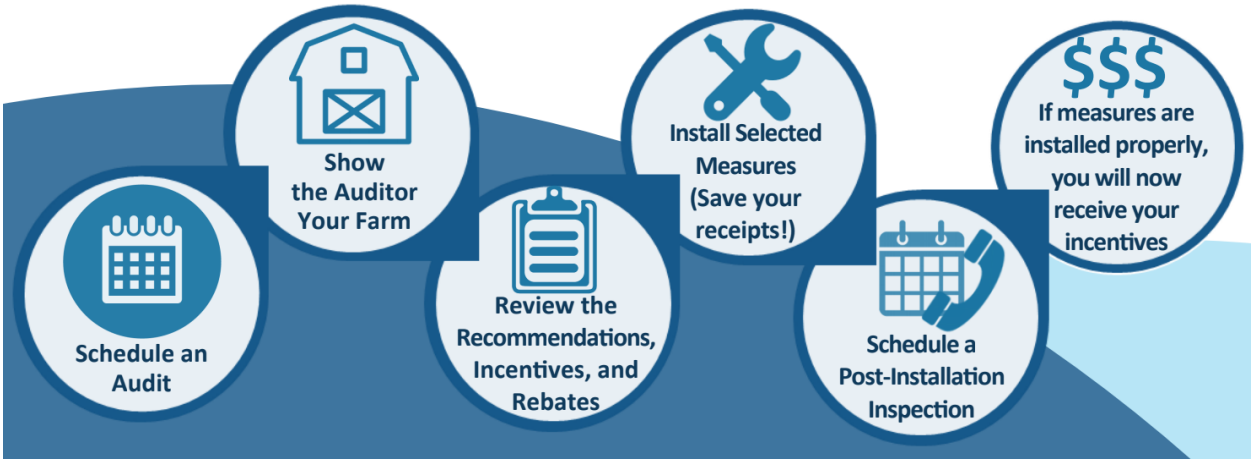

Figure 3: The Audit Process

Commercial vs. Residential Audits

There are residential energy audits and commercial energy audits. The 800-number listed above is specifically for commercial audits, but it never hurts to get a residential audit done as well, especially if you live and work on the same property. With smaller farming operations, it is common for there to be a grey area between commercial operations on the property and commercial operations within the home (e.g. inefficient freezers for market produce/meat only located inside the home, but for commercial purposes only).

To schedule a residential audit, call 1-888-633-7947.[4] 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.

[4] https://www.riseengineering.com/home-energy-assessment

After the Audit: What's Next?

The energy audit is the first step towards proceeding with grant applications or quantifying potential savings from energy efficiency upgrades. Shortly after the audit, the specialist will send you an *audit recommendation summary*. This summary lists energy efficiency recommendations, along with the estimated installed costs of these measures, estimated incentives to be received, and the estimated payback period on the recommendations (in years).

Sample Greenhouse Audit

Recommendation	Incentive	Remaining Cost	Expected Savings/yr
Perimeter Insulation	$1,194	$399	$399
Roll-up Sides	$883	$379	$319
PSC Inflation Fan	$69	$30	$31
Efficient Root Bed Boiler	$454	$151	$834
Totals	**$2,600**	**$959**	**$1,583**

Figure 4: Sample Post-Audit Recommendation Summary

How do I Know Which Energy Efficient Upgrades to Choose?

While there are numerous upgrades that can help improve energy efficiency on your property, such as lighting, heating, ventilation, insulation, refrigeration, greenhouses, pumps and motors, the step of choosing the best upgrades is already done for you. By getting an energy audit conducted on your farm, the energy specialist informs you of what upgrades will allow you to save energy and money. These upgrades are listed in the post-audit recommendation summary provided to you by the energy specialist. Depending on the payback period listed, you can pick and choose which upgrades you are willing to invest in.

In order to receive incentives, you must keep all receipts of purchase, delivery, and installation costs. When you are ready, the audit recommendation summary lists a name and phone number to call and schedule a *post-installation inspection*.

Overview of Financial Resources for Energy Efficiency

Incentives and Reimbursements

Farm Energy Efficiency Program (FEEP)

The Rhode Island Office of Energy Resources (OER) in partnership with National Grid, has developed the following program for National Grid agricultural customers in Rhode Island. Participants receive a no-cost, no-obligation energy assessment. During which, an energy specialist will visit the farm, examine certain farming equipment, and provide a written list of recommended energy efficiency improvements along with available incentives. In order to participate, you must be a National Grid customer and obtain consent from your landowner to

proceed with any installations. FEEP can help fund up to 75% of the total cost of recommended installed energy-efficient upgrades.

Environmental Quality Incentives Program (EQUIP)

Participants receive financial and technical assistance from the US Department of Agriculture (USDA) to implement structural and management conservation practices, including development of an Agricultural Energy Management Plan (AgEMP). The AgEMP can outline energy management practices specifically. In order to qualify, you must control or own eligible land, comply with income limitation provisions, and comply with highly erodible and wetland conservation requirements.

Grants

Rhode Island Agricultural Energy Program – Grant (RIAgEP)

Participants are selected through a competitive application process to receive grants up to $20,000 for qualifying energy efficiency improvements. In order to participate you must be a recognized farming operation that is capable of entering into a legally binding agreement with the State.

Rural Energy for America Program – Grant (REAP)

Participants are selected through a competitive application process by USDA to receive grants between $1,500-$250,000 for qualifying energy efficiency improvements for a portion of project costs. Participants MUST accrue at least 50% of gross income from agriculture OR small businesses in eligible rural areas (municipal populations less than 50,000)

Loans

Rural Energy for America Program – Loan (REAP)

Participants are selected through a competitive application process to receive a loan up to $250,000 for qualifying energy efficiency improvements and/or loan financing for a portion of project costs.. See eligibility requirements for REAP – Grant, above.

Commercial Property Assessed Clean Energy – Loan (C-PACE)

C-PACE finances cost-effective energy efficiency projects through a loan tied to the property assessment that can be transferrable with ownership and is structured to be cash-flow positive. Loan financing is available for up to 100% of total project costs. C-PACE requires that participants are located in a participating municipality and have a commercial meter on their property. To find out if you live in a participating municipality, visit https://ri-cpace.com/participating/.

Renewable Energy

Why Should I Be Interested in Generating My Own Electricity?

In 2018, Rhode Island was the 8th most expensive state for electricity in the country[5]. That year, natural gas fueled over half of the electric power sector and nearly all in-state electricity generation[6]. Generating your own renewable energy reduces reliance on fossil fuels and reduces the cost of electricity.

Figure 5: Ground Mount Solar System at Bedrock Tree Farm, Wakefield, RI.
This array offsets 100% of electricity usage, with a payback period of only 3-4 years.
Three different programs were used for the funding of this project: RIAgEP, REAP, and the Renewable Energy Fund.

Solar PV - What Is It?

Solar photo-voltaic (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, cost effective manner. You may have 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 distribution network to provide electricity.

[5] https://www.eia.gov/state/rankings/?sid=RI#series/31 - as of July 2018
[6] U.S Energy Information Administration, 2017

Solar PV System Components

Solar PV systems can seem complex – but don't let this overwhelm you! Choosing the best PV system for your property can be sorted out with the installer and the help of this guide.

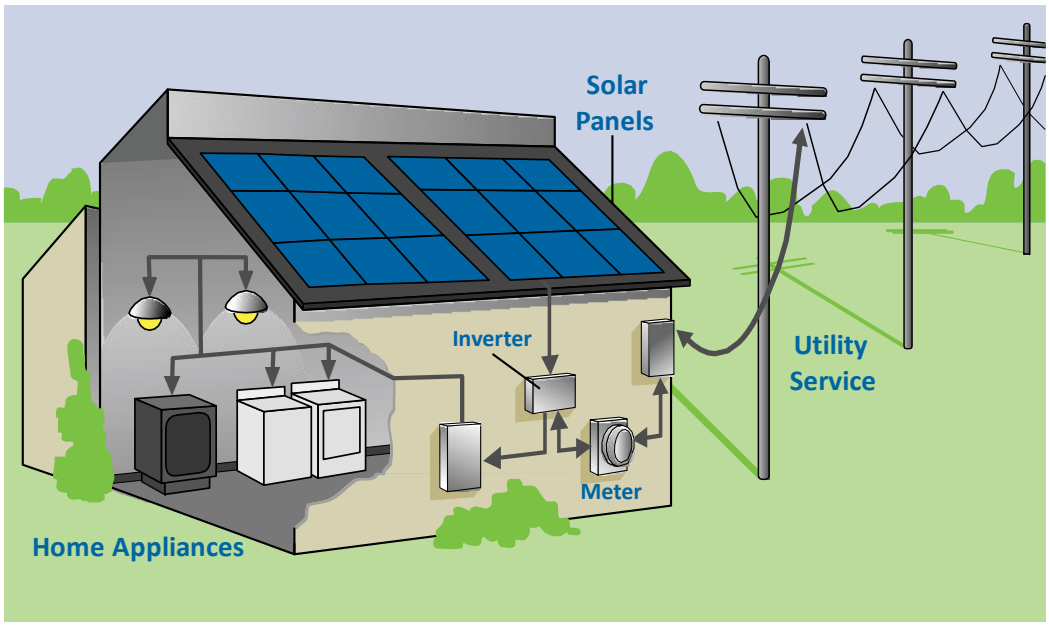

Figure 6:The Flow of Electricity from Rooftop Solar

Solar PV Cells and 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 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 grid 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.

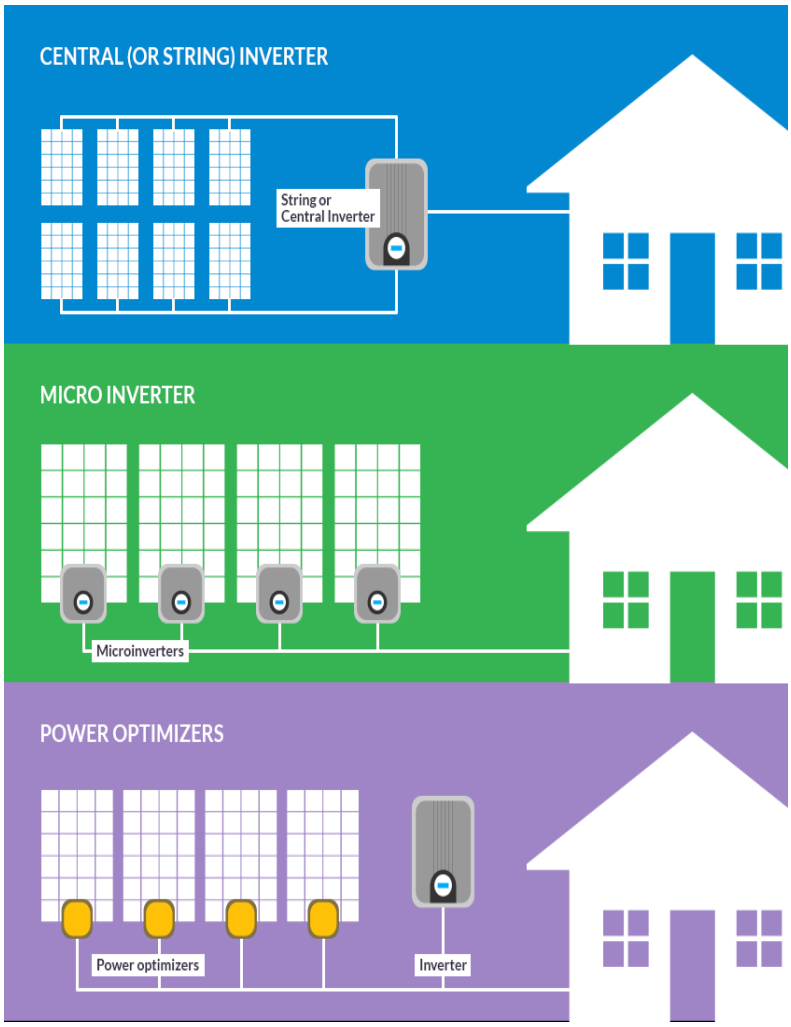

Figure 7: Types of Inverters

String Inverter vs. Micro-Inverter vs. Power Optimizers

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

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 microinverters. 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.

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 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.

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. 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 during a power outage due to their external shut-off mechanism. If a Solar PV system is battery-connected, it is operable during an outage. The following case study describes a scenario where a retrofitted battery project saved a local vineyard and winery from losing it's reserves to recurring unpredictable New England storms:

A Case Study in Battery Storage: Verde Vineyards

An Interview with Jim Verde, Owner of Verde Vineyards (Johnston, RI)

Verde Vineyards is a small vineyard and winery that opened in 2011, currently growing eight different varietals of grapes, three viniferas and five hybrids. It is situated in Johnston, RI, east of Moswansicut Pond - looking west toward Scituate.

"The Vineyard is located on land whose development rights were sold to the Providence Water Supply Board about a decade ago. The primary goal of the Board is to protect our water supply, which serves 65% of Rhode Islanders each day. In addition, they create many new green spaces devoted to agriculture - land that probably would have been gobbled up by urban sprawl"

"We heard about the grants available from the Northern RI Conservation District, whose office is located on Hartford Avenue in Johnston. In the beginning, the application process seemed daunting, but is now easier. Our energy audit was completed by RISE engineering, and we were

awarded the RI-AgEP grant to retrofit a battery system to our existing solar PV and geothermal installations. The primary purpose of the battery system is to protect the wine from power outages."

In 2012, Verde Vineyards installed geothermal heat pumps and a ground mount 10.5kW Solar PV system capable of producing enough power to offset consumption with zero carbon footprint. In 2018 however, the vineyard experienced a 2-week power outage and had to get an emergency generator to save the wine. Normal grid-tied solar systems must shut down during grid outages to protect linemen, but a new generation of grid tied inverters can disconnect from the grid during outages. This keeps solar operating during the day, while running off batteries at night.

This project retrofits the existing Solar PV system for uninterruptible operation with one of these hybrid-inverters and 40kWh battery bank. This keeps the PV system producing during outages, allows for time-shifting during peak grid usage, while also backing up critical winery circuits at night. This project guarantees temperature stability for the wine, zero carbon footprint, and generator fossil fuel cost savings estimated at over $2,000/yr.

"Since the winery makes all its own electricity, the batteries will be charged to full capacity during daylight, making it unnecessary to have generators which would require hauling in hydrocarbon fuels for large generators which we need here since the winery is heated AND cooled geothermally… Now we can rest easy, even in a power outage."

Overview of Financial Resources for Renewable Energy

Renewable Energy Growth Program (REG)

The Renewable Energy Growth Program is a feed-in tariff program where participants sell excess energy output under long-term tariffs at fixed prices. Participants must have solar projects less than or equal to 25kW Direct Current (DC) be interconnected with National Grid.

The REG program interconnection process is slightly different, as a second 'tenant' meter is required. The second meter captures the production from the solar PV system. The two meters (the original net-meter and the tenant meter) 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 deduction. If production is generated, National Grid provides financial compensation in the form of a Performance Based Incentive (PBI) check.[7]

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

Renewable Energy Fund (REF)

Participants receive a grant for renewable energy projects. Up to $8,000 maximum for systems greater than or equal to 8kW; up to $80,000 project maximum for larger systems. Farmers, businesses, municipalities, or non-profits must use their on-site energy in order to qualify. For this reason, REF and REG programs cannot be used together.

Federal Solar Investment Tax Credit (ITC)

Participants receive a tax credit based on total project cost. In order to be eligible, you must be a commercial property owner with an already existing solar system. ITC is a 30% one-year federal tax credit that starts declining in 2020 and is currently set to expire in 2022.

Grants

Rhode Island Agricultural Energy Program – Grant (RIAgEP)

Participants are selected through a competitive application process to receive grants up to $20,000 for qualifying renewable energy projects. See eligibility requirements for RIAgEP – Grant, page 9.

REAP Grant

Participants are selected through a competitive application process to receive grants between $1,500-$250,000 for qualifying renewable energy projects and/or loan financing for a portion of project costs. See eligibility requirements for REAP – Grant, page 9.

Loans

REAP – Loan

Participants are selected by USDA through a competitive application process to receive a loan up to $250,000 for qualifying renewable energy projects and/or loan financing for a portion of project costs. See eligibility requirements for REAP, page 9.

C-PACE loan

C-PACE finances cost-effective renewable energy projects through a loan tied to the property assessment that can be transferrable with ownership and is structured to be cash-flow positive. Loan financing is available for up to 100% of total project costs. C-PACE requires that participants are located in a participating municipality and have a commercial meter on their property. For information on participating municipalities, see page 9.

Do You Lease or Own Your Farmland?

If owned…

If you own your own farmland, utilizing the numerous grants and other incentives offered by these programs is straightforward. You can simply schedule an energy audit and see what opportunities are available for your property.

If leased…

If you lease farmland, it is important that you obtain consent from the owners of the land before proceeding with any installations or upgrades to your property. Getting consent is very simple, it's just important that you understand what the terms of your lease allow you to do, which is often times dependent on the type of lease.

Through Private Owners

When you lease land from private owners, obtaining consent is fairly simple. In most cases, this simply means that you ask/write them about your participation in the program, and they either accept or deny your request

Through a Land Trust

Installing energy-efficient or renewable upgrades on trusted land is a completely viable option for land-lease farmers! While the conditions of a lease on trusted land are aimed at limiting non-agricultural development, energy efficiency upgrades and renewable generation that doesn't require land use (i.e. rooftop solar) can greatly reduce environmental footprint without interfering with the terms of a lease.

Land Trusts

The relationship between land trusts and farming in Rhode Island is extremely important. Rhode Island is the smallest state in the nation, which is reflected in the extremely high demand for available agricultural space.

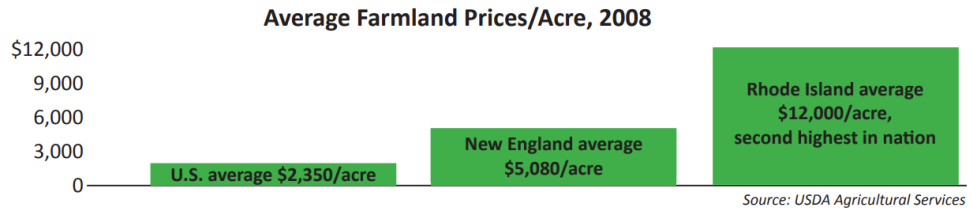

Figure 8: Average Price of US Farmland per Acre

The cost per acre of farmland is extremely high when compared to its development value, which can cause challenges for farmers. As a result, more than 80% of RI's farmland has disappeared since 1945, with only 40,000 acres still being used for agricultural production - this is less than 7% of the entire state! - This is because farmland often has very few constraints placed on it, and is therefore easy to develop. Also, most of the prime agricultural land in Rhode Island is located near the shoreline, which creates competition between farming and coastal housing or commercial developments.

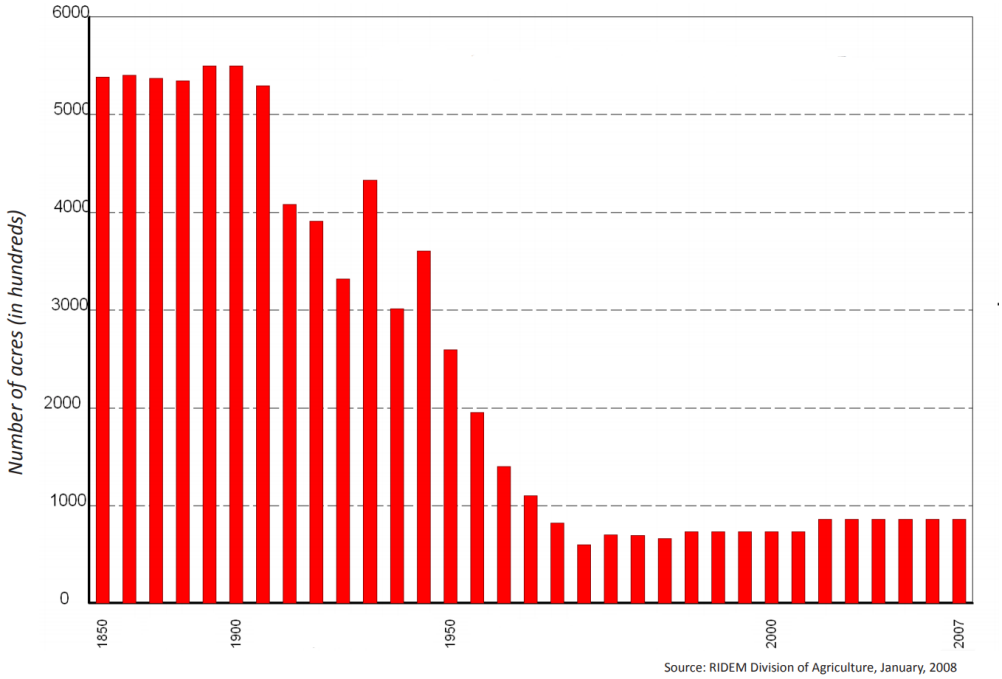

Figure 9:Farmland Loss in Rhode Island, 1850-2007

Because of these competing uses for limited and costly space, many farmers are "waiting in the wings" for farmland. This means Rhode Island farmers possess the knowledge, skillset, and/or workforce required for farming, but cannot obtain land necessary to make an income because it's too costly for considerable net profits. Farmland prices are averaged at approximately $13.6k per acre, which is often too expensive for new farmers to purchase property, pay a mortgage, and profit from the land.[8]

This agricultural land-use predicament in Rhode Island is most commonly solved with Land Trusts. Land trusts can offer up land to farmers in the form of a lease. Leases are sometimes paid in monetary value, and sometimes paid in produce (produce of equivalent dollar amount is donated to a food bank).

[8] FarmRI2.0 "Crafting the next generation of initiatives for saving Rhode Island's working farms" Report from the 2010 Charette, Rhode Island Land Trust Council - https://www.rilandtrusts.org/documents/FarmRI_2.0_Final.pdf

Is Clean Energy Development Still Possible on Trusted Land?

Yes. It is definitely still possible to make clean-energy improvements to your property, especially through energy efficient upgrades. Energy efficiency is a critical first step to saving energy and money, making all available incentive programs very useful to land trust farms. In addition, installing renewables such as solar PV is a viable option and can lead to significant savings as well.

Each land trust functions differently, with those differences depending on when and where they were established. As a result, each land trust has different rules and regulations for what can be done on the land. This means that each farmer leasing land through a trust should be aware of the regulations specific to their property.

Most farm land trusts involve some sort of **Farm Easement.** A farm easement prohibits nearly all development of non-farm-related installations, such as ground-mount solar panels. This is generally the case for most farm land trusts in an effort to protect the land. However, this does not mean clean energy development is impossible! While Farmers who use land trusts may not be able to install large ground-mount solar projects, they can most likely install rooftop solar systems, since rooftop installations have no effect on pre-existing land usage.

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 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 smartphone 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. 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.

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.

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.

Energy Audit

An energy audit is an on-site evaluation of a property's energy usage. An energy specialist comes to the property and identifies energy efficiency improvements that can be made. By talking with the customer, looking over energy bills, and utilizing diagnostic tools, a report is compiled that identifies all the ways your energy costs can be reduced.

Farm Easement

a deed restriction many land trusts voluntarily place on trusted land, to protect resources such as productive agricultural land, ground and surface water, wildlife habitat, etc.

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).

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.

Land Trust

A land trust is a legal entity that takes ownership of, or authority over, a piece of property at the behest of the property owner. Like other types of trust, each land trust's terms are unique.

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.

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.

Photovoltaic or PV

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

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.

Watt or W

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

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?

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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

Additional Resources

Land Trust Resources

FarmRI2.0 "Crafting the next generation of initiatives for saving Rhode Island's working farms" Report from the 2010 Charette, Rhode Island Land Trust Council - https://www.rilandtrusts.org/documents/FarmRI_2.0_Final.pdf

Solar PV Additional Resources

Rhode Island's Residential Guide to Going Solar - http://www.energy.ri.gov/documents/solar/Guide-to-Going-Solar.pdf

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