Maine's Solar Industry:

Technologies, workforce, market statistics, and Maine's position in the national solar industry

Maine's solar industry currently faces a major crossroads. In August 2013, Maine became the only state in the northeast without state incentives to support the expansion of solar energy.

This loss of funding is expected to slow the progress of a local industry that has shown significant growth at the national level. Between 2011 and 2012, the national solar industry saw an increase in installed capacity of 80%[1] and job growth of 13%[2].

This white paper summarizes the solar technologies available to homes and businesses in Maine, provides information related to the size and capacity of Maine's solar workforce, and compares Maine's solar industry to those in neighboring states.

Technologies

The solar industry is typically categorized into three sectors – solar heating, solar photovoltaics, and concentrating solar power (CSP). Since CSP technologies are not appropriate for our climate, they are not discussed in this document.

Solar Heating

Solar heating systems are often compared to energy efficiency appliances, since their purpose is to offset the energy that would be satisfied by other fuels.

Solar heating system performance is dependent upon the heating demand for a particular application. The higher the demand, the more energy a solar heating system will offset.

The solar heating sector encompasses several technologies including solar pool heating (SPH), solar water heating (SWH), and solar space heating (SSH).

Solar pool heating (SPH) has historically been the most common use of solar technology in the United States. In Maine, SPH is utilized to extend the season for outdoor swimming pools and to increase comfort in both indoor and outdoor swimming pools.

SPH systems are excluded from the Federal Investment Tax Credit (FITC) in residential and commercial applications due to their quick payback. When a SPH system is installed instead of a propane or heat pump pool heater, the payback is almost immediate. In a retrofit

[1] **U.S. Solar Market Trends 2012**, Interstate Renewable Energy Council, http://www.irecusa.org/wp-content/uploads/2013/10/Solar-Rpt_Oct2013_FINAL.pdf

[2] **National Solar Jobs Census 2012**, The Solar Foundation, http://thesolarfoundation.org/research/national-solar-jobs-census-2012

situation, the payback may be on the scale of 3-4 years. The economics of SPH systems are this favorable due to their high efficiency: SPH systems often heat water to a temperature close to the ambient outdoor temperature; furthermore, SPH systems use polypropylene collectors that cost roughly $4-5 per square foot.

California recently elected to incentivize solar pool heating in commercial, municipal, and educational applications by providing a state rebate for these systems[3]. In Maine, these applications include hotels, universities, recreational facilities, fitness centers, etc. Some of these pools require nearly $50,000 per year in fuel.

A solar pool heating system (above) utilizes polypropylene collectors to heat pool water, increasing pool comfort and extending the outdoor swimming season. Glazed solar collectors (below) are utilized in solar water heating systems and in some types of solar space heating systems.

Solar water heating (SWH) utilizes glazed collectors to heat domestic water for residences and businesses. Where SPH systems typically target end-use temperatures of 80-90 degrees F, SWH systems typically are utilized for applications ranging from 100-180 degrees F.

In Maine, SWH systems are commonly used to offset oil, propane, and electricity, due to the high cost of using these fuels to heat water.

In residential applications where daily hot water demand exceeds 50 gallons per day (a three-person household), system costs typically are between $8,000 and $12,000. The range of costs is heavily dependent upon the water heating appliance being supplemented – systems that supplant electricity for water heating are at the lower end of the scale while systems that also correct significant inefficiencies with an existing oil boiler are at the upper end of the scale. When offsetting electricity, oil, and propane, standard residential SWH systems have a payback of 9-14 years for owners who qualify for the 30% FITC. In new construction, SWH systems have an increased economic benefit due to the avoided costs of other water heating appliances.

In commercial applications, financial returns can be much higher due to economies of scale and the ability for businesses to benefit from the economic depreciation of the property.

Solar space heating (SSH) systems are utilized to assist with the space heating demands of a structure.

In some applications – commonly referred to as *combisystems* - SSH systems may be incorporated with domestic water heating. These systems commonly are used to supply heat to a low-temperature heating distribution system (such as a concrete slab with radiant tubing) that is able to maximize the contribution of the solar collection.

Other SSH applications utilize solar air heating. In these systems, air is circulated past a metal absorber that is heated by the sun. In residential applications, this involves the circulation of indoor air through a glazed collector that incorporates a painted absorber made of copper or aluminum.

[3] California Solar Incentive, http://www.cpuc.ca.gov/NR/rdonlyres/4394314B-A8A7-4AE5-9994-2C9696A52E0E/0/D1308004.pdf

In commercial, industrial, and municipal applications that require the supply of makeup air due to occupancy and operating requirements, solar air heating is particularly effective. These systems pull outdoor air in through a perforated cladding that is heated by the sun. These *transpired solar air heaters* have been installed on a number of facilities in Maine, including the Augusta Civic Center, Bangor Air National Guard, and Duratherm Corporation in Vassalboro.

Transpired solar air heaters (above) are integrated into the façade of the Augusta Civic Center to preheat makeup air for the facility. These types of systems reduce the quantity of fossil fuels requires to heat fresh air entering the building (photo courtesy of Shift Energy). The solar photovoltaic (PV) system shown below produces electricity that is used for residential electricity and a home business where it is produced. Excess electricity generated in the spring, summer, or fall is fed back to the grid and is metered to determine the credit required for the owner. PV can be installed in utility applications and sold on the wholesale market, as well.

While SSH have some limitations in Maine due to the limited availability of solar radiation during the times of year with the highest heating demands, the use of combisystems in new home construction and the incorporation of transpired solar air heating systems have financial returns that exceed their initial capital costs. Transpired air heaters are the most promising SSH system with a payback period of 3-6 years when installed on existing buildings. Faster paybacks are exhibited when incorporated in new construction.

Solar Photovoltaics (PV)

PV systems generate electricity when exposed to solar radiation. PV technology is highly scalable – the components used in utility-scale PV systems are similar or identical to those used in small residential systems.

Systems are described by their generation capacity. For example, a 1 kW system has a peak direct current (DC) potential of 1 kW. The annual production of a 1 kW PV system in Maine is roughly 1200 kWh when installed in a location with minimal shading and oriented within approximately 30 degrees of true south[4].

For reference, a 1 kW system most likely will consist of four (4) 250-watt modules that measure roughly 3'-3" x 5'-6".

The average Maine household uses 7,710 kWh per year[5]. To offset their full electrical usage, the average family would require a 6.5 kW PV system.

[4] Based upon NREL's PVWatts Performance Calculator for Grid Connected Systems, http://rredc.nrel.gov/solar/calculators/pvwatts/version1/

[5] Based upon a per capita electricity consumption of 3295kWH/yr (U.S. Energy Information Administration) and an average household size of 2.34 persons (U.S. Census Bureau)

Standard residential and light commercial PV installations consist of solar modules that are composed of silicone cells and produce DC current when exposed to solar radiation. This DC current is inverted to AC current through the use of either a single inverter or *microinverters* that are installed beneath each module.

Power generated by a PV system is first delivered to the electrical panel to which it is connected. Any excess electrical production is fed back to the grid, where it is utilized by neighboring electrical consumers. A dedicated electrical meter is installed to quantify the power that is fed to the grid. The utility determines the customer's monthly use or surplus based upon the difference between the meter than measures the electricity delivered to the customer and the meter that measures the energy the customer delivers to the grid.

Under current net metering rules in Maine, most residential and light commercial applications are sized to produce less energy than is consumed by the facility. This is due to the nuances of net billing – each month that a homeowner produces enough energy to meet their demand, 100 kWh is used to cover the minimum service charge for which they will receive no compensation. By undersizing the system, customers receive a benefit that is closer to the retail price of delivered electricity.

Based upon figures from Efficiency Maine, the average installed cost for a 3-6 kW system in Maine during 2013 is roughly $3.50 per watt. This is roughly 25% less than the national average[6]. For residential customers who qualify for a federal tax credit, this translates into a payback period of roughly 12-14 years.

The economic benefit for medium and large electricity consumers is much less attractive in Maine due to the utilization of a demand charge that greatly reduces the value of net metering.

Maine's Solar Workforce

The Solar Foundation estimates that there are 44 companies in Maine that are engaged in the installation, manufacturing, or sale of solar energy systems. These companies were estimated to employ 270 full-time workers at the end of 2012[7].

The dominant employment sector of Maine's solar industry is the installation sector. There are currently 35 companies that are registered as solar installers through Efficiency Maine[8]. These companies range from solar-specific companies to electrical, plumbing, and heating contractors that include solar as a service amidst their more traditional offerings. Many of Maine's solar installation companies are small businesses that employ 2-3 workers. One firm – ReVision Energy – employs over 40 professionals in its two Maine offices and has a dominant market share of the state's solar installation business.

Due to the seasonality of the solar construction season – weather and other factors reduce demand during the winter – many firms are engaged in complementary technologies and services to sustain themselves. Examples of work performed by Maine's solar installation companies includes: installation of energy efficient heating systems, energy engineering, seasonal installation in markets with warmer climates, energy auditing, technical training, and out-of-state consulting.

There is light representation of solar-specific manufacturers and wholesalers in Maine[9].

In addition to these solar-specific jobs, Maine's solar industry also supports jobs within Maine through the purchase of electrical and heating

[6] National Renewable Energy Laboratories' Open PV Project, https://openpv.nrel.gov

[7] The Solar Foundation's State Solar Jobs, http://thesolarfoundation.org/solarstates

[8] Efficiency Maine's Residential Vendor Locator, http://www.efficiencymaine.com/at-home/vendor-locator/

[9] The Solar Foundation's State Solar Jobs

equipment from companies that include Gilman Electric, Wesco, Coastal Winair, F.W. Webb, Bell Simons, Nelson & Small, Maine Green Building Supply, Hammond Lumber, Hancock Lumber, Fastenal, Homans, and General Insulation, among others. In addition, these companies utilize the services required of many small businesses – namely accounting, marketing, and promotional professionals.

A recent study in Colorado found that their state's solar industry – which employs 631.5 full-time workers – supported 981.5 full-time indirect and induced jobs during 2012[10]. No data are available to determine the indirect and induced job impacts of solar employment in Maine.

Maine has 22 installers who have received industry-leading national installer certification through the North American Board of Certified Energy Practitioners (NABCEP). These individuals represent 16 of Maine's solar installation firms[11].

In addition to Maine's existing solar jobs, the state also has significant capacity for solar workforce development. Kennebec Valley Community College is one of eight regional training providers for the Solar Instructor Training Network (SITN), an effort by the Department of Energy to increase the quality and accessibility of solar instruction across the United States. KVCC was initially tasked with helping community colleges, vocational high schools, universities, and trade associations across New England and New York to integrate solar heating technologies into their plumbing, heating, and/or building trades programs. Since early 2012, KVCC has been implementing a similar program that is instead focused on PV technologies. Northern Maine Community College, Eastern Maine Community College, and Southern Maine Community College have participated in SITN, as have several other trainers in Maine[12].

Market statistics

In FY2012, Efficiency Maine distributed roughly $658,000 of American Recovery and Reinvestment Act funding through the Solar & Wind Rebate Program. The projects funded through this program leveraged nearly $7,000,000 in private investment from the homeowners and businesses that utilized the program. The estimated aggregate annual energy savings resulting from the installation of these systems is roughly 10,000 MMBTU (2,930,000 kWh).

Efficiency Maine reports that 230 solar heating systems, 176 solar photovoltaic systems, and three (3) wind projects were installed in FY2012 through this program.[13]

Since Efficiency Maine is not involved in all solar projects implemented in Maine, the total production capacity of Maine's solar installations is difficult to quantify. The most recent nationally published statistics to include the size of Maine's solar heating industry were released by the Energy Information Administration for 2008 and 2009. During those two years, it is estimated that 100,000 square feet of collectors were shipped to Maine.[14]

A recent report by the Interstate Renewable Energy Council (IREC), entitled **U.S. Solar Market Trends 2012**, estimates that the cumulative capacity of installed PV capacity in Maine at 2.8 MW(dc). Of this capacity,

[10] *An Assessment of the Economic, Revenue, and Societal Impacts of Colorado's Solar Industry*, http://solarcommunities.org/wp-content/uploads/2013/10/TSF_COSEIA-Econ-Impact-Report_FINAL-VERSION.pdf

[11] NABCEP Installer Locator, http://www.nabcep.org/installer-locator?state=ME

[12] Solar Instructor Training Network, http://www.irecusa.org/workforce-education/solar-instructor-training-network/

[13] 2012 Annual Report of the Efficiency Maine Trust, http://www.efficiencymaine.com/docs/2012-Annual-Report.pdf

[14] data can be accessed at http://solarthermalworld.org/sites/gstec/files/solar.pdf

1.7MW(dc) was estimated to have been installed in 2012. For reference. There was 0.3MW(dc) of PV capacity at the end of 2009.

This growth in Maine's PV industry has been largely due to the recent drop in the price of PV modules. Since 2009, the average unit cost for PV modules has dropped by approximately two-thirds.

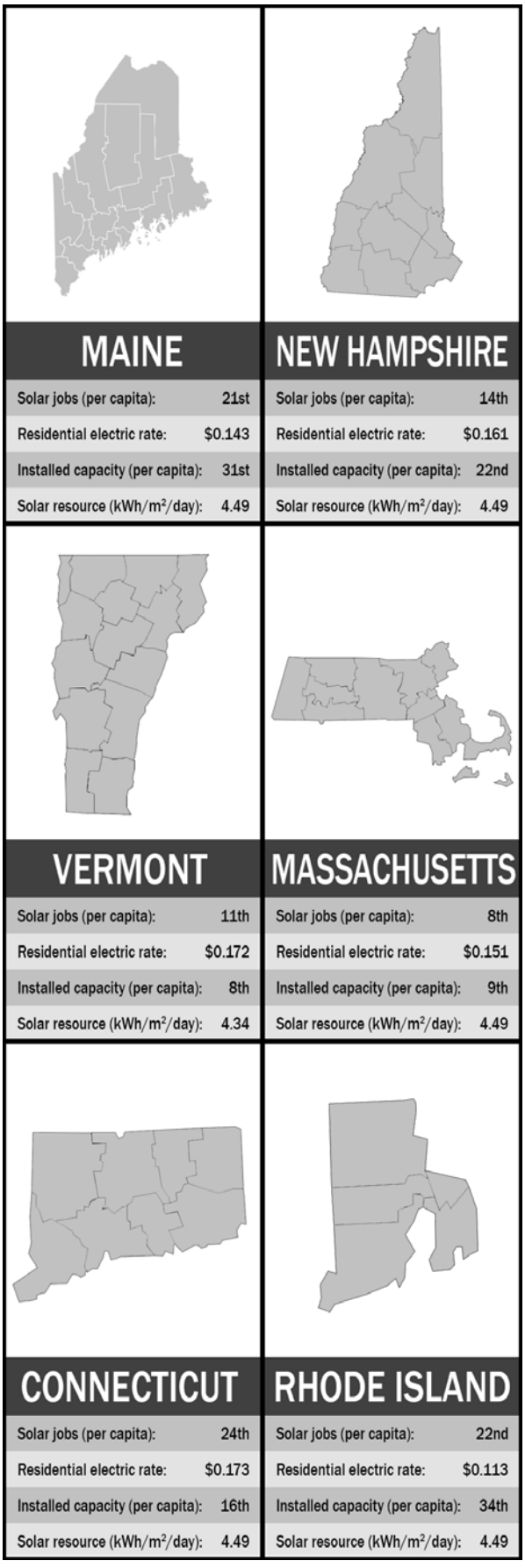
National Comparison

The northeastern U.S. has been a region of particular interest to investors due to its favorable conditions for solar implementation. The combination of high energy costs and available solar energy has led to states in the region – namely Massachusetts, New York, Vermont, and New Jersey – to become national leaders in solar implementation[15].

The energy costs and available solar radiation in Maine are comparable to the other states in the region. In some applications, Maine's potential is higher than in other northeastern states due to Maine's increased reliance upon oil and propane for heating purposes.

Compared to other states in the region, Maine's solar industry has a significant disadvantage due to the state's current solar policy. Every other state in the region has some combination of rebates, state income tax credits, state sales tax credits, or inclusion of solar in its renewable portfolio standard[16]. These policies have led to significant expansion of third-party ownership of solar energy systems, which allows homeowners and businesses to benefit from solar energy without incurring the capital costs associated with owning the system.

Since funding for the solar rebate program ended recently and installers are in the process of completing installations that will benefit from the



[15] Solar Energy Industries Association's 2012 Top Solar States, http://www.seia.org/research-resources/2012-top-10-solar-states

[16] See letter from Keyes, Fox & Wiedman to Jean Guzzetti, dated September 6, 2013.

now defunct program, no empirical data exist to quantify the impact that the loss of rebates will have on Maine's solar industry.

A questionnaire was provided to the members of the Maine Association of Building Efficiency Professionals (MABEP) Committee on Renewable Energy (CORE). CORE represents the largest trade association for Maine's solar installation companies. The questionnaire sought to obtain information related to the sale of solar energy systems since the expiration of rebate funding in August. Responses included:

- "I have refocused my marketing efforts to take advantage of the Boothbay Harbor area electric load reduction incentives, which are stimulating interest in solar electric systems."
- "Most of our company growth is likely to be in New Hampshire."
- "We have a few customers that appear to be going forward but at a very slow pace."
- "I have been investing more of my efforts in my out-of state clientele. As a result, my efforts to move my part-time employees to full-time will be suspended."
- "If history repeats itself, our solar sales will plummet. We did not want to face the great distress of layoffs again. Rather than growing we have been treading water for almost a year."

Analysis

Without the benefit of the consistent, robust incentives seen in neighboring states, Maine residents and small business owners have had limited access the third-party ownership models that have driven significant growth in Massachusetts, New York, and Vermont. As a result, the market has remained heavily dependent upon traditional ownership models that are accessible only to those with access to the capital to afford the initial investment in a system.

Even within this climate, Maine solar businesses have demonstrated some of the lowest installed costs for PV within the U.S.

With the state's heavy dependence upon expensive heating fuels – namely oil, propane, and electricity - significant opportunity exists to expand the implementation of solar technologies.

Recommendations

It is recommended by the members of CORE that the Energy, Utilities, and Technology committee recommend legislation that will:

(1) Require the Maine Public Utilities Commission to conduct a study that examines the value of solar heating and PV for Maine residents and businesses. In addition to the economic and workforce benefits mentioned in this document, solar energy also has benefits related to stabilizing energy costs, increasing grid capacity, reducing line losses, alleviating costs associated with transmission and distribution, and reduction of greenhouse gas emissions. IREC recently published a resource entitled **A Regulator's Guidebook: Calculating the Benefits and Costs of Distributed Solar Generation**[17] that provides a standardized approach for analyzing the costs and benefits of solar energy for the purposes of guiding public policy. Maine should join twelve other states that are currently going through this process[18].

(2) Provide interim funding for the solar rebate program until the results of the PUC study are integrated into Maine's energy policy. Extension of this funding is critical for maintaining the momentum seen in Maine's solar industry and supporting the long-term implementation of solar technology in Maine. Without this funding, consolidation is

[17] available for download at http://www.irecusa.org/wp-content/uploads/2013/10/IREC_Rabago_Regulators-Guidebook-to-Assessing-Benefits-and-Costs-of-DSG.pdf

[18] See http://twitpic.com/dhghzq

expected to be seen in the industry. This consolidation will decrease competition and affect the solar industry's ability to respond to demand due to increased energy costs and/or the implementation of future state incentives.

(3) Direct the PUC to suspend consideration of any rate changes or requests by the state's investor-owned utilities to implement standby charges for net-metered solar systems until the legislature has reviewed and considered the PUC's study on the value of solar for Maine.

For more information

For more information related to Maine's solar industry, please contact Vaughan Woodruff, Chairperson of the Committee on Renewable Energy (CORE) for the Maine Association of Building Efficiency Professionals (MABEP). Vaughan can be reached at (207) 659-1054 or at vwoodruff@insourcerenewables.com.