New England Solar Cost-Reduction Partnership

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Accomplishments, Lessons Learned, and Recommendations
Abstract

In 2013, five New England states — Connecticut, Massachusetts, New Hampshire, Rhode Island, and Vermont, with support and coordination from Clean Energy States Alliance (CESA), — forged the New England Solar Cost-Reduction Partnership to help drive down regional solar soft costs and enable scaled deployment of rooftop solar. Over the past three years, the Partnership tackled a wide range of "soft cost" barriers to PV deployment, including: difficult, costly, and slow permitting and interconnection processes in some locations; the need for new financing tools and cost-efficient group purchasing arrangements; and unfavorable zoning rules for solar in some jurisdictions. This report offers the public insights about project accomplishments, successes, lessons learned, and recommendations for future actions.
This report was prepared by the Clean Energy States Alliance (CESA) through the New England Solar Cost-Reduction Partnership, a project under the U.S. Department of Energy SunShot Initiative Rooftop Solar Challenge II program. Over the last three years, the New England Solar Cost-Reduction Partnership has worked to build the regional solar market by targeting non-hardware “soft” costs for photovoltaic (PV) electricity systems across Connecticut, Massachusetts, New Hampshire, Rhode Island, and Vermont.

The U.S. Department of Energy SunShot Initiative is a collaborative national effort that aggressively drives innovation to make solar energy fully cost-competitive with traditional energy sources before the end of the decade. Through SunShot, the Energy Department supports efforts by private companies, universities, and national energy laboratories to drive down the cost of solar electricity to $0.06 per kilowatt-hour. Learn more at energy.gov/sunshot.
Contents

Project Background .................................................................................................................................................. 6

Accomplishments .................................................................................................................................................. 7
  Community-Shared Solar ................................................................................................................................. 7
  Consumer Education ....................................................................................................................................... 8
  E-Permitting .................................................................................................................................................... 9
  Financing ....................................................................................................................................................... 10
  Fire Safety .................................................................................................................................................... 10
  Installer Licensing ......................................................................................................................................... 11
  Interconnection ............................................................................................................................................... 11
  Permitting .................................................................................................................................................... 12
  Solar Contractor Training ............................................................................................................................... 13
  Solar Scorecards .......................................................................................................................................... 14
  Solarize ......................................................................................................................................................... 14
  Structural Review ......................................................................................................................................... 15
  Zoning ........................................................................................................................................................... 16

Results and Cost-Savings ................................................................................................................................... 17
  Decline in Installation Costs ........................................................................................................................... 17
  Cost Decline and the New England Solar Cost Reduction Partnership ...................................................... 18

Lessons Learned and Recommendations ....................................................................................................... 21
  The Value of Sharing Information among States .......................................................................................... 21
  The Value of Leveraging Efforts among States ............................................................................................. 21
  The Importance of Relationship Building with Stakeholders ..................................................................... 21
  State-Driven Work Can Stimulate Independent Efforts .............................................................................. 22
  Solarize Continues to Be a Successful Cost-Reduction Strategy ................................................................ 22
  Not All Successful Strategies Can Cross State Lines .................................................................................. 22
Municipalities’ Authority Can Make Statewide Change Complicated .................................................. 23
Online Permitting Is Desirable but Was Difficult to Achieve ................................................................. 23
New Needs and Opportunities Emerged .................................................................................................. 24

Publications & Resources ......................................................................................................................... 25

Connecticut .................................................................................................................................................. 25
Massachusetts ............................................................................................................................................... 25
New Hampshire .......................................................................................................................................... 27
Rhode Island ................................................................................................................................................ 28
Vermont ....................................................................................................................................................... 28
Clean Energy States Alliance (CESA) ......................................................................................................... 28
Partnership Webpage .................................................................................................................................. 29
Project Background

In 2013, Connecticut, Massachusetts, New Hampshire, Rhode Island, and Vermont, with project coordination provided by the Clean Energy States Alliance (CESA), were awarded funding from the U.S. Department of Energy to help drive down regional solar soft costs. The New England Solar Cost-Reduction Partnership (Partnership), a three-year effort, was launched in September 2013. The state and quasi-state entities that participated actively in the Partnership were:

- Connecticut Green Bank
- Massachusetts Department of Energy Resources
- Massachusetts Clean Energy Center
- New Hampshire Office of Energy and Planning
- Rhode Island Office of Energy Resources
- Rhode Island Commerce Corporation
- Vermont Public Service Department

At the outset of the project, the Partnership collected and collated information to better understand the regional solar market. It surveyed participating states’ solar policies and programs and analyzed solar installation cost data to help ascertain regional solar pre-project cost baselines. The Partnership also held a meeting for regional solar industry representatives to provide information about the project and to gather ideas for actions to reduce solar soft costs.

Over the last three years, the Partnership has reduced solar soft costs by pursuing four broad objectives:

1. Increase coordination among participating states and with key stakeholders in those states.
2. Refine, combine, and deploy innovative tools and practices from Connecticut and Massachusetts Rooftop Solar Challenge I projects, and from other earlier efforts in those states and Vermont.
3. Implement other best practices more widely across the region, with a particular focus on achieving more consistent policies and practices across state lines.

The Partnership concluded its project in September 2016. This report provides information about project accomplishments, lessons learned, and recommendations for future actions.
Accomplishments

The New England Solar Cost-Reduction Partnership achieved significant soft-cost reduction successes. The accomplishments are described below under key project focus areas.

Community-Shared Solar
Because community-shared solar can be sized to create cost efficiencies and is accessible to electric customers who are renters or who have inadequate solar access at their homes, it presents a powerful tool to take advantage of economies of scale and reduce customer acquisitions costs. Massachusetts, New Hampshire, and Vermont had established community-shared solar programs in place in 2013. In 2015, the Connecticut Legislature created a shared renewables pilot program. In 2016, Rhode Island enacted legislation making net metering available for third-party owned PV systems and allowing for community remote net metering for the residential and the low- and moderate-income sectors.

The Partnership took important steps to make community-shared solar more accessible. Massachusetts worked with three of its municipalities on community shared solar-related projects:

- The City of Boston conducted a feasibility study for community-shared solar on its public buildings.
- The City of Cambridge, with oversight from CESA and the Massachusetts Department of Energy Resources, published a Solar Guide for Condominium Owners and Associations in Massachusetts. The guide discusses certain legal aspects of condominiums, explains how a solar project fits into an association’s decision making process, and provides information about the ownership models for solar projects at condominiums in Massachusetts.
- The Town of Winchester conducted a feasibility analysis for a prospective community-shared solar project to be sited on a building owned by a local, non-profit organization.

In February 2015, the Massachusetts Department of Energy Resources conducted a webinar on the Commonwealth’s role in supporting community-shared solar programs. The webinar highlighted various ownership models for community-shared solar projects in Massachusetts.

Vermont offered a Community Solar Loan Program, which provided financing to help low-income Vermonters buy an ownership interest in community solar projects. The interest-rate buy down program was administered through VSECU, a Vermont credit union, and specifically targeted community solar interests, offering unsecured or secured loans of up to $40,000, with
terms up to 15 years. The Vermont Public Service Department shared a model group net-metering contract with other participating states for use as a template.

CESA, in collaboration with stakeholders in Massachusetts and Vermont and with attorneys from the law firm of Foley Hoag, arranged for the submission of a private letter ruling request to the IRS to obtain guidance on the circumstances in which community-shared solar panel owners are eligible for the residential income tax credit under Section 25D of the U.S. Tax Code. The IRS issued a favorable private letter ruling in 2015 concluding that a particular owner of PV panels in an offsite, community-shared solar array is eligible for the Section 25D credit. CESA packaged and publicized the IRS private letter ruling and hosted a webinar discussing the ruling and its implications.

**Consumer Education**

Providing consumers with sound information about PV helps ensure a robust, competitive, and fair marketplace for solar over the long term. Toward this end, participating states engaged in various consumer outreach activities under Rooftop Solar Challenge II.

In 2016, Connecticut Green Bank launched a revamped [www.gosolarct.com](http://www.gosolarct.com) website, which provides Connecticut residents with information they need to make informed decisions about solar energy for their home. The website offers consumers information and resources to become educated solar shoppers. In 2015, Connecticut Green Bank developed and produced a consumer-focused “From Paperwork to Panels” video that guides homeowners through the residential solar installation process. The video is featured on the [gosolarct.com](http://gosolarct.com) website and has also been edited into shorter segments for promotion on social media platforms.

The New Hampshire Office of Energy and Planning, in conjunction with Lakes Region Community College, conducted three introductory solar PV trainings for New Hampshire residents. About 185 people attended these two-hour training sessions.

The Vermont Public Service Department published *A Vermonter’s Guide to Residential Solar*, a comprehensive handbook to inform Vermont consumers about residential solar PV and help them decide whether it makes sense for them to go solar and, if so, how.

CESA published a guide, *A Homeowner’s Guide to Solar Financing: Leases, Loans and PPAs*, to help homeowners navigate the complex landscape of residential solar PV system financing. The guide describes three popular residential solar financing choices – leases, loans, and power purchase agreements (PPAs) – and explains the advantages and disadvantages of each, as well as how they compare to a direct cash purchase. To make the guide serviceable to a broader audience, CESA translated and published the guide into Spanish. Massachusetts, New Mexico, and New York all built on CESA’s guide to publish state-specific versions of the guide for
homeowners who want to learn more about solar financing in their respective states. Vermont used CESA’s guide in developing *A Vermonter’s Guide to Residential Solar*. Connecticut provides a link to CESA’s guide on its www.gosolarct.com website.

**E-Permitting**

Transitioning to online solar permitting can increase permitting efficiency and transparency, saving time and money for building departments, installers, and residents alike.

**Twenty-four municipalities in Connecticut** have adopted online solar permitting. Some of these municipalities offer online permitting specifically for solar PV as a project type in their application portal, while others allow for submission of a solar PV application under their building or electrical application function. Many of the Connecticut municipalities that offer online permitting are also eligible to participate in a solar group purchasing program hosted by the Capitol Region Council of Governments. In spite of this progress, online solar permitting proved to be a difficult area due to product function limitations, costs, and integration challenges. These difficulties led Connecticut Green Bank to explore other permitting solutions, including remote submission of solar permit applications via email and web-based portals. As a result, an additional 19 Connecticut municipalities have adopted electronic submission of permit applications.

Massachusetts ran into many of the same e-permitting challenges that Connecticut did, but was nevertheless also able to make progress. Many Massachusetts municipalities now offer online permitting, including the City of Boston and Northampton. Through the Berkshire Regional Planning Commission, numerous municipalities in Berkshire County have adopted online permitting. The City of Pittsfield’s 2015 transition to online permitting was highlighted in a Massachusetts solar permitting case study, published by the Massachusetts Department of Energy Resources. In December 2015, Massachusetts Department of Energy Resources conducted a webinar on online permitting for Massachusetts municipalities.

The New England Solar Cost-Reduction Partnership supported Rhode Island’s ongoing transition to online permitting for a number of municipalities. Rhode Island worked with a vendor to pilot online permitting in three municipalities. Six additional Rhode Island municipalities are transitioning to online permitting and are expected to have e-permitting functionality by the end of 2016. In early 2017, three more Rhode Island cities, including Providence, are expected to transition to online permitting. By March 2017, most of Rhode Island’s population will be served by online permitting. At the state level, Rhode Island has implemented e-permitting for the state’s Fire Marshall’s Office and Building Code Commission Office. All state-owned facility applications that require a permit from either office now use an online permitting platform.
Financing

While solar costs have decreased considerably over the last decade, many customers still need long-term, low-cost financing to make installing a PV system affordable. Participating states explored solar-friendly financing arrangements to encourage solar deployment by reducing the financial barrier of up-front installation costs.

Through Rooftop Solar Challenge I, Connecticut Green Bank made substantial progress in developing innovative financing programs, including the Connecticut Solar Loan, the Connecticut Solar Lease II, and a commercial Property Assessed Clean Energy (PACE) program. All solar installers eligible for Connecticut’s Residential Solar Investment Program may offer Connecticut Green Bank’s financing products. Under Rooftop Solar Challenge II, Connecticut Green Bank trained over 90 solar installers on Connecticut’s Residential Solar Investment Program. Since the start of Rooftop Solar Challenge II, over 350 applications for solar PV installations were approved and completed under Connecticut Green Bank’s Smart-E Loan Program and four new lenders were added.

Drawing on Connecticut’s success, Massachusetts developed and launched the Mass Solar Loan Program. Mass Solar Loan connects potential Massachusetts solar customers with low-interest financing. The program uses funds in three ways: an interest rate buy-down to make a three percent interest rate cap possible; a loan-loss reserve to encourage lenders to loan to those without top credit scores; and a low-income component to buy down the loan principal for low-income borrowers. To date, over 960 loans have been completed under the program, collectively totaling over $32 million loaned. Building on CESA’s residential financing guide, Massachusetts published A Massachusetts Homeowner’s Guide to Solar Leases, Loans, and PPAs.

As noted above, Vermont offered a Community Solar Loan Program to help low-income Vermonters buy an ownership interest in community solar projects. Twenty loans were made under the program collectively totaling almost $340,000 in solar investment.

Fire Safety

Rooftop solar PV systems present special considerations for firefighters. If firefighters understand how to deal with fires on building equipped with PV systems, municipalities will be more likely to support and encourage continued solar development. The Partnership developed resources and training to educate firefighters in the region on PV fire safety.

In 2015, the Connecticut Green Bank partnered with the Connecticut Fire Academy to develop a solar PV and fire safety training for fire service personnel. Between 2015 and 2016, the
Connecticut Fire Academy held 16 trainings in Connecticut that reached over 750 fire officials. Building on Connecticut’s fire safety work, the Partnership produced a Solar PV Fire Safety Training Module. The module, designed as a three-hour instructional slideshow for firefighters, formed the basis for the PV fire safety trainings conducted throughout the New England region. In addition to Connecticut’s trainings, the Partnership conducted a total of seven PV fire safety trainings across the other four states. The PV Fire safety training conducted at the Vermont Fire Academy PV was designed as an in-depth “train the trainers” workshop for Vermont fire safety instructors, who in turn delivered training on this topic to local fire departments across the state.

Installer Licensing

In 2014, Rhode Island implemented a statewide Renewable Energy Professional Licensing program designed to remove electrical licensing barriers for solar installers. The Rhode Island Commerce Corporation and the Office of Energy Resources created licensing resources for new installers in the state. Installers seeking Renewable Energy Professional licensure now have a clearly prescribed process for receiving certification.

Interconnection

Each participating state worked with its utilities to identify specific steps the utilities could take to improve interconnection processes.

Connecticut’s major utilities, Connecticut Light & Power (now part of EverSource) and the United Illuminating Company (now part of Avangrid), proposed revisions to Connecticut’s distributed generation interconnection guidelines. Connecticut Green Bank encouraged Eversource and the United Illuminating Company to consider improvements to the guidelines that will keep interconnection fees and requirements reasonable for residential solar PV adopters. In September 2016 the utilities jointly submitted revised interconnection guidelines to the CT Public Utilities Regulatory Authority. The proposed guidelines expand the cap for the certified inverter interconnection process from 10kW to 20kW and include more flexible technical screens for small generators.

Two major Massachusetts electric utilities, National Grid and Northeast Utilities (now part of EverSource), participated in the Massachusetts Distributed Generation Working Group. The Massachusetts Distributed Generation Working Group offered recommendations to amend the Uniform Standards for Interconnecting Distributed Generation to help ease interconnection issues and to better support smooth grid operations in the state.
As part of the Partnership, New Hampshire developed an online Simplified Guide to Utility Interconnection Requirements, and Rhode Island’s electric utility, National Grid, held trainings on its interconnection tariff at Rhode Island Commerce Corporation. Vermont successfully worked with the state’s largest electric utility, Green Mountain Power, to eliminate the homeowner insurance requirement from its net metering rules. The new version of Vermont’s net-metering rule also eliminates the utility-accessible external disconnect requirement.

Permitting
Difficult, costly, or slow PV permitting presents a barrier to the widespread deployment of solar. Municipalities in Connecticut, Massachusetts, New Hampshire, and Rhode Island are responsible for permitting new solar systems. These states produced PV permitting guides and other advisory support to help municipalities simplify and streamline their residential solar permitting processes.


Over the course of the project, Connecticut Green Bank staff met with and provided individual consultation on solar permitting to nearly half of Connecticut’s municipalities. In addition, Connecticut held ten in-person trainings for building and code officials on solar PV in 2014 and 2015; over 400 people attended at least one of these trainings. In Connecticut, 82 percent of building departments now have all of their staff trained on solar PV; an additional 7 percent have at least half of their staff trained on solar PV. Over half of Connecticut municipalities have a solar PV permit package with comprehensive instructions for all required documentation, department approvals, and submission and inspection processes.

Under Rooftop Solar Challenge I, Massachusetts released a Recommended Model Permitting Processes document, which the state updated under the Partnership. In 2014, Massachusetts held six solar PV permitting trainings across the state and one webinar on the topic to further its solar permitting outreach efforts. Massachusetts also produced three permitting and safety webinars. The permitting and safety webinar series covered 1) Considerations for Aging Solar PV System Components, 2) Solar PV Inspection Techniques for Municipal Inspectors, and 3) Labeling Requirements for Solar PV Systems. Massachusetts published a series of case studies highlighting four municipalities—Boston, Northampton, Pittsfield, and Wellfleet—that have
made strides in streamlining their solar permitting processes. In 2016, Massachusetts conducted a webinar on the case studies to demonstrate how municipalities can save time and money by improving their solar PV permitting processes.

New Hampshire compiled information about permitting practices through a survey of municipalities and two stakeholder outreach meetings. Using this information, New Hampshire published a municipal map of solar permitting and ordinances and a municipal map of solar property tax exemptions for the state. It also developed and published a New Hampshire Residential Rooftop Solar PV Permitting, Zoning and Interconnection Guide. The guide covers current laws, recommendations, and information about interconnection and offers a suite of tools including permitting checklists, sample permitting applications, and simplified interconnection requirements. As part of its outreach effort, the New Hampshire Office of Energy and Planning presented its guide at a meeting of municipal building code officers, at a statewide gathering of local energy committees, and at a 2016 conference for planning staff and volunteer planning board members. The New Hampshire Office of Energy and Planning also worked with Lakes Region Community College to develop, advertise, and facilitate three introductory solar PV trainings for New Hampshire municipal officials, about 90 of whom attended these two-hour training sessions.

Rhode Island conducted two trainings for Rhode Island building and electrical officials on common PV system inspection issues.

In Vermont, most net-metered solar permitting happens through the Vermont Public Service Board, a single centralized entity. However, the City of Burlington has its own solar permitting system, which requires a zoning permit for PV installations as well as safety and zoning inspections. The Vermont Public Service Department worked with the City of Burlington’s Community and Economic Development Office to identify ways to streamline the city’s PV permitting process to reduce application costs and permitting times for residential installations.


**Solar Contractor Training**
Solar contractors play an important role in solar cost reduction efforts. Training contractors on ways to improve their own internal processes can help reduce their overhead costs. Moreover,
facilitating communication between state solar program administrators and the solar industry can smooth programmatic implementation.

At the outset of the project, the Partnership held a regional meeting for solar industry representatives to provide project information and to gather suggestions on areas to focus our efforts on. At the meeting, solar industry representatives noted a desire for more dialogue between building officials and solar contractors and for greater clarity on the eligibility of community solar panel owners for the Section 25D residential income tax credit. As a result, both of those topics became important focus areas for the Partnership during the project.

The Rhode Island Office of Energy Resource and the Rhode Island Commerce Corporation convened regular solar stakeholder meetings with solar contractors. Over the course of the project, they held eight of these meetings, which provided a venue to discuss the state’s solar programs and to generate ideas for achieving greater solar cost reductions.

The Vermont Public Service Department worked with a consultant to deliver training to solar and efficiency contractors on a program that combines PV installations with efficiency upgrades to maximize energy investment. The program simplifies the contracting process for energy improvements and guarantees savings for eligible customers.

**Solar Scorecards**

To encourage municipalities to take actions to become more solar friendly, Connecticut Green Bank contracted with the Yale Environmental Performance Index to create a statewide solar scoring system for municipalities. The Connecticut Solar Scorecards, published in 2016, established an index and ranking system for municipal solar permit processes and other solar initiatives for all 169 Connecticut municipalities. A webinar on the Connecticut municipal solar scorecards was conducted in July 2016.

**Solarize**

Solarize is a group purchasing program for solar PV systems that lowers acquisition costs for residential systems. As more homeowners join the group purchasing program, their cost goes down, because of a tiered-pricing plan with reduced prices for more participation. Both Connecticut and Massachusetts established robust Solarize programs under Rooftop Solar Challenge I. Both states’ Solarize programs continued under Rooftop Solar Challenge II and have proven to be highly successful in increasing the rate of residential PV adoption by expanding the solar PV customer base, speeding up solar deployment, and driving down installation prices for consumers.
Connecticut Green Bank ran 39 Solarize campaigns during the Partnership. Fifty municipalities participated in these campaigns, resulting in over 2,000 solar installations and 16 MW of contracted capacity. Several variations of the classic Solarize model were tested, including Solarize Choice (three installers versus one installer); Solarize Express (a 10-week campaign versus a 20-week campaign); Solarize Select (randomly selected municipalities rather than by application); Solarize Prime (customers received a single discounted price rather than tiered pricing levels); Solarize Online (customers used EnergySage’s online platform with a choice of installers who were allowed to bid on projects at their discretion); and Solarize U (an online campaign that ran at six universities). Solarize Connecticut’s success propelled Connecticut Green Bank to transition program operation to the private sector in 2015. A Solarize Connecticut successor program, Solarize E-Z, is run by the national non-profit marketing organization SmartPower without financial support from Connecticut Green Bank.

The Massachusetts Clean Energy Center ran 13 Solarize Mass campaigns during the Partnership. Twenty municipalities participated, resulting in 1,187 solar installations and nearly 8 MW of contracted capacity. In 2015, the Massachusetts Clean Energy Center partnered with the non-profit Massachusetts Energy Consumers Alliance to launch Mass Solar Connect, a solar group-purchasing program for Massachusetts Energy Consumers Alliance members. Mass Solar Connect resulted in 261 solar installations and nearly 2 MW of contracted capacity.

In an effort to mirror Connecticut and Massachusetts’ Solarize success, Rhode Island launched a Solarize program in three Rhode Island municipalities in 2015. To date, 13 Rhode Island municipalities have participated in the program, resulting in over 400 solar installations.

CESA published a Solarize Guide entitled Planning and Implementing a Solarize Initiative: A Guide for State Program Managers. This guide features detailed case studies from Solarize Connecticut and Solarize Mass to help state program managers across the country develop Solarize programs. A draft of the guide was used by Rhode Island as it was developing the Solarize Rhode Island program. In 2014, CESA hosted a webinar highlighting Connecticut’s Solarize success.

Structural Review
Several of the participating states took steps to make structural review guidance for small residential installations available to municipalities to limit the instances where a full professional engineer’s review is required.

With funding provided under Rooftop Solar Challenge I, Massachusetts consulted with an engineering firm to create a prescriptive process for structural approval of small PV systems when certain structural criteria have been met. With Rooftop Solar Challenge II funding, and
assistance from the engineering firm of Simpson Gumpertz & Heger, Connecticut released its own structural review worksheet to evaluate the integrity of a roof’s framing for a proposed PV system. In 2014, Connecticut presented a webinar on its structural review worksheet.

As a component of New Hampshire’s solar permitting and zoning guide, New Hampshire produced a Residential Solar PV Structural Review Worksheet to help building owners and installers determine whether they will need an engineer to assess a building’s structural soundness for a rooftop PV installation.

**Zoning**

Connecticut included a model zoning ordinance and general zoning guidance in its Connecticut Rooftop Solar PV Permitting Guide. Connecticut also integrated solar-friendly zoning into its Clean Energy Community program so that Connecticut municipalities may receive Clean Energy Community points for amending their zoning regulations to make them more friendly towards solar PV. Thirty-two Connecticut municipalities now have zoning regulation exemptions for solar PV.

Massachusetts developed a model solar zoning bylaw and policy guidance. Massachusetts also conducted a webinar on its model solar zoning bylaw to introduce the bylaw to the state’s municipalities.

New Hampshire included model zoning considerations for municipalities in the Residential Rooftop Solar PV Permitting, Zoning and Interconnection Guide that it published. New Hampshire Office of Energy and Planning staff worked with the Town of Holderness in drafting proposed amendments to its zoning ordinance. This process generated a model zoning document that can be used as an example for other New Hampshire municipalities that want to streamline their solar permitting and zoning processes.

Using the model solar zoning documents developed by Connecticut and Massachusetts as guides, Rhode Island provided feedback on the City of Providence’s proposed zoning ordinance to make Providence’s zoning update significantly more friendly towards PV.
Results and Cost-Savings

Installed costs of residential solar systems in the New England region have declined considerably during the period covered by the Rooftop Solar Challenge II award, and a significant portion of the decline was probably in soft costs. While it is difficult to precisely quantify how much of the decrease was due to the work of the Partnership, project activities likely meaningfully contributed to the decrease in soft costs and will likely have further cost-reduction effects that have not been captured in our data.

Decline in Installation Costs

Data the Partnership collected over the course of our project shows reductions in installation costs for residential solar. In Connecticut, median installed cost fell from $4.35/W to $3.45/W from 2013 to 2016. In Massachusetts, median cost fell from $4.66/W to $3.83/W over the same period. Data from New Hampshire showed the state’s median installed cost rising slightly from $3.65/W to $3.72/W. In Rhode Island, median cost fell from $4.46/W to $3.90/W.1 Vermont’s median installed cost in 2013 was $4.72. Because Vermont ceased collecting residential solar cost information, the Partnership was not able to derive a 2016 median residential solar installation cost for Vermont. However, a 2016 Vermont solar cost study produced for the Vermont Public Service Department through the Partnership modeled a $3.55/W system cost for a typical 10kW rooftop system in Vermont.2

The installation cost lines the Partnership derived are consistent with state-by-state data presented in Lawrence Berkeley National Laboratory’s report, Tracking the Sun, which shows that the median cost of a solar installation, averaged across the five participating states, declined from $4.98/W in 2012 to $3.98/W in 2015. Variation in installed costs between those reported in Tracking the Sun and those the Partnership derived are likely due to differences in the data used. While both data sets came from information provided through state incentive programs or solar renewable energy credit registration systems, the precise timeframes differed, as did our methods of standardizing and cleaning up the data. For example, consistent with data practices employed in Tracking the Sun, the Partnership attempted to remove from state data samples all installations that were performed by integrated third-party owners and that involved no actual sale, but methods for inferring integrated third-party ownership may have varied.

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1 Results from different states may not be strictly comparable due to variations in the state data sets.
2 The approach used in the Vermont Solar Cost Study was a “bottom-up” cost model adjusted to cost data for roof-mounted systems between 9 kW and 11 kW installed in Vermont from September 2014 to August 2015.
Solar cost reductions in the New England region mirror national cost reductions. According to *Tracking the Sun*, median solar installation costs nationwide for small residential projects declined from $5.30/W in 2012 to $4.10/W in 2015.³ Preliminary data shows that installation costs in 2016 have continued to decline, and were $0.40/W lower in the first half of 2016 than in the first half of 2015.⁴

Solar installation costs include module costs, non-module hardware costs, and soft costs. National data used in *Tracking the Sun* shows that module costs have been fairly stable since 2012, and that, while there has been some decrease in non-module hardware costs, a significant portion of total cost reductions are due to reductions in soft costs. According to *Tracking the Sun*, “Reductions in inverter and racking equipment costs constitute roughly 20 percent of the drop in non-module costs for residential systems in recent years. Much of the remainder can be attributed to reductions in the aggregate set of “soft” costs, which have fallen partly as a result of increases in system size and module efficiency, though also because of a broader array of efforts within the industry and among policymakers to target soft costs.”⁵ While this is describing national trends, it may be reasonable to assume that hardware cost reductions are relatively consistent across the nation, and therefore that the same percentage of cost reductions is attributable to soft costs in the five-state region as nationwide.

**Cost Decline and the New England Solar Cost Reduction Partnership**

For many reasons, it is difficult to precisely calculate the cost reductions resulting from the project. These reasons include:

- Many of the processes addressed in the project are linked to the cost of installing solar, but in ways that are indirect and difficult to quantify. The Rhode Island simplified licensing program is a good example of a case where it is hard to measure and quantify cost reductions. How many installers have been (and will be) licensed under the new system who would not have been licensed under the old system? How does an increase in the number of installers affect competition in the Rhode Island solar industry, and how does that affect the average price of residential solar systems? Answering these questions with any level of precision would require research far beyond the scope of this report.

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³ Until the 2014 *Tracking the Sun* report (covering the year 2013), all projects were categorized by size, and the relevant category was residential and commercial projects under 10 kW. Starting with the 2015 report (covering the year 2014), residential projects were categorized separately.

⁴ This figure excludes California, which otherwise dominates the data and has high installation costs.

⁵ *Tracking the Sun*, p.2.
• Cost savings from our project include savings that are not captured in a residential $/W metric. For example, financing programs may lower costs for consumers without lowering the system cost in $/W. A low-interest loan program can reduce the total amount paid by consumers over the life of the loan without affecting installation cost. Another example of cost saving that are not reflected in the residential $/W metric are the savings that can come with community solar. Community solar arrays are often counted as commercial, rather than residential, projects even when all of the participants they serve are residential customers.

• Some project activities may have delayed effects. Many of the project activities involved developing written resources, whether a consumer guide, a solar zoning guide for municipalities, or a guide to solar on condominiums. The impact of these resources are likely to be long term. In the case of the solar zoning guide for municipalities, its effects will increase every time a municipality adopts the recommendations of the guide.

• Some project activities have not had sufficient time to have a demonstrable impact yet. Guides and other resources were produced up to the end of the grant period. Solar cost reductions associated with some of these resources have not been felt yet.

Nevertheless, we believe significant cost reductions occurred as a result of the project. Our reasons for this include:

• **Our metrics show improvements.** The National Renewable Energy Laboratory’s Solar Metrics (SM3) program scored 13 municipalities in the five-state region in 2011, 2013, and 2016 on a range of factors aimed at assessing the ease of installing solar in those places. Between 2013 and 2016, the scores of every one of the 13 tracked cities and towns improved, from an average of 532 to an average of 701. This increase reflects improvements in areas including permitting, interconnection, and zoning. Some of the improvements reflected in the SM3 score, such as improvements in the permitting process in Burlington, Vermont, were in municipalities and processes specifically addressed by the New England Solar Cost Reduction Partnership. We also have specific cost-reduction data for some project activities. For example, Solarize campaigns were undertaken in each of the five states; in some cases, led by participating agencies and in other cases by unaffiliated organizations. In Massachusetts, where Solarize efforts were led by the Massachusetts Clean Energy Center, two rounds of Solarize, in 2013 and in 2015, led to cost savings of 19% and 21%, respectively, compared to costs immediately before the Solarize campaigns in the same communities.
• **Empirical evidence.** The Partnership engaged a wide variety of solar stakeholders to identify inefficiencies and propose solutions. We have confidence in our processes for identifying problems that needed to be fixed, and in our stakeholder participation process and have received positive feedback from those we have engaged.

• **Logical extrapolation.** Community solar reduces costs through economies of scale and through improved siting. Consumer education reduces customer acquisition costs by preparing consumers to have well-informed discussions with solar companies, at the same time that it makes consumers less likely to sign up for inappropriately expensive solar systems. Improvements in permitting, zoning, and interconnection have the potential to reduce costs by reducing fees and simplifying processes. Financing options, such as low-interest loans, reduce long-term costs for consumers. Simplified installer licensing reduces costs by increasing competition. Solarize programs reduce costs by reducing customer acquisition costs and by creating competition among installers.

• **Broader national trends.** As described in the *Tracking the Sun* report, there is an ongoing nationwide decline in soft costs. Many of these soft costs, such as permitting and interconnection costs, can only be addressed at a regional or even local level. A nationwide decline in soft costs indicates that regional and local efforts are having some success. The corresponding decline in soft costs within Partnership states indicates that efforts like ours are having an impact.
Lessons Learned and Recommendations

The Value of Sharing Information among States
Through the Partnership, strong relationships were established among the five participating states, CESA, and the U.S. Department of Energy. CESA regularly conducted monthly conference calls and maintained a project email list of state partners for information sharing. Participating states regularly reached out to CESA and each other for input, ideas, and resources related to their solar programs. By coordinating and sharing information, participating states were able to develop their own materials more quickly and economically. For example, Rhode Island used Connecticut and Massachusetts’ materials on solar zoning to advise its towns in developing and adopting more solar friendly zoning ordinances. New Hampshire was able to capitalize on Connecticut and Massachusetts’ work in developing its state’s rooftop PV permitting, zoning, and interconnection guide.

The Value of Leveraging Efforts among States
Participating states were able to develop project materials at a lower cost by working together and leveraging their resources. For instance, by having CESA contract with a single engineering firm to work on structural review guidance for multiple participating states, the Partnership saved states’ time and money in contracting and structural review analysis. Even though the states ultimately had unique considerations demanding state-specific outputs, they did not have to individually go out to bid and the selected engineering firm did not have start its analysis from scratch. Similarly, by hiring fire safety instructors to conduct trainings across the region, the Partnership was able to provide high-quality, economical trainings with greater regional consistency across the states.

The Importance of Relationship Building with Stakeholders
One of the key takeaways from this project has been the importance of relationship building with stakeholders. Participating states worked to create open lines of communication with industry groups and other stakeholders. It was helpful to publish resource materials, but individual outreach and consultation were often necessary to make meaningful soft-cost impacts, particularly when it came to working with municipalities to make their zoning and permitting processes more solar friendly. Conducting in-person trainings at the local level proved to be an important element of the project for all participating states: Connecticut and Massachusetts held in-person trainings for building officials; New Hampshire held in-person trainings for solar consumer and municipal officials; Rhode Island convened regular solar stakeholder meetings; and Vermont conducted training for solar and efficiency contractors.
State-Driven Work Can Stimulate Independent Efforts

In some cases, state-driven work spurred valuable independent efforts. For example, in the wake of the success of Solarize Mass, several municipalities in Massachusetts launched their own Solarize-like PV group purchasing programs. New Hampshire also had independent “Solarize” initiatives launch during the project—one led by Vital Communities, a local nonprofit organization, and the other led by the Southern New Hampshire Planning Commission. Another example where the Partnership’s work stimulated local efforts of the same kind occurred after the Connecticut Green Bank worked with the Connecticut Fire Academy to develop materials on PV fire safety for firefighters. Once these training materials were refined, many local fire departments in Connecticut commissioned their own department-level PV fire safety trainings. The same dynamic occurred in Vermont: Vermont’s fire safety training at the Vermont Fire Academy helped spur the state’s Department of Public Safety to conduct local fire safety trainings across the state. Although these follow-on efforts have not occurred directly under the aegis of our Partnership, we view them as a positive indication of our project’s impact.

Solarize Continues to Be a Successful Cost-Reduction Strategy

Based on results in Connecticut, Massachusetts, and Rhode Island, there is strong evidence showing cost savings associated with the Solarize model. In Massachusetts, for example, two rounds of Solarize in 2013 and in 2015 led to cost savings of 19 percent and 21 percent, respectively, compared to costs immediately before the Solarize campaigns in the same communities. Solarize has proven to be an effective strategy for expanding the potential solar customer base, expediting solar deployment, and reducing solar customer acquisition costs for participating communities.

Not All Successful Strategies Can Cross State Lines

Although sharing information and promising practices between states was very valuable, not all state cost-reduction practices were replicable in other states. Different regulatory frameworks and different market conditions presented unique challenges in each state. For example, in the course of our project, Vermont shared with the other states information about its expedited small-scale PV registration process in the hopes that other participating states could adopt parts of its streamlined process. But, unlike other states where solar permitting occurs through individual municipal building departments, net-metered solar permitting in Vermont happens through the Vermont Public Service Board, a single centralized entity. This regulatory difference proved to be insurmountable for other participating states, all of which indicated that Vermont’s small-scale PV registration process is not applicable to their permitting regimes.
Municipalities’ Authority Can Make Statewide Change Complicated

In New England, individual municipalities are often given independent authority to establish their own permit processes and requirements for solar PV installations. This framework made it difficult for participating state partners to actuate process improvements on a statewide level.

As a result, participating states had to find creative ways to effect process changes. Connecticut Green Bank, in partnership with Yale University, made strides on solar permitting by creating municipal solar scorecards to encourage cities and towns to make solar friendly improvements.

The Connecticut Green Bank’s initial relationship-building work helped induce broader efforts too. Outreach to the Office of the State Building Inspector at the outset of the project developed into a working group of solar stakeholders, which met regularly to discuss PV permitting issues in Connecticut and helped spark efforts for statewide residential solar PV permitting requirements.

Online Permitting Is Desirable but Was Difficult to Achieve

The Partnership had planned to expand online solar permitting to municipalities in Connecticut, Massachusetts, and Rhode Island, but various setbacks slowed our progress. One of the online solar permitting vendors that we originally partnered with changed its business model mid-course and opted to drop municipal-level marketing of its product. Another online permitting vendor’s platform experienced functionality issues. The high cost of municipal permitting software, significant staff resources required for implementation, and extensive coordination required to get all applicable departments onboard made the switch from a paper processes seem daunting. In addition, switching to online permitting was a low-value proposition for many small, resource-constrained municipalities with only part-time building department staffing.

These difficulties forced Connecticut and Massachusetts to recalibrate their online permitting goals and to explore other permitting solutions, including remote submission of solar permit applications via mail, email, and web-based portals. By eliminating the need for in-person application submittal, some Connecticut and Massachusetts municipalities were able to achieve time savings without major software overhauls. Rhode Island’s online permitting program, which is being overseen by the state’s Office of Digital Excellence, experienced delays, but the program has made considerable progress and implementation will continue after Rooftop Solar Challenge II funding concludes.
New Needs and Opportunities Emerged

Several aspects of the New England Solar Cost-Reduction Partnership took on greater-than-envisioned emphasis in the course of conducting our activities. Topic areas that we explored more deeply than we expected included community solar, PV fire safety, and solar financing and loan programs. With the resources and relationships developed during this project, the soft-cost reduction efforts in these areas will continue beyond the end of this project.
Publications & Resources

The following is a list of some of the publications and other resources produced by the Partnership:

Connecticut

*Clean Energy Communities Municipal Action Steps for Solar Permitting:*

*Connecticut Rooftop Solar PV Permitting Guide:*

Energize Connecticut’s Rooftop Solar Challenge Webpage:

Webinar Recording:

*Evaluation of Residential Roof Structures for Solar PV Systems:*

Webinar Recording:

*The Rooftop Solar PV Permitting Guide:*
  [https://ctcleanenergy.wistia.com/medias/47iub86ak7](https://ctcleanenergy.wistia.com/medias/47iub86ak7)

Webinar Recording:

*How Your Community Can Earn Clean Energy Communities Credit with Solar PV Permitting:*
  [http://ctcleanenergy.wistia.com/medias/0eme2q21nb](http://ctcleanenergy.wistia.com/medias/0eme2q21nb)

Website: [www.gosolarct.com](http://www.gosolarct.com)

Yale University’s *Data Hack Visualizations on Connecticut Residential Solar Adoption Patterns:*

Video: *From Panels to Paperwork:*
  [https://www.youtube.com/watch?v=2zwVc_pQgg](https://www.youtube.com/watch?v=2zwVc_pQgg)

Massachusetts

*A Massachusetts Homeowner’s Guide to Solar Leases, Loans, and PPAs:*


Municipal Case Studies: Permitting Solar PV in Massachusetts:
[www.mass.gov/eea/docs/doer/renewables/solar/additional-resources.pdf](www.mass.gov/eea/docs/doer/renewables/solar/additional-resources.pdf);
[www.mass.gov/eea/docs/doer/renewables/solar/case-study-boston.pdf](www.mass.gov/eea/docs/doer/renewables/solar/case-study-boston.pdf);
[www.mass.gov/eea/docs/doer/renewables/solar/case-study-northampton.pdf](www.mass.gov/eea/docs/doer/renewables/solar/case-study-northampton.pdf);
[www.mass.gov/eea/docs/doer/renewables/solar/case-study-pittsfield.pdf](www.mass.gov/eea/docs/doer/renewables/solar/case-study-pittsfield.pdf); and


Webinar Recording:

Webinar Recording:

Webinar Recording:

Webinar Recording:
Regulating Solar Energy Systems at the Local Level in Massachusetts:
www.mass.gov/eea/docs/doer/green-communities/pubs-reports/sunshot-initiative-guidance-for-ma-municipalities.wmv

Webinar Recording:
Rooftop Solar Challenge II Municipal Permitting Case Studies:
www.mass.gov/eea/docs/doer/green-communities/pubs-reports/2016-02-25-rscii-municipal-permitting-case-studies.mp4

Webinar Recording:

Webinar Recording:

Webinar Recording:
Streamlining the Solar Permitting Process and Developing Supportive Zoning Bylaws:
https://www.youtube.com/watch?v=ASCwG4N6NpA

Massachusetts Residential Solar Loan Program: www.masssolarloan.com

New Hampshire

New Hampshire Residential Rooftop Solar PV Permitting, Zoning and Interconnection Guide:


New Hampshire Sample Standardized Solar PV Permit Application:


Simplified New Hampshire Utility Interconnection Requirements:
Solar Friendly Best Planning Practices for New Hampshire Communities:

New Hampshire Residential Solar 101 Training:
https://www.youtube.com/watch?v=BrSBlkooV1Q&feature=youtu.be

Rhode Island
Rhode Island’s Renewable Energy Professional License Application:
www.energy.ri.gov/documents/REP/2014%20Renewable%20Energy%20AND%20Solar%20Tere
tial%2020Application%2007%2029.doc

Frequently Asked Questions About What Rhode Island Electricians and Non-Electricians Can Do on Solar PV Job Sites: www.energy.ri.gov/documents/REP/8-18-15%20-
%20Solar%20Installations%20-
%20Questions%20and%20Answers%20from%20DLT%20and%20OER.pdf

Rhode Island’s E-Permitting Portal: http://permits.ri.gov/search.php

The Rhode Island Office of Energy Resources System Reliability Procurement Solar DG Pilot Project: www.energy.ri.gov/reliability;
www.renewableenergyworld.com/ugc/blogs/2016/07/state_leadershipin.html

Vermont
Vermont Community Solar Loan Program: www.cesa.org/projects/Clean-Energy-for-Low-

Vermont Solar Cost Study: A Report on Photovoltaic System Cost and Performance Differences Based on Design and Siting Factors: www.cesa.org/assets/Uploads/Vermont-Solar-Cost-
Study.pdf

Vermonters’ Guide to Residential Solar:

Clean Energy States Alliance (CESA)
Private Letter Ruling on the Eligibility of an Individual Panel Owner in an Offsite, Net-Metered Community-Shared Solar Project to Claim the Section 25D Tax Credit: www.cesa.org/resource-
library/resource/private-letter-ruling-on-the-eligibility-of-an-individual-panel-owner-in-an-
offsite-net-metered-community-shared-solar-project-to-claim-the-section-25d-tax-credit
Planning and Implementing a Solarize Initiative—A Guide for State Program Managers:  


Summary of New England States’ Solar Policies and Programs:  

CESA Training Module  

Webinar Recording:  
Federal Residential Tax Credit Eligibility for Community-Shared Solar Panel Owners:  

Webinar Recording: (password: rsc2)  

Webinar Recording:  

Webinar Recording:  


Partnership Webpage  
The Clean Energy States Alliance (CESA) is a national, nonprofit coalition of public agencies and organizations working together to advance clean energy. CESA members—mostly state agencies—include many of the most innovative, successful, and influential public funders of clean energy initiatives in the country.

CESA works with state leaders, federal agencies, industry representatives, and other stakeholders to develop and promote clean energy technologies and markets. It supports effective state and local policies, programs, and innovation in the clean energy sector, with emphasis on renewable energy, power generation, financing strategies, and economic development. CESA facilitates information sharing, provides technical assistance, coordinates multi-state collaborative projects, and communicates the positions and achievements of its members.