845 Brook Street
Rocky Hill, Connecticut 06067

300 Main Street, 4th Floor
Stamford, Connecticut 06901

T: 860.563.0015
F: 860.563.4877
www.ctcleanenergy.com

CLEAN ENERGY
FINANCE AND INVESTMENT AUTHORITY

October 31, 2013

A Message from the President and CEO

The U.S. Department of Energy (DOE) SunShot Initiative Rooftop Solar Challenge provided funding support for the "Sun Rise New England – Open for Business" project (the Project), giving Connecticut an opportunity to explore where non-hardware or "soft costs" can be reduced for rooftop solar photovoltaic (PV) installation. This Project supports Governor Malloy's clean energy goals to deploy "cleaner, cheaper, and more reliable sources of energy." He has challenged us to "do more with less…and faster!"

As this final project report highlights, working with the Project partners, we were able to discover several areas where we can reduce these "soft costs" – by streamlining permitting, planning and zoning, and interconnection rules and processes, reducing customer acquisition costs, and increasing access to financing. As a result of the Project, we also saw a 113% increase in our DOE "solar metrics" progress score. By continuing to lower overall installed costs of rooftop solar PV and reducing market barriers, we can make clean energy more accessible and affordable to household, business, and institutional consumers.

Over this past year and a half, the Clean Energy Finance and Investment Authority (CEFIA) and its partners have achieved the following results:

- **Deployment** – we are approaching a doubling of installed residential solar PV capacity in less than two years, having deployed 10.3 MW since inception of the residential solar investment program (RSIP) in March 2012 – with an additional 3.2 MW heading into construction – adding to the existing 13.4 MW installed in the prior decade. We have a statutory goal of 30 MW of deployment through RSIP by 2022, which we expect to meet seven years ahead of schedule in 2015. We have begun to work with Geostellar, a DOE SunShot Initiative Incubator award recipient, to chart out Connecticut's residential rooftop solar PV potential – and we believe that it is economical at the gigawatt scale.
- **Leverage** – as a result of installed cost reductions of some 15% over this past year from $5.20/W to $4.50/W, and a reduction in the proportion of ratepayer incentives being offered per project from 50% of the total installed costs to 25% to 30%, nearly $65 million of investment has gone into residential solar PV using $20 million of ratepayer resources at a ratio of over three to one. As we continue to transition the market away from being driven by subsidies and towards easier access to affordable private capital, we will continue to increase our ratepayer leverage and realize our statewide potential.
- **Financing** – with our "green bank" focus we created the first public-private partnership including a $60 million fund with a tax equity investor and syndicate of debt providers to offer customers a lease product called the Connecticut Solar Lease whose repayment is cheaper than the price a customer would have paid for their electricity and will ultimately

replenish ratepayer funds contributed to CEFIA. We also offer a 5, 7, 10, and 12-year maturity term, low interest unsecured loan called the Smart-E Loan in partnership with local credit unions and community banks, as well as a 15-year unsecured loan called the Connecticut Solar Loan. We figured out how Commercial Property Assessed Clean Energy (C-PACE) can be used for commercial rooftop solar PV to reduce the level of subsidy needed in the state's zero emissions renewable energy credit reverse auction to enable a solar PV project to better compete and move forward as a result of low interest rates and longer maturity terms.

As a result of Governor Malloy's imperative for Connecticut's "green bank" to "do more with less…and faster," since we began the Project we have not only attracted an investment of $125 million in residential rooftop solar PV which will lead to about 30 MW of deployment, but in the process we have created nearly 1,000 jobs in a year-and-a-half and are reducing over 150,000 tons of carbon dioxide emissions over the life of the installed residential rooftop solar PV systems.

Sun Rise New England – Open for Business has enabled Connecticut to see the true potential of the rooftop solar PV market. Our focus now is to continue to work with the industry to drive down "soft costs" not only in Connecticut, but throughout the New England region so that we can meet the goals of providing cleaner, cheaper and more reliable sources of energy for Connecticut ratepayers, while also creating jobs and supporting local economic development in our communities.

Bryan Garcia
President and CEO

SUN RISE NEW ENGLAND - OPEN FOR BUSINESS

CONNECTICUT'S ROOFTOP SOLAR CHALLENGE

2013

FINAL PROJECT REPORT

United States Department of Energy

SunShot Initiative Rooftop Solar Challenge

Prepared by Connecticut's

Sun Rise New England - Open for Business Team

October 31, 2013

www.energizect.com/sunriseNE

CLEAN ENERGY
FINANCE AND INVESTMENT AUTHORITY

Executive Summary

The U.S. Department of Energy (DOE) SunShot Initiative is a collaborative national effort targeting a 75% reduction in installed solar technology system costs by 2020. Achieving this level of cost reduction would enable scaled deployment of solar energy systems across the country. The U.S. DOE SunShot Initiative Rooftop Solar Challenge provided funding and resources to regional awardees to address highly varying, time-intensive and costly administrative processes required to finance and install residential and commercial rooftop solar photovoltaic (PV) systems. Improving these processes will result in the reduction of non-hardware or "soft costs" and the elimination of market barriers that are becoming increasingly significant as solar PV hardware costs continue to fall. Connecticut's Sun Rise New England – Open for Business team was one of twenty-two teams working to streamline permitting, planning and zoning, and interconnection rules and processes, and increase access to financing for rooftop solar PV.

The Connecticut (CT) project team, led by the Clean Energy Finance and Investment Authority (CEFIA), achieved a 113% increase in the overall DOE Solar Metrics score reflecting improvements in the action areas indicated in Table 1. This work was supported by almost $482,000 of funding from the U.S. Department of Energy (DOE) as well as a documented team in-kind contribution of $175,746 for work performed between February 15, 2012 and February 14, 2013.

Table 1: Connecticut Project DOE Solar Metrics Scores

DOE Solar Metrics Action Area	Score 2011	Score 2013	% Increase
Permitting Process	47	269	427%
Interconnection Process	88	93	6%
Enabling Financing Options	55	125	127%
Siting, Planning and Zoning	8	30	275%
NNEC: Net Metering	85	85	0
NNEC: Interconnection	0	0	0
Installed PV Capacity and PV Costs	0	0	0
Total	283	602	113%

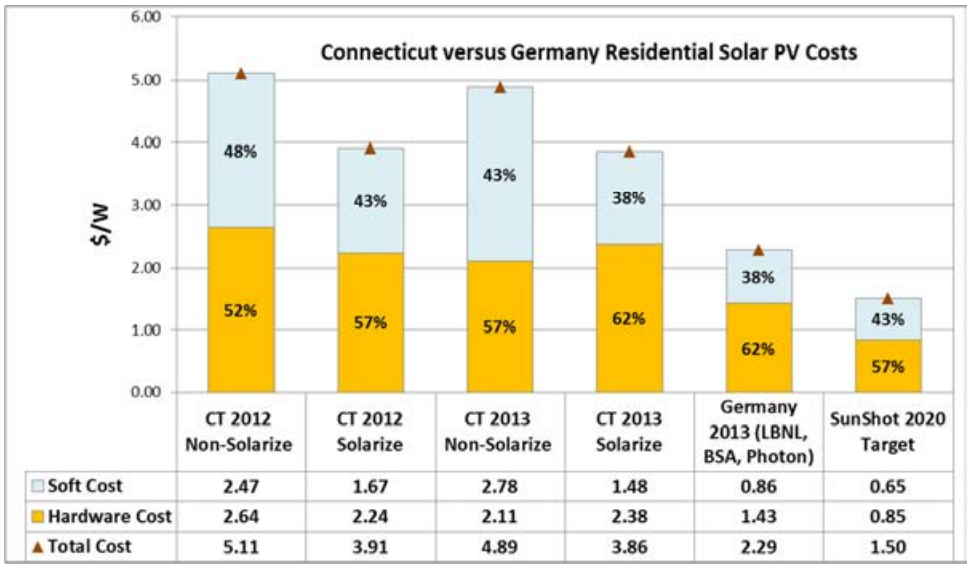
Project team members and other collaborators included 12 participating CT jurisdictions - Bridgeport, Cornwall, Coventry, Danbury, Fairfield, Greenwich, Hampton, Manchester, Middletown, Milford, Stamford, West Hartford), Solar Connecticut, Yale University, the University of Connecticut, Simply Civic, CT's two major utilities – Connecticut Light & Power (CL&P) and United Illuminating Co. (UI), the Department of Energy and Environmental Protection (DEEP), several project team consultants with valuable expertise, and many other individuals and organizations. See the Acknowledgements – Project Contributors section of this report for a complete list.

To better understand the opportunity for solar PV soft cost reduction, the project team followed three complementary approaches: (1) Collection and analysis of required DOE Solar Metrics data encompassing all Rooftop Solar Challenge topic areas to assess the status of processes and rules primarily at the local/ jurisdiction and utility levels, (2) Bottom up estimating of soft cost reduction opportunities to identify low hanging fruit as well as to compare with numbers provided by national laboratory analyses and analysis of CEFIA data, and (3) Review of existing research on non-hardware or soft costs for solar PV conducted by U.S. national labs, and analysis of and comparison with CEFIA incentive program data, in particular recent CT residential solar PV installation data. The biggest takeaways from the analysis efforts were as follows:

- Soft costs for solar PV installation in Connecticut are significant and over time will need to be reduced in order to move toward Germany costs which are significantly lower than U.S. and in

Cover page photo credit: The front cover photo is a solar PV system on the roof of the B.H. Davis Company Millwork shop in Thompson, Connecticut, courtesy of Real Goods Solar, Inc.

particular CT costs as presented in Figure 1.[1] Further cost reductions will be needed to reach DOE's 2020 target of $1.50/W. The largest reductions in total residential solar PV installation costs in Connecticut seen to date result from Solarize customer aggregation campaigns launched in 2012, achieving over $1/W cost reductions versus non-Solarize costs (2012 and preliminary 2013 data). Solarize 2013 total installed costs are $3.86/W, with only 38% due to soft costs. Continuing to reduce soft costs through mechanisms such as Solarize as well as other soft cost reduction strategies will help CT move toward Germany costs (section 4.3 provides more cost comparison discussion).



	CT 2012 Non-Solarize	CT 2012 Solarize	CT 2013 Non-Solarize	CT 2013 Solarize	Germany 2013 (LBNL, BSA, Photon)	SunShot 2020 Target
Soft Cost	2.47	1.67	2.78	1.48	0.86	0.65
Hardware Cost	2.64	2.24	2.11	2.38	1.43	0.85
Total Cost	5.11	3.91	4.89	3.86	2.29	1.50

Figure 1: Connecticut Residential Solar PV Hardware and Non-Hardware Costs versus Germany Costs and SunShot Initiative Target for 2020

- Further work can be done to obtain better resolution on solar PV cost components. CEFIA could improve definition and collection of solar PV cost data requested of installers through CEFIA's Residential Solar Investment Program (RSIP), through which CT installers apply for residential solar PV installation incentives. Non-residential solar PV installations are now incentivized through CT's utility administered Zero Emissions Renewable Energy Credit (ZREC) Program, which began in 2012 (detailed cost component data was not being collected for this program).
- Large soft cost reduction opportunities exist in customer acquisition, installer overhead and labor, permitting, and interconnection costs on the order of 25-30% in aggregate in the near term. Examples of specific cost reduction opportunities are as follows:
  - **Permitting** – The project team estimated the permitting cost savings opportunity to be $1700 for an average-sized residential solar PV system in CT in 2012 (7kW, $35,000), which translates to $0.24/W.
  - **Customer acquisition** – Acquiring customers has been shown by national lab studies and verification by CT installers to be a significant cost, on the order of $0.67/W (industry average) or $0.50/W (CT installer estimate). The project team estimates that this cost was reduced to $0.14/W for solar PV systems installed through the Solarize Program.

[1] 2013 Germany costs are courtesy of Joachim Seel, Galen Barbose and Ryan Wiser of the Environmental Energy Technologies Division at Lawrence Berkeley National Laboratory who provided an analysis of 2013 cost data obtained from the Germany Solar Industry Association (BSW-Solar) and from Photon International.

- **Installer overhead and labor, and other balance of system costs** – The CT Solarize Program has achieved over $1/W in cost reductions over non-Solarize solar PV systems. A portion of this cost, roughly $0.35/W, is attributable to customer acquisition cost reduction. The rest, as well as further cost reduction potential through Solarize and more generally, is thought to reflect installer overhead and labor savings, as well as remaining balance of system costs.
- **Interconnection** – In the area of interconnection, the project team worked with CL&P and UI, as well as surveyed installers, to identify opportunities for cost reductions and process improvements. A cost reduction example implemented in 2013 was UI removing the need for the additional equipment and installer labor cost associated with installation of a second meter for net metering, estimated at $500 for a residential installation. Three other examples of process streamlining that have been implemented are: (1) CL&P offering an online interconnection application, (2) CL&P and UI waiving the annual proof of insurance requirement for solar PV systems 10kW and smaller, and (3) CL&P waiving witness tests for installers after the first few installations. Other potential cost reductions and process improvements include: (1) Reduction of interconnection fees for systems over 10kW in size, (2) Adoption of online processes by both utilities (CL&P is already online), and (3) Reconsideration of the utility external disconnect switch requirement. More details on these potential improvements are provided in the respective section of this report. Along with improvement opportunities, this report acknowledges improvements which CL&P and UI have already made pro-actively to streamline interconnection and reduce application turn-around times.

Data collected during the study through surveys, questionnaires, emails, and in person and phone interviews, along with research on best practices informed the project team's development of tools and recommendations for improving practices in Connecticut. While some of these recommendations will clearly bring about cost reductions, and while the ultimate goal of the SunShot Initiative is to achieve dramatic cost reductions, some process, legal, and regulatory improvements don't have immediate or easily measured impacts on cost reduction, but are critical to removing barriers to broad deployment of solar energy.

The following are observations and recommendations pertaining to improvements that can be made in the permitting, building codes, planning and zoning and financing arenas, at the local and state levels, some impacting costs and some having impact in removal of barriers to solar PV deployment. The body of the report provides more information about each the following topics, generally organized in terms of local/jurisdictional level recommendations versus state level recommendations.

- **Permitting** – Some argue that permitting costs are not a significant soft cost. Permitting costs can in fact be significant with the most easily quantified permitting cost, the permit fee, itself being quite high in some cases (reaching over $1500 in at least one CT jurisdiction). Secondly, some jurisdiction processes are so burdensome as to require many extra man-hours spent on acquiring a permit. A Clean Power Finance survey of 273 installers representing 12 U.S. states found that 36% of installers avoid jurisdictions with particularly challenging permitting processes.[2] An installer avoiding bringing solar PV to a jurisdiction due to difficult permitting is the ultimate COST to customers and the industry. At least one installer in Connecticut recommended that the state adopt a state-level permitting system; this certainly would be efficient if feasible. In the meantime, it makes sense to develop and implement tools and measures which standardize and streamline current permitting processes across Connecticut now, with the possibility of state-level permitting in the future.

[2] www.cleanpowerfinance.com/about-us/media-center/press-release/more-than-a-third-of-u-s-solar-installers-say-permitting-requirements-limit-growth and "Nationwide Analysis of Solar Permitting and the Implications for Soft Costs," James Tong, Senior Director, Clean Power Finance, Dec.2012, solarpermit.org/media/upfiles/CPF-DOE_Permitting_Study_Dec2012_Final.pdf.

- **Building Codes** – Connecticut's State Building Code includes many model codes within it including the model 2009 International Energy Conservation Code (IECC) which provides energy efficiency requirements for new construction. More can be done with respect to codes by adopting the 2012 IECC and by making improvements to CT's building code where appropriate to include a specification for "solar-ready" construction, as has been done in California and Minnesota. Lastly, where the state is not yet ready to adopt a stricter building code, jurisdictions should be enabled to do so locally through enactment of a model stretch code as has been done in Massachusetts.
- **Planning and Zoning (P&Z)** – Though most local permitting is not hindered by planning and zoning requirements, P&Z review should not be required for standard residential and small scale non-residential rooftop solar PV installations. This best practice should be formalized as part of a model permitting process and/or solar PV ordinance adopted by CT jurisdictions. In CT, much work can be done to provide solar access protections for future solar PV customers and those who have already installed solar PV. The first step is to adopt a state level solar access law to protect a constituent's right for access to sunlight, which can be impeded by neighboring structures and trees, as well as the right to install solar PV, which can be impeded by private and local government restrictions.
- **Financing** – CEFIA has made great strides in developing and launching new financing products for residential and non-residential clean energy deployment and solar PV installation in particular. Innovative financing will make solar PV accessible to more customers, bring in affordable private capital to help CT's clean energy industry grow, and help CEFIA and the industry shift away from ratepayer subsidies.

Other developments in CT related to this project are as follows:

- Legislation passed in 2013 now mandates that jurisdictions waive commercial property tax assessments on solar PV equipment. Without this tax waiver, the economic benefits of installing solar PV on a commercial property were at jeopardy. Other significant legislative developments included passing of enhanced virtual net metering rules, enhanced C-PACE provisions, and many other provisions reflecting strong support for clean energy deployment. See section 5.3 of this report for brief summaries and links to major public acts adopted in CT's 2013 legislative session, following on the landmark legislation, PA-1180, passed in 2011, also referenced in the report.
- Given tremendous policy, legislative, industry, utility and broad stakeholder support for clean energy deployment in Connecticut, the state anticipates a ramping up of solar PV capacity additions. An estimate of cumulative residential and non-residential solar PV capacity installed and anticipated to be online by the end of 2013 in CT amounts to 82.3 MW of solar PV, representing installations tracked through CEFIA's incentive programs and the utility ZREC program.
- University of Connecticut project team members produced an analysis of solar PV adoption patterns utilizing sophisticated map-based spatial analysis methodology. This analysis will inform Connecticut stakeholder understanding of factors spatially associated with adoption of solar PV.

For more information about specific topic areas in the above summary, see the Table of Contents to find the respective section of the report. For questions, feedback or corrections, please contact our project team at sunshot@ctcleanenergy.com. Also see our project website and related sites as follows**:**

- Sun Rise New England project website: **www.energizeCT.com/sunriseNE**.
- Connecticut's energy related program and resource information is now provided on the EnergizeCT platform, which we encourage you to access at **www.energizeCT.com.**
- CEFIA-specific organizational information: **www.ctcleanenergy.com.**

Acknowledgment and Disclaimer

This material is based upon work supported by the U.S. Department of Energy SunShot Initiative Rooftop Solar Challenge under award number DE-EE0005688 issued to the Sun Rise New England - Open for Business team, led by Connecticut's Clean Energy Finance and Investment Authority (CEFIA).

Powered by
SunShot
U.S. Department of Energy

Acknowledgment – Project Contributors

First, a big thank you to the following twelve participating municipalities who contributed tremendously to this project. Leaders and staff from these towns assisted in the process of applying for the funding award; provided vision, input and guidance before and during the project; responded to long surveys and numerous follow-up inquiries; patiently answered emails and phone calls; made time for meetings, interviews and conference calls; and most of all shared in our enthusiasm to pave the way for increased deployment of solar energy in their towns and throughout Connecticut's 169 jurisdictions.

Bridgeport: Bill Finch, Ted Grabarz, Bieu Tran, Adam Wood, Peter Paajanen, Denis Bunkley

Cornwall: Gordon Ridgway, Joyce Hart, Paul Prindle, Karen Nelson, Katherine Freygang

Coventry: John Elsesser, Joseph Callahan, Bridget Tanganelli, Eric Trott

Danbury: Mark D. Boughton, Rick Palanzo, Wayne Shepperd, Sue Kaminski, Dennis Elpern, Sean Hearty, Leo Null

Fairfield: Michael Tetreau, Ed Boman, Jennifer Carpenter, James Gilleran, Joe Devonshuk, Nancy Fray

Greenwich: Denise Savageau, Peter J. Tesei, William Marr, Katie Blankley, Diane Fox, Aamina Ahmad

Hampton: Allan Cahill, Liz Stillman, John Berard, Martha Fraenkel

Manchester: Brian Wolverton, Mark Pellegrini, Jim Roy, James Davis, Greg Smith

Middletown: Ron Klattenberg, Dean Lisitano, Richard DeMaio, Bob Young, Bob Dobmeier, John Hall, Bill Warner

Milford: Thomas Ivers, Jocelyn Mathiasen, Steve Fournier, David Sulkis, Benjamin G. Blake

Stamford: Nancy Pipicelli, Todd Dumais, Norman Cole, Robert DeMarco, Michael Pavia, Karen Cammarota

West Hartford: Mary Ann Basile, Tim MiKloiche, Catherine Diviney, Brian Pudlik, Milagros T. Limson, Ron Van Winkle

Connecticut's Clean Energy Finance and Investment Authority (CEFIA) provided leadership on the project and gratefully acknowledges the organizations and individuals of the Sun Rise New England – Open for Business team for their dedication and hard work towards the success and usefulness of this project.

CEFIA extends a special thank you to the Sun Rise New England – Open for Business project editors, Victoria Stahl and Michael Phillips, who worked tirelessly and creatively to edit, write, collect data, research, analyze, verify and correct information, document resources and citations, design and create forms and graphics, take and select photographs, format, produce and polish this report and a forthcoming CT permitting guide, and for their passion to make this report as useful and impactful as possible.

The following individuals and organizations on the Sun Rise New England – Open for Business team collaborated to win U.S. DOE funds for this project and contributed to leadership, visioning, planning, research, data collection, analysis, writing, editing, development and implementation of tools, document production, budgeting and accounting, outreach and more to realize project goals.

Solar Connecticut, Inc.: Michael Trahan

Pemberton Renewables LLC: Richard Dziadul

Dorgan Architecture & Planning: Kathleen Dorgan

Simply Civic LLC: Dan Hensley, David Roach

Yale University: Stuart DeCew, Kenneth Gillingham, Kathryn Wright, Emily Greenlee, Hayley Fink, Hilary Staver, Vijeta Jangra

The University of Connecticut (UConn): William Waite, Marcello Graziano, Fred Carstensen, Jeffrey Osleeb, Chuanrong Zhang, Zhiqiang Liu, Daniel Civco

Connecticut Light and Power/Northeast Utilities (CL&P): David Ferrante, Denae Corcoran, Einat Dorobantzu, Ronald Araujo, Camilo Serna, Christie Bradway

The United Illuminating Company (UI): Devang Patel, Patricia Roche, Patrick Healey, Gary Zielanski, Alan Trotta

Connecticut Department of Energy and Environmental Protection (DEEP): Teddi Ezzo, Walter Murray, Katie Dykes, Tracy Babbidge, Lynn Stoddard, Mark Quinlan, Kim Walford

City of New Haven: John DeStefano, Jr., Giovanni Zinn, Robert Smuts, Christine Tang, Jennifer Pugh, Andrew Rizzo, Karyn Gilvarg

Snugg Home LLC: Ann Livingston, Jeff Friesen, Adam Stenftenagel

The Clean Energy Finance and Investment Authority (CEFIA), the CEFIA Board of Directors and Connecticut Innovations (CI): Bryan Garcia (CEFIA President and CEO), Mackey Dykes, Bob Wall, David Goldberg, Selya Price (Sun Rise New England project manager), Maria Leonardi, Joe Buonannata, George Bellas, Joseph Landry, Brian Farnen, Loyola French, Alex Kovtunenko, Brent Packer, Lucy Charpentier, Kim Stevenson, John Murphy, Joseph Teng, Amanda White, Isabelle Hazlewood, William Colonis, Andrea Mancini, Robert Schmitt, Benjamin Healey, Bert Hunter, Alexandra Lieberman, Fiona Stewart, Kerry O'Neill, Cheryl Samuels, Dale Hedman, Dave Ljungquist, Edward Kranich, Neil McCarthy, Mary Vigil, John Murphy, Jessica Bailey, Genevieve Sherman, Gina Perusse, Irene Turker, Joe Casparino, Kim Peretto, Matthew Ranelli, Paige Rasid, Deb Santy, Claire Leonardi, Barbara Lesh, Suzanne Kaswan.

The Sun Rise New England – Open for Business team thanks the following individuals and solar PV installers who contributed thoughtful survey responses and input on permitting, interconnection, planning and zoning, non-hardware costs, and other topics covered by this project. These installers also provided review of document drafts, letters of support, advice, photographs of solar PV systems, and other input and assistance as needed, many times in a short timeframe. We are very grateful for their time and effort on this project, and especially for their contributions to the solar industry, to the state of Connecticut, for all the solar PV systems they have installed, and for all the solar PV systems they will install.

Aegis Solar Energy: Chris Lenda, Elliott Hitchcock

AllGreen IT LLC: Peter Stevenson

American Solar & Alternative Power: Jerry Charlup

Astrum Solar Inc.: Michael Brooks

Befree Solar: Harsh Luthra, Kapil Luthra

CT Electrical Services: Bruce Angeloszek, Erik Anderson

DCS Energy: Craig Bradway

Elektron Solar: Tony Eason

Encon: Nathan Roumanis

Harness The Sun LLC: Emil Thomen

JD Solar Solutions LLC: Jodi Dean

Lenz Electric: Chris Harrington
Litchfield Hills Solar, LLC: James LaPorta, Ray Furse
Mercury Solar Systems: Brendan Rafferty
Northeast Smart Energy LLC: Dwayne Escola
PurePoint Energy LLC: Chris Lobdell, Tom Wemyss
PV Squared: Susan Begin
Real Goods Solar: Tonya Morgan, Gordon Schies, Amy Bowman
Renewable Resources Energy Solutions: Thomas Loredo, Jim Bamman
Ross Solar Group: Jason Ross, Joshua Ross, David Disalvo, Tim Sadler
Shippee Solar and Construction LLC: Tom Shippee
SolarCity: Shaun Chapman, Alicia DeMaio
Sunlight Solar Energy, Inc.: Annalisa Paltauf, Dan Britton, Rachel Oxman
Trinity Solar: Michael Mazzamurro, Bill Condit
Waldo Renewable Electric, LLC: Rebecca Waldo

The Sun Rise New England – Open for Business team thanks the following individuals and organizations who gave generously of their time and ideas, provided input, feedback, assistance and support of various kinds to help us achieve the goals of this project.

Capital Region Council of Governments (CRCOG): Pauline Yoder
Cobalt Power: Kurt Newick
Concursive: Philip Kessler
Connecticut Office of Policy & Management: Tyler J. Kleykamp
Go Solar Broward (Florida) Rooftop Solar Challenge Team: Jeffery Halsey, Maribel Feliciano
Mass Solar: Making it EZ Rooftop Solar Challenge Team: Sarah Cassanego, Natalie Andrews
Meister Consultants Group: Andrew Belden, Neil Veilleux, Wilson Rickerson
Murtha Cullina LLP: Paul Michaud, Alfred Smith
New England Governors' Conference Inc. (NEGC): John Kerry, John Shea, Anne Bowe
Town of Canton: Jerome Shea
Town of Mansfield: Linda Painter, Matthew Hart
U.S. Department of Energy: Joshua Huneycutt, Rose Marie Holsing
View Point: Nasser Hajo

Thank you to the following talented photographers and organizations working within the creative commons network: AllFred, cmiper, CT State Democrats, Department of Energy Solar Decathlon, Thomas Hawk, Hampton University and Old Dominion University Solar Decathlon team, lcm1863, mangosymphony, Michael Phillips, Pomfret Community School, Town of Rocky Hill, Katy Silberger, Wissotzky. (Please see photo credits throughout the report.)

Table of Contents

EXECUTIVE SUMMARY **2**
ACKNOWLEDGMENT AND DISCLAIMER **6**
ACKNOWLEDGMENT – PROJECT CONTRIBUTORS **7**
1.0 SUNSHOT INITIATIVE **17**
2.0 ROOFTOP SOLAR CHALLENGE **17**
3.0 SUN RISE NEW ENGLAND – OPEN FOR BUSINESS **18**
3.1 CONNECTICUT CONTEXT 18
3.2 BENEFITS OF SOLAR ENERGY 18
3.3 THE CLEAN ENERGY FINANCE AND INVESTMENT AUTHORITY 20
3.4 SUN RISE NEW ENGLAND – OPEN FOR BUSINESS PROJECT ACCOMPLISHMENTS 21
3.5 SUN RISE NEW ENGLAND PARTNER COMMUNITIES 22
4.0 SOFT COST REDUCTION OPPORTUNITY IN THE UNITED STATES AND CONNECTICUT **24**
4.1 DOE SOLAR METRICS DATA 25
4.2 BOTTOM-UP ESTIMATES OF SOFT COST REDUCTION OPPORTUNITIES 25
4.3 OVERVIEW OF U.S. AND GERMANY SOFT COST ANALYSES AND COMPARISON TO CONNECTICUT NON-SOLARIZE AND SOLARIZE DATA 28
5.0 SCALING UP SOLAR PV DEPLOYMENT IN CONNECTICUT **37**
5.1 INSTALLED SOLAR PV CAPACITY IN CONNECTICUT 37
5.2 SOLAR PV ADOPTION PATTERNS 39
5.3 CONNECTICUT'S 2013 LEGISLATIVE SESSION – SUPPORT FOR CLEAN ENERGY 41
6.0 PROJECT DATA COLLECTION AND METHODOLOGY **44**
7.0 PERMITTING PROCESSES IN CONNECTICUT **44**
7.1 SUMMARY OF FINDINGS AND CONCLUSIONS 44
7.2 ROOFTOP SOLAR PV PERMITTING – OPPORTUNITIES FOR IMPROVEMENT 45
8.0 ROOFTOP SOLAR PV PERMITTING RECOMMENDATIONS FOR JURISDICTIONS **50**
8.1 MAKE INFORMATION AVAILABLE 50
8.2 STREAMLINE PERMIT APPLICATION SUBMISSION 51
8.3 WAIVE OR REDUCE PERMIT FEES 51
8.4 STREAMLINE REVIEW AND INSPECTION REQUIREMENTS 51
8.5 FORMALIZE BEST PRACTICES 52
8.6 CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE 53
8.7 MODEL SOLAR PV ORDINANCE FOR JURISDICTIONS 53

8.8 ONLINE PERMITTING 54
8.9 SOLAR-READY MUNICIPALITY RATING MAP – IS YOUR TOWN OPEN FOR BUSINESS? 55
9.0 PERMITTING RECOMMENDATIONS FOR THE STATE OF CONNECTICUT 56
9.1 WAIVED FEE OR FLAT FEE BASED ON COST-RECOVERY FEE STRUCTURE WITH A CAP 56
9.2 MANDATORY PERMIT DECISION DEADLINE 57
9.3 IMPROVE THE STATE BUILDING CODE AND ALLOW STRETCH CODES 58
9.4 ALLOW ELECTRONIC WET STAMPS 59
9.5 EDUCATION & TRAINING 60
10.0 PLANNING & ZONING 61
10.1 DATA COLLECTION AND METHODS 61
10.2 SUMMARY OF FINDINGS AND CONCLUSIONS 61
11.0 PLANNING AND ZONING RECOMMENDATIONS FOR THE STATE OF CONNECTICUT 65
11.1 ADOPT A STATEWIDE SOLAR ACCESS LAW 66
11.2 PUBLICIZE, ENFORCE, AND STRENGTHEN EXISTING CONNECTICUT LAWS AND CODES 69
12.0 PLANNING AND ZONING RECOMMENDATIONS FOR CONNECTICUT JURISDICTIONS 72
12.1 LOCAL POLICY RECOMMENDATIONS FOR REMOVING ZONING BARRIERS TO SOLAR ENERGY 72
13.0 INTERCONNECTION 76
13.1 CONNECTICUT CONTEXT 76
13.2 UTILITY PARTICIPATION IN CT'S ROOFTOP SOLAR CHALLENGE 77
13.3 CONNECTICUT'S "FREEING THE GRID" REPORT CARD 78
13.4 NET METERING 78
13.5 VIRTUAL NET METERING 78
13.6 INTERCONNECTION 79
13.7 INTERSTATE COMPARISON TABLE 80
13.8 INTERCONNECTION RECOMMENDATIONS 84
13.9 RECOMMENDATIONS FOR INTERCONNECTION GUIDELINES 84
13.10 EXTERNAL DISCONNECT SWITCH 85
13.11 UTILITY STRENGTHS AND BEST PRACTICES 87
13.12 UTILITY PRACTICE RECOMMENDATIONS 88
13.13 RECOMMENDATIONS FOR PURA 89
13.14 DATA COLLECTED -- UTILITY INTERVIEWS AND INSTALLER SURVEY RESPONSES 90
14.0 FINANCING 92
14.1 CONNECTICUT'S INNOVATIVE FINANCING MECHANISMS 92

14.2 GREEN BANK FINANCING MODEL 92
14.3 FINANCING PROGRAMS 93
14.4 ENERGIZE CONNECTICUT SOLAR LEASE 94
14.5 ENERGIZE CONNECTICUT SMART–E LOANS 94
14.6 ENERGIZE CONNECTICUT SOLAR LOAN POWERED BY SUNGAGE 95
14.7 CAPITAL COMPETITION PROGRAM 96
14.8 COMMERCIAL PROPERTY ASSESSED CLEAN ENERGY (C-PACE) FINANCING 96
14.9 ZERO EMISSION RENEWABLE ENERGY CREDIT (ZREC) PROGRAM 97
14.10 RESIDENTIAL SOLAR INVESTMENT PROGRAM (RSIP) 97
14.11 REVENUES FROM RSIP RECS 98
15.0 SOLARIZE CONNECTICUT[SM] 99
15.1 BACKGROUND 99
15.2 PHASE I PROGRAM IMPACTS 100
15.3 CUSTOMER ACQUISITION 101
15.4 SOLARIZE PHASE II 101
15.5 SOLARIZE PHASE III 102
15.6 SOLARIZE CHOICE AND SOLARIZE EXPRESS 102
15.7 CONNECTICUT SOLAR CHALLENGE 102
APPENDIX I 103
PERMITTING RECOMMENDATIONS SPECIFIC TO EACH OF THE TWELVE SUN RISE NEW ENGLAND – OPEN FOR BUSINESS PARTNER COMMUNITIES 103
BRIDGEPORT 104
CORNWALL 107
COVENTRY 110
DANBURY 113
FAIRFIELD 116
GREENWICH 119
HAMPTON 122
MANCHESTER 125
MIDDLETOWN 128
MILFORD 131
STAMFORD 134
WEST HARTFORD 137
APPENDIX II 140

MUNICIPAL PERMITTING SURVEY 140
APPENDIX III 169
INSTALLER PERMITTING SURVEY 169
APPENDIX IV 183
MUNICIPAL PLANNING AND ZONING SURVEY 183
APPENDIX V 186
INSTALLER PLANNING AND ZONING SURVEY 186
APPENDIX VI 188
PLANNING & ZONING – EXAMPLE SOLAR ACCESS ORDINANCES 188
APPENDIX VII 190
SAMPLE SOLAR SITE DESIGN WORKSHEET FOR A PROPOSED SUBDIVISION 190
APPENDIX VIII 191
INSTALLER INTERCONNECTION SURVEY 191

List of Figures

FIGURE 1: CONNECTICUT RESIDENTIAL SOLAR PV HARDWARE AND NON-HARDWARE COSTS VERSUS GERMANY COSTS AND SUNSHOT INITIATIVE TARGET FOR 2020 3
FIGURE 2: CT NET ELECTRICITY GENERATION BY SOURCE 18
FIGURE 3: SUN RISE NEW ENGLAND PARTICIPATING CT JURISDICTIONS 22
FIGURE 4: CT RESIDENTIAL SOLAR PV COST AND COST REDUCTION OPPORTUNITIES ($/W) 27
FIGURE 5: U.S. RESIDENTIAL SOLAR PV COST COMPONENTS ($/W OR %, LBNL/NREL COMPOSITE 2010-2011 DATA) 30
FIGURE 6: CEFIA CT 2012 RESIDENTIAL SOLAR PV COST COMPONENTS ($/W OR %) 31
FIGURE 7: CT 2012 RESIDENTIAL SOLAR PV COST COMPONENTS USING U.S. COMPOSITE DATA PERCENTAGES ($/W OR %) 31
FIGURE 8: CEFIA RESIDENTIAL SOLAR PV HARDWARE AND NON-HARDWARE CONTRIBUTIONS TO INSTALLED COST (2004-2013) 35
FIGURE 9: CEFIA NON-SOLARIZE VERSUS SOLARIZE HARDWARE, NON-HARDWARE AND TOTAL SYSTEM COSTS (2012-2013) 36
FIGURE 10: CEFIA RESIDENTIAL SOLAR PV SYSTEM COSTS DECLINING, INSTALLATION VOLUME INCREASING, RATEPAYER COST CONTRIBUTIONS DECREASING (2004-2013) 37
FIGURE 11: CUMULATIVE RESIDENTIAL SOLAR PV INSTALLATIONS PER SQUARE MILE (WITH DATA GROUPED INTO QUINTILES) 39
FIGURE 12: CUMULATIVE RESIDENTIAL SOLAR PV INSTALLATION DATA PER SQUARE MILE (SAME-SIZED DATA DISPLAY INTERVALS) 40
FIGURE 13: RESIDENTIAL SOLAR PV ADOPTION MAP WITH DATA AGGREGATED BY CENSUS BLOCK GROUPS AND WEIGHTED BY POPULATION 40
FIGURE 14: RESIDENTIAL SOLAR PV ADOPTION ASSOCIATED WITH HIGHER INCOME LEVELS BUT THE HIGHEST INCOME LEVELS ARE NOT THE HIGHEST ADOPTERS 41
FIGURE 15: RESIDENTIAL SOLAR PV CUSTOMERS ARE PAYING PERMIT FEES IN EXCESS OF ESTIMATED PROCESSING COSTS 48
FIGURE 16: "GO SOLAR CHESTER!" SIGNAGE FOR THE CT SOLAR CHALLENGE, COURTESY OF MICHAEL PHILLIPS 50
FIGURE 17: SUN RISE NEW ENGLAND – OPEN FOR BUSINESS WEBSITE SOLAR-READINESS RATING FOR THE TOWN OF DURHAM 55
FIGURE 18: SUN RISE NEW ENGLAND – OPEN FOR BUSINESS WEBSITE, SOLAR-READY MUNICIPALITY RATING MAP 55
FIGURE 19: NEW HAVEN LIGHTHOUSE SOLAR PV INSTALLATION, COURTESY OF ROSS SOLAR GROUP 56
FIGURE 20: SOLAR PV INSTALLATION IN MANCHESTER, COURTESY OF ROSS SOLAR GROUP 65
FIGURE 21: MAP OF STATE SOLAR ACCESS LAWS, DSIRE, FEBRUARY 2013 66
FIGURE 22: SOLAR PV INSTALLATION IN CORNWALL, COURTESY OF LENZ ELECTRIC 72
FIGURE 23: CT CAPITOL REGION COUNCIL OF GOVERNMENTS (CRCOG) TOWNS IN SUSTAINABLE LAND USE REGULATION PROJECT WORKING GROUP 75
FIGURE 24: CL&P SERVICE TERRITORY MAP 76

FIGURE 25: UI SERVICE TERRITORY MAP 76
FIGURE 26: CONNECTICUT'S FREEING THE GRID REPORT CARD ON NET METERING AND INTERCONNECTION 78
FIGURE 27: UTILITY ACCESSIBLE ALTERNATE CURRENT EXTERNAL DISCONNECT SWITCH 85
FIGURE 28: CT SOLAR LEASE REPRESENTATIVE CASH FLOW 94
FIGURE 29: SMART-E LOAN REPRESENTATIVE CASH FLOW 95
FIGURE 30: CT SOLAR LOAN REPRESENTATIVE CASH FLOW 96
FIGURE 31: DRAMATIC INCREASES IN SOLAR CONTRACTS SIGNED DURING AND SINCE THE 2012 SOLARIZE CONNECTICUT PILOT IN THE COMMUNITIES OF DURHAM, FAIRFIELD, PORTLAND AND WESTPORT 99
FIGURE 32: DECREASE IN RESIDENTIAL SOLAR PV INSTALLED COST AS A RESULT OF SOLARIZE 100

List of Tables

TABLE 1: CONNECTICUT PROJECT DOE SOLAR METRICS SCORES 2
TABLE 2: HIGHEST U.S. RETAIL ELECTRICITY PRICES 18
TABLE 3: SUN RISE NEW ENGLAND PARTNER COMMUNITIES IN CONNECTICUT (AS OF 4/40/13) 23
TABLE 4: DOE SOLAR METRICS ACTION AREAS AND SCORING 24
TABLE 5: CONNECTICUT PROJECT DOE SOLAR METRICS SCORES 25
TABLE 6: SUMMARY OF ANALYSES ON RESIDENTIAL SOLAR PV COMPONENTS BY U.S. NATIONAL LABS; ANALYSIS OF CEFIA CT SOLAR PV DATA; AND COMPARISON TO GERMANY SOLAR PV COSTS AND THE SUNSHOT INITIATIVE TARGET 29
TABLE 7: RESIDENTIAL SOLAR PV PERMITTING, INSPECTION AND INTERCONNECTION (PII) COST ESTIMATE COMPARISON 33
TABLE 8: CEFIA RESIDENTIAL SOLAR PV HARDWARE AND NON-HARDWARE COST DATA (2004-PRELIMINARY 2013 DATA) 34
TABLE 9: ESTIMATE OF CT CUMULATIVE SOLAR PV CAPACITY INSTALLED AND COMMITTED THROUGH 2013 (MW) 38
TABLE 10: 2013 LEGISLATIVE DEVELOPMENTS SUPPORTING DEPLOYMENT OF CLEAN ENERGY (PLUS REFERENCE TO PA 11-80) 42
TABLE 11: NUMBER OF DEPARTMENTS REQUIRING APPROVAL FOR ONE SOLAR PV PERMIT APPLICATION 46
TABLE 12: INSPECTION PRACTICES - SPECIFIC APPOINTMENTS VERSUS WINDOWS OF TIME; SINGLE VERSUS MULTIPLE INSPECTION APPOINTMENTS 47
TABLE 13: EXAMPLES OF STATE SOLAR ACCESS LAWS 68
TABLE 14: INTERCONNECTION GUIDELINES - COMPARISON AMONG FIVE STATES 82
TABLE 15: INTERCONNECTION GUIDELINES - COMPARISON AMONG FIVE STATES (CONTINUED FROM TABLE 14) 83
TABLE 16: RETAIL PRICE ($/KWH) AS A FUNCTION OF SOLARIZE INSTALLED COST LEVELS AND GREEN BANK LOANS 92

TABLE 17: ROADMAP TO RESIDENTIAL ROOFTOP SOLAR PV FINANCING IN CONNECTICUT 93
TABLE 18: COMPARISON OF FINANCING OPTIONS 93
TABLE 19: NET PRESENT VALUE GIVEN VARYING ZREC PRICES 97
TABLE 20: RESIDENTIAL SOLAR INVESTMENT PROGRAM (RSIP) – DECLINING INCENTIVES 98
TABLE 21: SOLARIZE CT CUSTOMER ACQUISITION COSTS 101
TABLE 22: SOLAR RIGHTS AND ACCESS DATA FOR PARTICIPATING JURISDICTIONS 183
TABLE 23: ZONING DATA FOR PARTICIPATING JURISDICTIONS 184
TABLE 24: NEW CONSTRUCTION STANDARDS; OTHER SOLAR AND CLEAN ENERGY COMMITMENTS 185

1.0 SunShot Initiative

The U.S. Department of Energy (DOE) SunShot Initiative is a collaborative national effort to dramatically reduce the costs of solar energy, making it cost-competitive with other forms of energy by the end of the decade.

Under the SunShot Initiative, DOE invests in competitive research and development for solar technologies that promise to transform the way we generate, store and utilize energy. To make solar energy more accessible and affordable, SunShot aggressively drives innovation by investing in private companies, academia, and national laboratories, targeting a 75% reduction in installed solar technology system costs by 2020. Achieving this level of cost reduction would enable scaled deployment of solar energy systems across the country, enabling solar technology-generated electricity (from photovoltaic and concentrating solar technologies together) to meet 14% of U.S. electricity needs by 2030.

SunShot Initiative advancements will ultimately benefit everyone by:

- Providing clean, low-cost energy for home owners, communities, businesses, and government;
- Enhancing America's global technology leadership through advanced solar energy technologies and smart grid innovation;
- Creating U.S. jobs through domestic solar manufacturing, distribution, and installation; and
- Reducing greenhouse gas emissions and protecting the environment.

Learn more about SunShot and DOE's efforts to expand deployment of clean, inexpensive solar energy by visiting eere.energy.gov/solar/sunshot. For an in-depth assessment of the potential for solar technologies to meet a significant share of electricity demand in the United States during the next several decades, see the SunShot Vision Study report, eere.energy.gov/solar/sunshot/vision_study.html.

2.0 Rooftop Solar Challenge

The U.S. Department of Energy SunShot Initiative Rooftop Solar Challenge provides funding and resources to regional awardees to address highly varying, time-intensive and costly administrative processes required to finance and install residential and commercial rooftop solar photovoltaic (PV) systems. Improving these administrative processes will result in the reduction of non-hardware or "soft costs" and the elimination of market barriers that are becoming increasingly significant as solar PV hardware costs continue to fall.

Twenty-two Rooftop Solar Challenge teams from across the country are working to streamline permitting processes, update planning and zoning regulations, improve standards and processes for connecting solar energy systems to the electric grid, and increase access to financing for rooftop solar PV. The teams bring together municipal, county, and state officials, regulatory entities, private industry, universities, local utilities, and other regional stakeholders to clear a path for rapid expansion of solar energy and serve as models for other communities across the nation.

Learn more about the Rooftop Solar Challenge at: eere.energy.gov/solarchallenge. Learn more about Connecticut's Sun Rise New England – Open for Business project and access project deliverables at: energizect.com/sunrisene.

3.0 Sun Rise New England – Open for Business

3.1 Connecticut Context

Although Connecticut ranks the fifth lowest in energy use per capita in the United States, it has one of the highest retail electricity rates in the United States at 15.50 cents per kilowatt-hour (kWh) across sectors, and $17.40 cents per kWh for the residential sector, as of April 2013.[3] Scaled deployment of clean energy including solar energy is part of Connecticut's strategy to put the state on a path to a cheaper, cleaner and more reliable energy future.[4] Electricity produced from solar energy will contribute to reducing energy costs, increasing energy reliability and security, reducing greenhouse gas emissions, and meeting the State's renewable portfolio standard to meet 27% of retail electricity load with renewable energy by 2020.[5]

Table 2: Highest U.S. Retail Electricity Prices

Average Retail Price of Electricity - All Sectors, April 2013 (¢/ kWh)	
Hawaii	33.33
Alaska	16.91
Connecticut	**15.50**
Vermont	14.73
New Hampshire	14.38
New York	14.38

3.2 Benefits of Solar Energy

Environmental Benefits

The majority of Connecticut's electricity is produced from natural gas and nuclear energy.[6] Although natural gas and nuclear based electricity generation technologies produce lower emissions than technologies based on other petroleum fuels and coal, solar energy provides a zero emissions alternative (or near zero on a life cycle basis).[7] On average, for every residential solar PV system installed in Connecticut, the U.S. avoids 3.5 tons of greenhouse gas emissions each year. Over the lifetime of a typical system, over 87 tons of carbon dioxide (CO_2) will be offset. The lifetime impact of approximately 9.3 MW of residential solar PV capacity (1325 projects) installed under CEFIA's current incentive program (March 2012 – June 2013), is avoided emissions of over 115 thousand tons of CO_2, 52 tons of nitrous oxides (NO_x) and 48 tons of sulfur dioxide (SO_2).

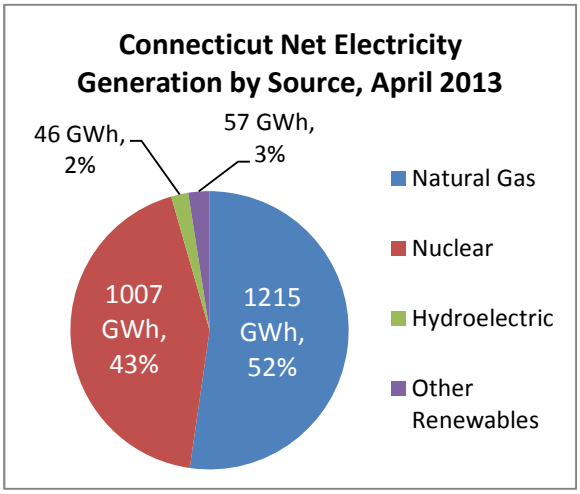


Figure 2: CT Net Electricity Generation by Source

[3] U.S. Department of Energy, Energy Information Administration (EIA) April 2013: eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_6_a; eia.gov/state/?sid=CT

[4] The Department of Energy and Environmental Protection (DEEP) developed and issued in 2013 the first-ever Comprehensive Energy Strategy for the State of Connecticut: ct.gov/deep/cwp/view.asp?a=4405&q=500752&deepNav_GID=2121%20

[5] ct.gov/pura/cwp/view.asp?a=3354&q=415186

[6] www.eia.gov/state/?sid=CT

[7] Lifecycle Greenhouse Gas Emissions from Electricity Generation, January 2013: nrel.gov/docs/fy13osti/57187.pdf or nrel.gov/analysis/sustain_lca_results.html

Economic Benefits

In addition to the environmental benefits of installing solar PV there are significant economic benefits resulting from widespread adoption of solar PV in Connecticut. Increased deployment of solar PV creates direct, indirect and induced jobs. Connecticut's 9.3 MW of residential solar PV capacity installed between March 2012 and June 2013 is estimated to result in 255 new direct jobs, and 410 indirect and induced jobs, for a total of 665 new jobs.

Another economic benefit of solar energy is that it provides a hedge against volatility and increases in fossil fuel prices. Though natural gas prices have recently been relatively low, solar energy systems rely on a free, limitless fuel source so that payments for electricity generated from a solar PV system are known and can be fixed over 20 years or other fixed period of time.

Solar energy increases Connecticut's energy security through diversity, reliability and independence. Securing Connecticut's energy supply has become increasingly important given losses estimated at $2-4 billion each year on power outages and quality issues.[8]

As population increases in the Northeast United States, the demand for electricity, particularly peak energy, will increase as well. Solar PV generates electricity during parts of the day at or around the times when energy demands are at their highest. Power plants built just for meeting peak electricity demand are very expensive.

Some of the benefits of solar energy systems are attributable to the fact that residential and commercial solar PV systems usually provide distributed generation, at or near the point of use. For example, distributed solar PV avoids transmission and distribution line losses which translate to avoided cost. Additionally, solar energy and other distributed generation help relieve electric grid congestion and as mentioned previously, the cost of adding new power plants to the grid.

Energy expenditures in 2012 were estimated to account for between 9% and 78% of homeowner after tax income, depending on income bracket.[9] Providing a stable, low cost source of energy will increase residents' disposable income and the competitiveness of Connecticut businesses. For many homeowners and businesses, having known costs are helpful for budgeting; on-site solar energy production frees system owners from unknown and escalating fuel costs.

A benefit of residential solar PV systems in addition to the electricity cost savings to the system owner is that they are reported to increase home selling prices. An analysis based on data in California, the most mature market in the United States, conducted by the Lawrence Berkeley National Laboratory and San Diego State University quantified the benefits in terms of the prices paid for solar PV systems:[10]

> The effects range, on average, from approximately $3.9 to $6.4 per installed watt (DC) of PV, with most coalescing near $5.5/Watt, which corresponds to a home sales price premium of approximately $17,000 for a relatively new 3.1 kW PV system (the average size of PV systems in the study). Thus, these average sales price premiums appear to be comparable to the investment that homeowners have made to install PV systems in California, which from 2001

[8] "Clean Energy Tops Agenda in Connecticut," William Pentland, Forbes Online (11/09/2010). forbes.com/sites/williampentland/2010/11/09/microgrids

[9] "Energy Cost Impacts on American Families, 2001-2012," American Coalition for Clean Coal Electricity. americaspower.org/sites/default/files/Energy_Cost_Impacts_2012_FINAL.pdf

[10] "An Analysis of the Effects of Residential Photovoltaic Energy Systems on Home Sales Prices in California," Ben Hoen, Ryan Wiser, Peter Cappers and Mark Thayer, Lawrence Berkeley National Laboratory, Environmental Energy Technologies Division, and San Diego State University, April 2011, eetd.lbl.gov/ea/emp/reports/lbnl-4476e.pdf.

through 2009 averaged approximately $5/Watt (DC). Homeowners with PV also benefit from electricity cost savings after PV system installation and prior to home sale.

Another study based on California data, conducted by University of California San Diego and University of California Los Angeles researchers, estimates that a home with a solar PV system will sell for 3-4% more than a comparable home without solar PV.[11] The sales price premium is larger in communities with more registered Prius hybrid vehicles and a greater share of college graduates, and in environmentalist communities where there is a community approval aspect to being green.

Finally, net metering rules in Connecticut have improved over time, allowing owners to better capture the benefit of the electricity generated by their solar PV systems. Virtual net metering, described in the Interconnection section (section 13.5) of this report, was adopted in 2011 in Public Act 11-80. Expanded virtual net metering provisions enacted in Public Act 13-298 in Connecticut's 2013 legislative session will increase this value even further. Virtual Net Metering was expanded to state agencies and agricultural customers in addition to municipalities, the maximum installation size was increased from 2MW up to 3MW, allowance was made for class III resources such as cogeneration, and customers connected to a micro-grid may now share credits with up to ten non-state or municipal critical facilities (e.g. hospitals, police and fire stations, and municipal centers).[12] For a link to the text of the legislation, see section 5.3 of this report, Connecticut's 2013 Legislative Session – Support for Clean Energy.

Quantifying Community-Level Benefits

An analysis conducted by AECOM for Sunrun evaluated the economic and fiscal implications of streamlining local government permitting for installing solar PV systems on residences in California between 2012 and 2020. The AECOM report[13] presents the following findings:

- Under the streamlined permitting regime presented by the Sunrun report, which results in a 75% reduction in local permitting costs, California homeowners are projected to install an additional 132,000 systems overall, a 13% increase relative to the baseline market projection.
- AECOM's analysis estimates that the incremental growth and the additional savings that result from permitting reform would contribute nearly $5.1 billion to the California state economy between 2012 and 2020. AECOM's modeling indicates that approximately 3,900 full-time jobs would be generated by this economic contribution.

A specific analysis would need to be conducted to quantify similar benefits for Connecticut taking into account differences in state and local laws and other factors. However, the benefits analysis done for California indicates that streamlining solar PV permitting results in increased solar PV adoption which in turn benefits local and state economies.

3.3 The Clean Energy Finance and Investment Authority

The Clean Energy Finance and Investment Authority (CEFIA),[14] the successor organization to the Connecticut Clean Energy Fund (CCEF), was created by the Connecticut Legislature through Public Act

[11] "Understanding the Solar Home Price Premium: Electricity Generation and 'Green' Social Status," Samuel Dastrup, Joshua Graff Zivin, Dora Costa, and Matthew Kahn. European Economic Review 56 (2012): 961-973. works.bepress.com/josh_graffzivin/37.

[12] An Act Concerning Implementation of Connecticut's Comprehensive Energy Strategy. House Bill 6360, Public Act 13-298, cga.ct.gov/2013/ACT/PA/2013PA-00298-R00HB-06360-PA.htm

[13] Economic and Fiscal Impact Analysis of Residential Solar Permitting Reform. July 2011. AECOM. sunrunhome.com/download_file/view/415/189/

[14] ctcleanenergy.com, then click on "About"

No. 11-80 (PA 11-80), effective July 1, 2011.[15] As the nation's first green bank, CEFIA invests its resources in an array of enterprises, initiatives and projects aimed to attract and deploy capital to finance the clean energy goals of Connecticut, develop and implement strategies that lower the cost of clean energy to make it more accessible and affordable to consumers and reduce reliance on grants, rebates and other subsidies, and move toward innovative low-cost financing of clean energy deployment. CEFIA led the Sun Rise New England – Open for Business[16] team in applying to the U.S. Department of Energy SunShot Initiative Rooftop Solar Challenge to bring efforts and resources to bear on reducing rooftop solar PV installation costs and market barriers in Connecticut.

3.4 Sun Rise New England – Open for Business Project Accomplishments

Connecticut's Sun Rise New England – Open for Business team was one of 22 teams nationwide to win an award under the Rooftop Solar Challenge Program.[17] The Connecticut team received almost $482,000 of funding from the U.S. Department of Energy (DOE), spent during the project period spanning February 15, 2012 through February 14, 2013, and with a documented in-kind contribution totaling $175,746 during the official project period.

The following is a summary of project activities and accomplishments (with more details provided in relevant sections of this project report, and in a forthcoming CT Rooftop Solar PV Permitting Guide):

- Conducted data collection, research and analysis on rooftop solar PV non-hardware or soft costs and market barriers including those associated with permitting, planning and zoning, interconnection, and financing. Data collection was conducted with 12 partner communities, Connecticut's two major utility companies, and numerous solar PV installers. The focus of data collection was on DOE Solar Metrics data, though the project team conducting additional data collection as needed to understand issues pertaining to solar PV soft costs.
- Produced this report summarizing research, findings and recommendations on permitting, planning and zoning, interconnection, innovative financing and solar PV soft cost analysis and market drivers.
- Produced permitting improvement recommendations generally applicable to any CT jurisdiction and specific recommendations for jurisdictions participating in the project. See section 8.0 and Appendix I of this report, respectively.
- Project partner Simply Civic developed and implemented an affordable online permitting system and conducted outreach to provide demonstrations of the system throughout Connecticut. See section 8.8, Online Permitting.
- Performed data collection, research and analysis, and drafting of legislation mandating waived or flat permit fees, capped at $200 for residential solar PV. The proposed legislation did not get a hearing in the 2013 legislative session but is automatically put on the list for consideration in 2014. Additionally, the work on the proposed legislation allowed the team to write an informed recommendation for voluntary municipal permit fee reduction. See sections 7.2 and 8.3.
- Developed and implemented an online rating system comparing Connecticut communities in terms of solar friendliness/readiness. The rating data will be updated to incorporate additional variables as more tools and measures are implemented, including those found in the CT Rooftop Solar PV Permitting Guide. See section 8.9 of this report for more information.

[15] An Act Concerning the Establishment of the Department of Energy and Environmental Protection and Planning for Connecticut's Energy Future, cga.ct.gov/2011/act/pa/2011PA-00080-R00SB-01243-PA.htm
[16] energizect.com/SunRiseNE
[17] eere.energy.gov/solarchallenge

- Developed a CT Standardized Solar PV Permit Application Package provided in the CT Rooftop Solar PV Permitting Guide.
- Developed a model solar PV ordinance for Connecticut jurisdictions provided in the CT Rooftop Solar PV Permitting Guide.
- Developed and deployed innovative financing models, programs and products for the Connecticut solar PV and clean energy market, to expand access to affordable capital and reduce dependence on ratepayer funds. See section 14.0 on financing.
- Established a network of municipal, state, industry, utility, university, regional, federal and other stakeholders aligned to continue efforts toward reduction of solar PV costs, elimination of market barriers and scaled deployment of solar PV.
- Drafted a forthcoming CT Rooftop Solar PV Permitting Guide, carried out and funded by CEFIA after the official project period, including and expanding on tools and measures developed during the Rooftop Solar Challenge Project period. Contents of the Guide include the Connecticut Standardized Solar PV Permit Application Package, a summary of permitting recommendations for CT jurisdictions, detailed guidance and resources on streamlining solar PV permit review and inspection, information about online permitting systems, an example solar PV inspection checklist, a model solar PV ordinance for Connecticut jurisdictions, a checklist for earning CT Clean Energy Communities Program points as a result of permitting improvements, and a Sample Solar Site Design Worksheet for a Proposed Subdivision. For a complete list, see section 8.6 titled **Connecticut Rooftop Solar PV Permitting Guide** ✹ in this report and the Permitting Guide tab on the Sun Rise New England - Open for Business website.

Questions about the Sun Rise New England – Open for Business project may be directed to sunshot@ctcleanenergy.com.

3.5 Sun Rise New England Partner Communities

Connecticut may be a relatively small state but its 169 municipalities operate under a diverse set of rules, regulations and permitting processes that makes it challenging for those doing business across the state, including solar PV installers. Bringing consistency and improvements to these processes will ultimately attract more solar PV installation and other business to Connecticut communities. Twelve communities were asked to participate in this project, providing a range of characteristics and strengths:

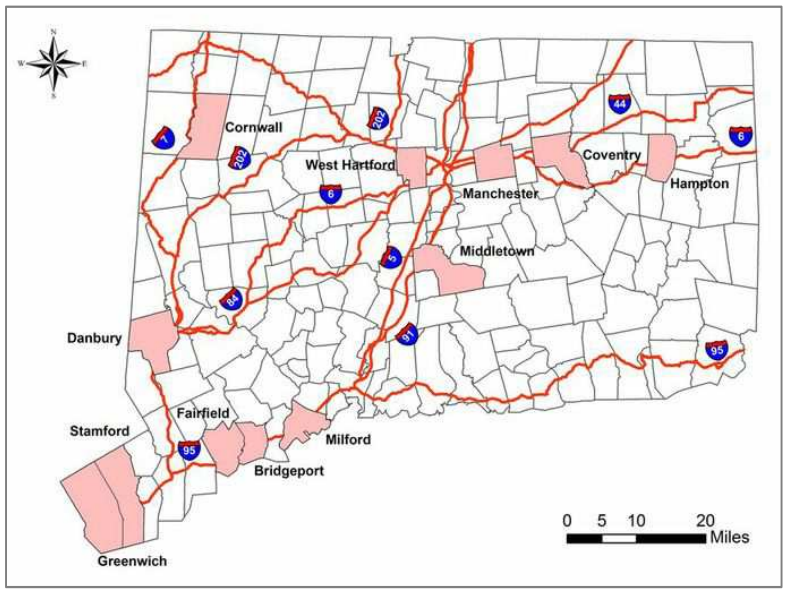


Figure 3: Sun Rise New England Participating CT Jurisdictions

- A strong record in terms of number of installations and capacity installed per capita and/or strong clean energy leadership in other ways such as through the CT Clean Energy Communities (CEC) Program and/or a clean energy task force. All 12 towns earned a municipal solar PV system through success as CEC participants in the original

version of the Program.[18] A new version of the CEC Program has been launched, so community commitments are in the process of being renewed.

- Diversity in terms of representing large and small populations, community types (i.e. urban, suburban, rural), income levels and the two major utility service territories (i.e., Connecticut Light and Power and United Illuminating service territories).

Table 3: Sun Rise New England Partner Communities in Connecticut (as of 4/40/13)

				Non-Residential		Residential				
Rooftop Solar Challenge Community	Population (CERC 2011)	Number of Households (CERC 2011)	Community Type	# Projects	Total Capacity (kW)	# Projects	Total Capacity (kW)	Household Penetration	Total # Projects	Total Capacity (kW)
Bridgeport	146,824	52,261	Urban	5	382	7	39	0.01%	12	421
Cornwall	1,429	643	Rural	1	9	12	93	1.87%	13	102
Coventry	12,572	4,738	Rural	1	76	28	191	0.59%	29	268
Danbury	82,409	29,508	Urban	5	1271	34	229	0.12%	39	1500
Fairfield	59,625	20,556	Suburban	5	621	125	912	0.61%	130	1533
Greenwich	61,983	23,382	Suburban	4	218	37	199	0.16%	41	417
Hampton	1,890	768	Rural	2	19	15	87	1.95%	17	106
Manchester	59,175	25,194	Suburban	5	416	27	181	0.11%	32	597
Middletown	48,041	20,233	Suburban	7	565	43	224	0.21%	50	789
Milford	52,894	21,910	Suburban	2	370	70	447	0.32%	72	816
Stamford	124,908	48,288	Urban	8	1139	39	227	0.08%	47	1366
West Hartford	63,649	25,513	Suburban	6	351	45	266	0.18%	51	617
Totals	**715,399**	**272,994**		**50**	**5429**	**482**	**3094**	**0.18%**	**533**	**8532**

Table 3 represents CEFIA/CCEF residential and non-residential solar PV incentive program data for the 12 participating Sun Rise New England towns from 2004 through 2013. CEFIA's current residential solar PV incentive program is called the Residential Solar Investment Program (RSIP), launched in March 2012.

Non-residential installations are captured primarily from 2004-2011, after which only 4 non-residential installations were included in the CEFIA dataset for these 12 communities. Incentives for non-residential solar projects were provided by CCEF's former On-Site Distributed Generation Program. Incentives for commercial and industrial systems are now provided by the Zero Emission Renewable Energy Credit (ZREC) Program, administered by CT's two large utility companies.[19]

Projects competitively selected through the ZREC Program which may be in service by the end of 2013 in the above 12 municipalities include the following: a 297 kW commercial project in Fairfield, four projects (three commercial, one industrial) in Manchester totaling 1.1 MW, two commercial projects in Stamford totaling 327 kW, and two commercial projects in West Hartford totaling 634 kW. These nine projects together total 2.4 MW.[20]

[18] All 12 have had their municipal solar PV system installed except for Danbury whose system is yet to be installed.
[19] www.cl-p.com/Home/SaveEnergy/GoingGreen/Renewable_Energy_Credits/ and for UI: UI LREC/ZREC link and UI Small ZREC link. Residential projects are also eligible for the ZREC program which is run as an auction, though larger systems will have a cost advantage. UI's Small ZREC Program is limited to projects of size less than 100 kW.
[20] This report also presents total anticipated solar PV installation capacity for the 2012 ZREC solicitation, namely 45 MW to be installed by the end of 2013 (see section 5.1 titled "Installed Solar PV Capacity in Connecticut").

The following are a few observations about the data in the Table 3:

- Each participating town has at least one non-residential installation consisting of a CT Clean Energy Communities Program municipal installation, except for Danbury who has earned a PV system but has not yet installed it.
- Fairfield has the most projects installed and the highest installed capacity of the participating towns. Fairfield participated in the Solarize Program, which has been very impactful in deployment of record amounts of solar PV in Solarize communities as well as significant cost reductions.
- The two smallest towns, Cornwall and Hampton, reached the highest residential household penetration rates of the 12. Note that the town of Durham (with a population of 7416 in 2011) achieved the highest residential solar PV market penetration rate in Connecticut as of May 2013, reaching over 5% household penetration as a result of its successful Solarize Program.

More information about each of the 12 participating towns including clean energy commitments, permitting best practices and recommendations for permitting improvements are provided in town-specific summaries in Appendix I.

4.0 Soft Cost Reduction Opportunity in the United States and Connecticut

The goal of the Rooftop Solar Challenge Program (RSC) is to reduce soft costs and eliminate market barriers associated with installation of rooftop solar PV. The U.S. Department of Energy identifies the areas of permitting, planning and zoning, interconnection and financing as key areas for process improvements and cost reductions.

During the course of Connecticut's RSC efforts, several approaches informed understanding of soft cost reduction opportunities. A large portion of the Sun Rise New England project efforts were focused on collecting and analyzing data defined by DOE Solar Metrics requirements for the 12 participating communities, then developing and implementing recommendations and tools to address opportunities for improvements. Three approaches undertaken during the project to understand soft costs are listed below, including the collection of DOE Solar Metrics data already mentioned.

1. Collect data and conduct research and analysis related to Solar Metrics questions defined and required by DOE.
2. Identify specific cost savings opportunities in the various action areas using a bottom-up approach.
3. Survey the latest literature summarizing research and analysis conducted on soft costs nationwide; analyze Connecticut solar PV installation data collected through CCEF/CEFIA incentive programs.

Table 4: DOE Solar Metrics Action Areas and Scoring

ACTION AREA	POINTS
Permitting Process	**460**
Application	110
Information Access	60
Process Time	110
Fee	30
Model Process	30
Inspection	80
Communication w/ Utility	40
Interconnection Process	**110**
Application	40
Information Access	20
Process Time	20
Inspection	30
Interconnection Standard	**100**
Net Metering Standard	**100**
Financing Options	**150**
Third Party Ownership (or equivalent)	90
Direct Finance Options	25
Community Solar	15
Other	20
Planning and Zoning	**80**
Solar Rights and Access	54
Zoning	20
New Construction	6
TOTAL POINTS POSSIBLE	**1000**

4.1 DOE Solar Metrics Data

Approach one involved collecting answers to DOE Solar Metrics questions in all action areas. This included permitting and planning and zoning data from 12 towns participating in the project, and interconnection process data for utilities. In addition, the project team collected information from solar PV installers on permitting, planning and zoning, and interconnection processes to obtain insight on how to improve processes and requirements in these areas. Table 4 on the previous page shows the Solar Metrics action areas and point allocations provided by DOE to guide the targeting of improvements. The permitting process for rooftop solar PV is emphasized as a key area of needed improvement, representing 460 out of the total 1000 DOE points possible. DOE Solar Metrics permitting questions were verified by a Lawrence Berkeley National Laboratory (LBNL) analysis published in April 2013 to provide a meaningful measure of jurisdiction-level permitting scores.[21]

Table 5 shows that the overall DOE Solar Metrics score for Connecticut improved from 283 to 602 points, an increase of 113%, with the biggest increases coming from permitting process improvements, planning and zoning, and development and launch of financing options. The permitting and planning and zoning areas started out with the lowest scores, whereas CT's interconnection process score was already high relative to the maximum number of points.

Table 5: Connecticut Project DOE Solar Metrics Scores

DOE Solar Metrics Action Area	Score 2011	Score 2013	% Increase
Permitting Process	47	269	427%
Interconnection Process	88	93	6%
Enabling Financing Options	55	125	127%
Siting, Planning and Zoning	8	30	275%
NNEC: Net Metering	85	85	0
NNEC: Interconnection	0	0	0
Installed PV Capacity and PV Costs	0	0	0
Total	283	602	113%

Note that there are process areas and soft cost components not included in the DOE action areas, for example customer acquisition, which is known to contribute significantly to soft costs. Also note that while some action areas may not seem as relevant to cost reduction, they may be impactful in enabling solar PV deployment by reducing or eliminating market barriers. An example may be solar rights and access which could impact adoption of solar PV as well as solar PV performance after installation. Permitting both contributes to soft costs and can pose as a market barrier. A Clean Power Finance survey of 273 installers representing 12 states found that 36% of installers avoid jurisdictions with particularly challenging permitting processes.[22]

4.2 Bottom-up Estimates of Soft Cost Reduction Opportunities

A second approach involved adding up specific opportunities for cost reductions that were identified during the project through a bottom-up approach. For example, interviews with municipalities, utilities and solar PV installers helped the team focus extra efforts on a few opportunities that could be targeted.

[21] Wiser, Ryan H, and Dong, Changgui. "The Impact of City-level Permitting Processes on Residential Photovoltaic Installation Prices and Development Times: An Empirical Analysis of Solar Systems in California Cities," 2013. emp.lbl.gov/reports/re.

[22] www.cleanpowerfinance.com/about-us/media-center/press-release/more-than-a-third-of-u-s-solar-installers-say-permitting-requirements-limit-growth and "Nationwide Analysis of Solar Permitting and the Implications for Soft Costs," James Tong, Senior Director, Clean Power Finance, Dec.2012, solarpermit.org/media/upfiles/CPF-DOE_Permitting_Study_Dec2012_Final.pdf.

Examples of specific cost reduction opportunities are as follows:

- **Permit fee reductions** were approached both by preparing a legislative proposal for a state-level mandate and by providing an informed recommendation to jurisdictions on a better permit fee structure for solar PV. An analysis of permit fee data throughout Connecticut and permitting recommendations provided by the project team are detailed in the section 7.2, Rooftop Solar PV Permitting – Opportunities for Improvement. On average, reducing permit fees to a flat fee of $200 for an average-sized residential solar PV system would result in $228 in savings for a solar PV installation. In the highest permit fee towns, the savings could be as high as $1500 or more. The project team developed an online rating system presenting information about jurisdiction adoption of solar-friendly policies, programs and practices such as Commercial Property Assessed Clean Energy (C-PACE) adoption, Solarize Program participation, implementation of permit fee waivers and reductions, and adoption of online permitting. Jurisdictions are thus encouraged to adopt measures that make them solar-ready, whereby they can attract more business to their communities.
- Another permitting cost reduction example was to provide all Connecticut communities **access to affordable online permitting**, which can simplify the work of municipal staff, save installers' time and expense in travel time, and help streamline the permitting process generally, especially if used in combination with a standardized solar PV permit application. Simply Civic, the project team's partner in offering an online permitting solution for Connecticut towns, estimates savings of at least $250 on an average for a residential solar PV installation as a result of using online permitting. See section 8.8 of this report on online permitting for information about a number of online permitting solutions which Connecticut towns are using.
- A third example of an interconnection cost reduction opportunity, identified by United Illuminating (UI) during the project, was **elimination of the need for a second meter for net metering of electricity produced by a PV system**. By the writing of this project report, UI had found a solution to eliminate the need for this additional equipment. This additional equipment had added approximately $500 to the cost of each solar PV installation, consisting of $270 for the additional meter plus additional installer labor. What had been required was an update or upgrade to a billing system which can be a complex undertaking for a large company serving many customers.
- In the 2013 legislative session, CEFIA leadership worked with the Connecticut legislature to achieve a **property tax exemption for commercial and industrial class I renewable energy projects**. This exemption was critical to ensuring economic viability of commercial clean energy systems. Without the exemption, the cash flow benefit which makes solar PV and other clean energy system adoption feasible would be offset by commercial property taxes on the equipment. A property tax waiver had already been in place for residential solar PV systems; residents are required to file paperwork once with their jurisdiction to obtain the waiver.

In Figure 4 on the next page, individual cost reduction opportunities such as those in the above list are presented or shown consolidated with other opportunities in the same category to show the impact of a combination of cost reductions.

Starting with a 2013 Connecticut residential solar PV installation cost of $4.89/W (includes only projects not participating in the Solarize Program), the combined impact of the cost reductions shown is a reduction of $1.40/W, bringing the cost down to $3.49/W. Germany installed cost of $2.29/W in 2013 is

shown for comparison next to the potential reduced CT cost.[23] More discussion comparing U.S., CT, and Germany residential solar PV installation costs is presented in the next section (section 4.3).

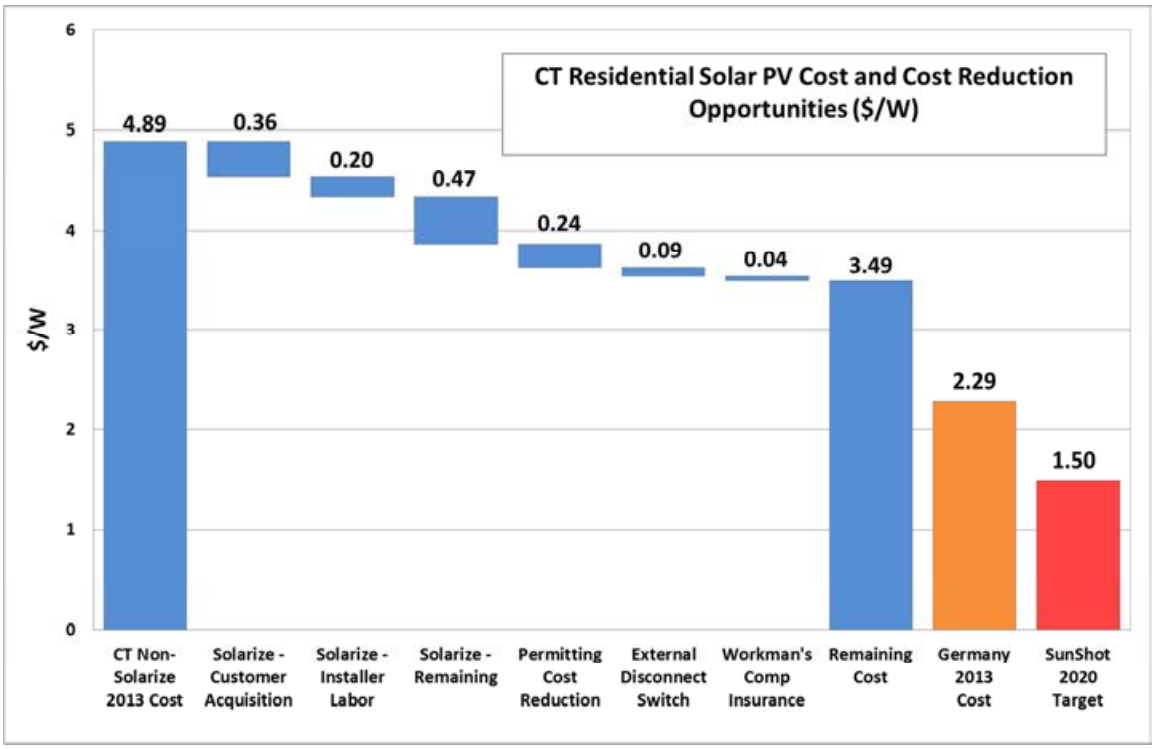


Figure 4: CT Residential Solar PV Cost and Cost Reduction Opportunities ($/W)

The cost reduction opportunities presented in Figure 4 include the CT Solarize Program, launched in the summer of 2012. Solarize is a group purchasing program that has resulted in approximately $1/W in soft cost savings which can be attributed to savings in customer acquisition ($0.36/W), as well as installer labor ($0.20/W), installer overhead and other installation costs that can be spread out over a larger number of systems being installed in one Solarize community.

Permitting improvements were estimated to add up to almost $1700 for an average residential solar PV installation in Connecticut (7kW in year 2012) amounting to cost savings of $0.24/W. This included potential permitting cost savings resulting from the following: eliminating unnecessary professional engineering/structural reviews; streamlining permit application submission, review, inspection and approval through process improvements and tools such as a standardized solar PV permit application package; and, online permitting. To get another reference point on permitting costs, a Sunrun analysis estimated local permitting costs in California for a 5kW system to be $2516 per installation (or $0.50/W) and potential permitting cost savings to be $1900 per installation or $0.38/W.[24] The Sunrun number included some customer acquisition costs for sales and marketing ($440 of potential savings out of $520). Removing the customer acquisition portion of the cost savings from the Sunrun estimate results

[23] 2013 Germany costs are courtesy of Joachim Seel, Galen Barbose and Ryan Wiser of the Environmental Energy Technologies Division at Lawrence Berkeley National Laboratory who provided an analysis of 2013 cost data obtained from the Germany Solar Industry Association (BSW-Solar) and from Photon International.

[24] Economic and Fiscal Impact Analysis of Residential Solar Permitting Reform. July 2011. AECOM. www.sunrunhome.com/download_file/view/415/189/

in an estimated permitting cost savings potential of $1460 for a 5kW system, or $0.29/W, higher but comparable to the CT project team estimate of $0.24/W.

Another reference point on permitting costs is an LBNL analysis published in April 2013 which concludes that those California cities with the most favorable permitting processes are found to reduce average residential PV system prices by $0.27-$0.77/W and shorten development times by around 24 days, compared to cities with the most onerous permitting practices. In this analysis, LBNL controlled for confounding factors impacting system costs (e.g., system size, cost of living and education level) to attempt to isolate the effect of favorable permitting processes. LBNL notes that the measured effect on system costs was significant while the results were less robust but evident for project development times.[25]

In the area of interconnection, the project team worked with CL&P and UI, as well as surveyed installers, to identify opportunities for cost reductions and process improvements. A cost reduction example implemented in 2013 was UI removing the need for the additional equipment and installer labor cost associated with installation of a second meter for net metering, estimated at $500 for a residential installation. Three other examples of process streamlining that have been implemented are: (1) CL&P offering an online interconnection application, (2) CL&P and UI waiving the annual proof of insurance requirement for solar PV systems 10kW and smaller, and (3) CL&P waiving witness tests for installers after the first few installations. Other potential cost reductions and process improvements include: (1) Reduction of interconnection fees for systems over 10kW in size, (2) Adoption of online processes by both utilities (CL&P is already online), and (3) Reconsideration of the utility external disconnect switch requirement. More details on these potential improvements are provided in the respective section of this report. Along with improvement opportunities, this report acknowledges improvements which CL&P and UI have already made pro-actively to streamline interconnection and reduce application turn-around times.

Another soft cost savings opportunity, identified by the solar industry, is the high cost of insurance, one example being **workmen's compensation insurance which could potentially be reduced by $300.**

4.3 Overview of U.S. and Germany Soft Cost Analyses and Comparison to Connecticut Non-Solarize and Solarize Data

Approach three to better understanding soft costs consisted of review of research and analysis led by national laboratory (e.g., NREL, LBNL) and university researchers to better understand contributions to solar PV installation costs, categorized in terms of hardware and non-hardware (soft) costs. These analyses are based on survey data and/or rely on bottom-up cost modeling. As solar PV hardware cost components have become better understood and as PV module prices have decreased significantly over recent years and have started to stabilize, more attention has been focused on better identifying and reducing soft costs. The reviewed literature and analyses provided a framework for understanding soft costs in the global, U.S. and Connecticut contexts, for reference in analyzing Connecticut solar PV data collected to date, informing future data collection and cost reduction strategies.

Note that the word "cost" is used throughout this discussion though cost may be more correctly referred to as "price," which is what is being paid for the systems by customers, through installers.

[25] Wiser, Ryan H, and Dong, Changgui. "The Impact of City-level Permitting Processes on Residential Photovoltaic Installation Prices and Development Times: An Empirical Analysis of Solar Systems in California Cities," 2013. emp.lbl.gov/reports/re.

Table 6 summarizes recent analyses on U.S. residential solar PV installation cost and cost components conducted by the National Renewable Energy Laboratory (NREL), Lawrence Berkeley National Laboratory (LBNL), and the Sun Rise New England project team (using CEFIA residential solar PV incentive program data), alongside an estimate of residential solar PV costs in Germany and SunShot Initiative 2020 targets. In recent analyses, U.S. hardware and non-hardware costs have each contributed approximately 50% to total system costs. The cost component categories provided by recent NREL analyses were used to compare data across sources to the extent possible. Germany 2011 installed cost of $3.00/W from an LBNL study is included here as the study breaks soft costs out into components. Germany 2013 data is also presented to show that the cost has dropped further, down to $2.29/W.[26]

Table 6: Summary of Analyses on Residential Solar PV Components by U.S. National Labs; Analysis of CEFIA CT Solar PV data; and Comparison to Germany Solar PV costs and the SunShot Initiative target

Summary of Analysis on Residential Solar PV System Component Costs all costs in this table are **average costs in $/W** unless shown as a %	**U.S. NREL/ LBNL Survey & Analysis (1)**	**U.S. LBNL Data Composite (4)**	**U.S. NREL Goodrich Cost Model (2)**	**U.S. NREL/ Goodrich/ LBNL Cost Model (3)**	**CT CEFIA 2012 Data**	**CT CEFIA 2012 Data Non-Solarize**	**CT CEFIA 2012 Data Solarize**	**CT CEFIA 2013 Data**	**CT CEFIA 2013 Data Non-Solarize**	**CT CEFIA 2013 Data Solarize**	**Germany LBNL Survey; BNEF; Langen 2011 (4)**	**Germany LBNL; BSW; Photon 2013**	**SunShot Initiative U.S. 2020 Target**
Publication Year	2012	2012	2011	Nov-2012							2012		
Data Year	2010	2011, 2010	2010	Q4 2011	2012	2012	2012	2013	2013	2013	2011, 2010	2013	
Total Cost	**6.60**	**6.19**	**5.71**	**4.39**	**4.95**	**5.11**	**3.91**	**4.50**	**4.89**	**3.86**	**3.00**	**2.29**	**1.50**
Hardware Cost	**3.28**	**2.85**	**3.03**	**2.04**	**2.59**	**2.64**	**2.24**	**2.22**	**2.11**	**2.38**	**2.38**	**1.43**	**0.85**
Module	3.28	1.83	2.17	1.15	1.80	1.88	1.30	1.44	1.43	1.47	2.38	0.79	
Inverter		0.55	0.40	0.43	0.67	0.66	0.78	0.66	0.59	0.77		0.30	
Wiring		0.47	0.46	0.46								0.34	
Mounting hardware													
Monitoring equipment					0.11	0.11	0.17	0.12	0.10	0.14			
Non-Hardware/ Soft Cost	**3.32**	**3.34**	**2.68**	**2.35**	**2.36**	**2.47**	**1.67**	**2.28**	**2.78**	**1.48**	**0.62**	**0.86**	**0.65**
Soft Cost Component Subtotal - customer acquisition, PII, installation labor, etc	1.71	1.81	1.08		1.79	1.78	1.40	1.69	1.73	1.25	0.17		
Customer Acquisition	0.67	0.69			0.50	0.50	0.14	0.50	0.50	0.14	0.07		
Permitting, Inspection, Interconnection (PII) Fees and Costs Subtotal	0.22	0.24			0.23	0.19	0.41	0.23	0.18	0.29	0.03		
PII Labor	0.13	0.15	0.17		0.11	0.08	0.21	0.12	0.08	0.15	0.03		
Interconnection Fee					0.03	0.03	0.07	0.03	0.03	0.05			
Permit Fee	0.09	0.09			0.09	0.08	0.13	0.08	0.07	0.09	0.00		
Installation Labor	0.59	0.59	0.63		0.91	0.94	0.72	0.83	0.91	0.71	0.04		
Labor for arranging third party financing	0.02												
Engineering and Design Cost (CEFIA data only)					0.15	0.15	0.14	0.13	0.14	0.12			
Sales tax	0.21	0.29	0.29		0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Balance of System (BOS) costs*	1.60	1.53	1.60		0.57	0.69	0.27	0.59	1.05	0.23	0.45		
Hardware Cost %	**50%**	**46%**	**53%**	**47%**	**52%**	**52%**	**57%**	**49%**	**43%**	**62%**	**79%**	**63%**	**57%**
Non-hardware/ Soft Cost %	**50%**	**54%**	**47%**	**53%**	**48%**	**48%**	**43%**	**51%**	**57%**	**38%**	**21%**	**37%**	**43%**

[26] 2013 Germany costs are courtesy of Joachim Seel, Galen Barbose and Ryan Wiser of the Environmental Energy Technologies Division at Lawrence Berkeley National Laboratory who provided an analysis of 2013 cost data obtained from the Germany Solar Industry Association (BSW-Solar) and from Photon International.

The following four analyses are referenced in Table 6 (in parentheses in the heading of each column):

(1) Kristen Ardani (*), Galen Barbose (**), Robert Margolis (*), Ryan Wiser (**), David Feldman (*), and Sean Ong (*). *Benchmarking Non-Hardware Balance of System (Soft) Costs for U.S. Photovoltaic Systems Using a Data-Driven Analysis from PV Installer Survey Results*, National Renewable Energy Laboratory (*-NREL) and Lawrence Berkeley National Laboratory (**-LBNL), Report DOE/GO-10212-3834, November 2012, www.nrel.gov/docs/fy13osti/56806.pdf.

(2) Alan Goodrich, Ted James, and Michael Woodhouse. *Residential, Commercial, and Utility-Scale Photovoltaic (PV) System Prices in the United States: Current Drivers and Cost-Reduction Opportunities,* NREL, Report TP-6A20-53347, February 2012, www.nrel.gov/docs/fy12osti/53347.pdf.

(3) David Feldman, Galen L Barbose, Robert Margolis, Ryan H Wiser, Naïm Darghouth, and Alan Goodrich. *Photovoltaic (PV) Pricing Trends: Historical, Recent, and Near-Term Projections,* 2012. www.nrel.gov/docs/fy13osti/56776.pdf.

(4) Joachim Seel, Galen Barbose, and Ryan Wiser. *Why Are Residential PV Prices in Germany So Much Lower Than in the United States? A Scoping Analysis,* LBNL, Presentation, February 2013 Revision (with updated data on installation labor requirements). emp.lbl.gov/sites/all/files/german-us-pv-price-ppt.pdf. Note that 2013 Germany prices in Table 6 were estimated using a related analysis provided directly by LBNL.[27]

Benchmarking Residential Solar PV Cost Components

The NREL analysis published in 2012, source (1) above, was based on a 2010 survey of U.S. installers, with results presented in the leftmost column of data in Table 6. The survey was aimed at obtaining granularity on solar PV soft cost components.

Sources (2) and (3) rely on solar PV bottom-up cost modeling by NREL (Goodrich et al) to estimate U.S. solar PV cost components. A comparison of two sets of residential solar PV data from Goodrich, one based on 2010 data and one based on Q4 2011 data (both in Table 6) indicate that module costs declined significantly, approximately $1/W, during this time period, and that the module (or the corresponding hardware) cost decline accounted for about three-quarters of the 23% overall installed cost decline. As a result of the hardware cost decline, the hardware cost contribution decreased from 53% to 47% of installed cost, while the soft cost contribution increased from 47% to 53%. This example illustrates the increasing importance of soft costs as hardware costs have declined.

Source (4) provides a composite of U.S. 2010 and 2011 solar PV cost component data including data from sources (1) through (3). Figure 5 presents consolidated data from source (4) and adds further resolution on installer overhead and installer profit using percentages provided by Goodrich et al in source (2). Figure 5 is based on a $6.19/W system.

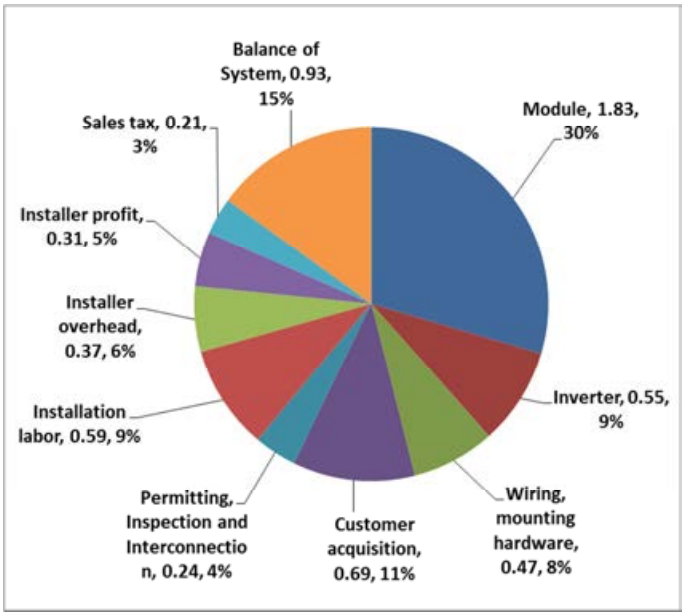


Figure 5: U.S. Residential Solar PV Cost Components ($/W or %, LBNL/NREL composite 2010-2011 data)

[27] 2013 Germany costs are courtesy of Joachim Seel, Galen Barbose and Ryan Wiser of the Environmental Energy Technologies Division at Lawrence Berkeley National Laboratory who provided an analysis of 2013 cost data obtained from the Germany Solar Industry Association (BSW-Solar) and from Photon International.

What is CEFIA's breakout of Connecticut residential solar PV cost components? CEFIA collects data for the following cost components through its residential solar PV incentive program application system: module, inverter, monitoring equipment, permitting fee, interconnection fee, municipal inspections, utility inspections, engineering and design (assumed to be labor), installation labor, and balance of system (BOS).

For the analyses of the CEFIA data done for this report, the permitting fee, interconnection fee and the municipal and utility inspections costs are combined into a cost category called permitting, inspection and interconnection (PII) costs.

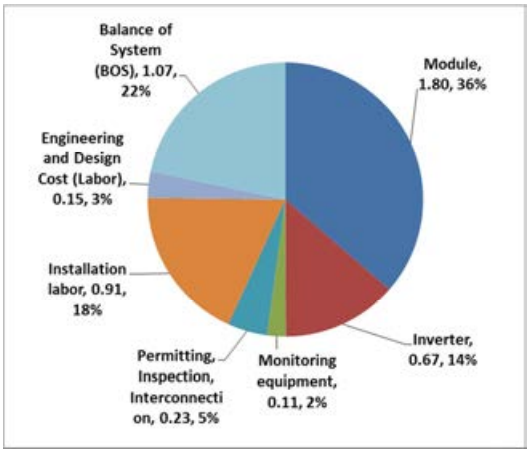


Figure 7: CEFIA CT 2012 Residential Solar PV Cost Components ($/W or %)

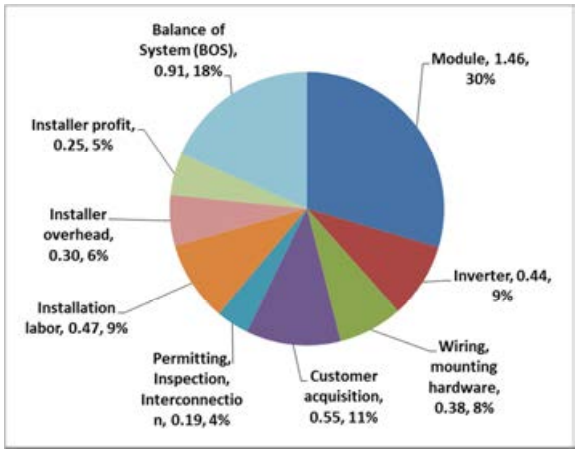


Figure 6: CT 2012 Residential Solar PV Cost Components using U.S. Composite Data Percentages ($/W or %)

CEFIA does not collect separate data on wiring and racking costs. CEFIA's calculation for hardware cost in this report thus includes: module, inverter and monitoring equipment. Installers may have reported wiring and racking costs as part of the module cost or as part of the BOS cost. Therefore the BOS cost might include both non-hardware as well as some soft cost contributions.

Figure 6 shows CEFIA's CT data for 2012 cost components collected from installer incentive applications. Figure 7 shows what the CT 2012 cost components would be using the U.S. composite cost component percentages benchmarked in Figure 5. In Figure 7, the sales tax cost component would have been $0.17/W or 3% of the total cost based on the cost component breakdown in Figure 5; however, this portion was included with the BOS cost because CT exempts solar PV from sales tax.

Comparing Figures 6 and 7 illustrates how soft cost component datasets may reflect lack of resolution or uncertainty on some cost components. For example, the CEFIA raw data in Figure 6 suggests that installation labor is 18% of the installed cost. Figure 7 shows that the U.S. benchmark data attributes only 9% to installation labor. Combining installation labor, installer overhead and installer profit from Figure 7 gets us to 20%, indicating that the CEFIA "installation labor" raw data point could possibly include other cost contributions such as installer overhead and/or profit.

Customer acquisition cost in CT is estimated by speaking to installers to be $0.50/W, though this data point is not captured by the CEFIA incentive program dataset and therefore is assumed to be part of the Balance of System (BOS) cost of $1.07/W. The $0.50/W estimate is comparable to the $0.55/W number attributed to customer acquisition based on the U.S. composite benchmark in Figure 7.

Solarize versus Non-Solarize

In Connecticut, the Solarize Program has had a tremendous impact on reducing solar PV installation costs, so the CEFIA data presented in Table 6 shows complete CEFIA data, as well as data for non-Solarize and Solarize installations separated out for 2012 and 2013 data. Solarize installations in 2012 were $1.20/W or 23% lower in cost than non-Solarize installations, with about one-third of this cost difference due to lower hardware (i.e., module) costs and about two-thirds or $0.80/W due to lower soft costs. In 2012, soft costs for solarize installations were lower, 43% of installed cost, as compared to soft costs for non-Solarize installations, 48% of installed cost.

In preliminary 2013 data (from May 2013), Solarize installations are $1.03/W or 21% lower in cost than non-Solarize installations, with soft costs accounting for a $1.30/W cost reduction and hardware costs contributing a $0.27/cost *increase* for solarize versus non-solarize installations in 2013.[28] Soft costs for Solarize installations were 38% of installed cost in 2013 versus 57% for non-Solarize installations.

The soft cost components accounting for lower Solarize installation costs in 2012 are as follows: customer acquisition cost, installation labor, engineering and design cost, and balance of system (BOS) costs. BOS costs include installer overhead, profit, supply chain and other costs. Note that BOS costs in the CEFIA data may for some data points include some hardware costs such as wiring and racking for which there is no separate category in the CEFIA data. Installers may have reported these additional hardware costs either in the module cost number or in the BOS cost number. Racking and wiring costs together are estimated to be slightly higher than the cost of an inverter.[29]

Soft Costs in Germany versus Connecticut

Connecticut's Solarize Program has had the effect of reducing soft costs to an estimated 38% of system cost according to preliminary 2013 data. In Germany, where total installation costs are lower than in the United States, soft costs may contribute to an estimated 21-38% of total installation cost, based on data from 2011-2013. Table 6 allows for comparison of installed costs in Germany in 2011 and in 2013 as compared to the United States and in particular to Connecticut 2013 Solarize installation costs. Both hardware and soft costs are lower in Germany, with soft costs lower primarily in the following categories: customer acquisition; installation labor; permitting, inspection and interconnection (or PII); and other balance of system costs.

The 2013 Germany data presented in Table 6, obtained from a separate analysis by LBNL, reflects a higher number for soft costs in 2013 than in 2011.[30] The LBNL data on 2011 Germany soft costs were obtained via installer surveys and could be low end estimates in several categories based on LBNL's comparison of their surveyed soft costs for Germany to other reference points.

[28] See page 36 for discussion of increase in average hardware costs for 2013 versus 2012 Solarize projects.

[29] Alan Goodrich, Ted James, and Michael Woodhouse. *Residential, Commercial, and Utility-Scale Photovoltaic (PV) System Prices in the United States: Current Drivers and Cost-Reduction Opportunities,* NREL, Report TP-6A20-53347, February 2012, www.nrel.gov/docs/fy12osti/53347.pdf.

[30] 2013 Germany costs are courtesy of Joachim Seel, Galen Barbose and Ryan Wiser of the Environmental Energy Technologies Division at Lawrence Berkeley National Laboratory who provided an analysis of 2013 cost data obtained from the Germany Solar Industry Association (BSW-Solar) and from Photon International. The LBNL analysis provided total installed cost from BSW-Solar and module and inverter spot costs from Photon. Hardware cost was estimated using module and inverter spot costs plus an estimate for racking and wiring using the Goodrich cost model, specifically a multiplier of 1.14 for the cost of racking and wiring as compared to the inverter cost. The multiplier comes from cost component percent estimates for racking and wiring at 8% versus an inverter costing about 7% of total installed costs.

Table 7: Residential Solar PV Permitting, Inspection and Interconnection (PII) Cost Estimate Comparison

Fees/Costs ($/W)	U.S. 2010 data NREL/ LBNL survey	CEFIA 2012 data	Known/ Estimated Cost in CT	Comments
Permit fee	0.09	0.09	0.063	Known cost in CT is based on a $442 average permit fee in CT for a $35,000, 7kW system.
Interconnection fee	Not specified	0.03	0.014	Known cost in CT based on a $100 interconnection fee for a system of size < 10kW
Permitting, inspection and interconnection (PII) labor	0.13	0.11	0.18	NREL number represents PII labor. CEFIA data includes municipal and utility inspection costs but not permit preparation and submittal, which NREL analysis estimates to be $.07/W. Estimated CT cost is thus 0.11+.07=.18
Total	**0.22**	**0.23**	**0.26**	**Estimated CT PII cost based on known CT fees, adjusted using NREL and CEFIA data**

For examples:

- The LBNL survey estimated customer acquisition costs in Germany to be $0.07/W versus the $0.69/W for the United States per the NREL survey (or $0.50/W as reported by CT installers). A previous study by Langen, cited in the LBNL report, estimated U.S. and Germany customer acquisition costs to be higher, at $1.1/W for the U.S. and $0.4/W for Germany. The cost differences between the U.S. and Germany numbers, however, are similar at $0.62/W for both sets of comparisons.
- LBNL/NREL PII estimates are $0.24/W for the U.S and $0.03/W for Germany. Langen estimates PII at $0.80/W in the U.S. and $0.10/W in Germany, so the Langen estimates are higher for both, and suggest a bigger gap between U.S. and Germany PII costs.
- Installation labor in the U.S. is $0.59/W according to LBNL/NREL survey data and is estimated to be $0.23/W in Germany based on an LBNL survey. An EuPD study cited in the LBNL report estimated Germany installation labor at $0.42/W, still lower than U.S. installation labor but with a smaller difference. The estimate of $0.23/W for installation labor provided by Germany installers reflects 39 hours of installation time in Germany versus an average of 75 hours per system needed by U.S. installers.

Whether the 2011 or 2013 soft cost numbers for Germany are more accurate, it is clear that solar PV costs in the U.S. and Connecticut will not be able to reach Germany's cost levels without significant reductions in soft costs.

Improving Data Definition and Collection

As stated previously, the last cost component category in Table 6, identified as balance of system (BOS) cost, may include some hardware as well as some soft cost and thus introduces uncertainty into the analysis of CT data. Collaborators from the Yale team surveyed a small sample of solar PV installers and verified that some installers are including racking and wiring cost contributions with module (and therefore hardware) costs and in some cases with balance of system costs.

Further resolution on Connecticut residential solar PV cost components may be obtained by improving how cost component data is defined and collected through incentive program applications and/or by conducting a survey of Connecticut installers, similar to NREL's nationwide installer survey or LBNL's survey of Germany installers.

NREL and CEFIA Soft Cost Comparison

Comparing the NREL soft cost survey data to CEFIA data is not straightforward given differences in the cost component variables used and uncertainty in both sets of data. In the NREL data, surveyed soft costs amounted to about half of total soft costs, with the remaining soft costs still needing to be resolved, including installer overhead, profit, financing costs (non-labor), and other soft costs represented in Table 6 as Balance of System (BOS) costs. For the CEFIA data, BOS costs may include additional installer labor not captured by cost component categories in CEFIA's dataset and possibly some hardware costs such as wiring and racking as stated previously. Therefore, better data definition and collection is needed to obtain complete soft cost component breakouts.

Regardless of the differences in soft cost component categories as well as uncertainties in the data, some comparison can still be made for permitting, inspection and interconnection (or collectively, PII) data. Shown in Table 7, total PII costs represented in the NREL analysis are about $0.22/W for 2010 data and are $0.23/W in both CEFIA's 2012 and 2013 datasets. (Interestingly, Solarize installations appear to have higher PII costs than non-Solarize in CEFIA's 2012 and 2013 dataset, though there are uncertainties in the accuracy of the data and the 2013 data is still preliminary from May 2013). Table 7 provides a third comparison with estimated PII numbers based on known Connecticut permitting and interconnection fees, as compared to CEFIA data reported by installers through the incentive program.

As with soft cost component data in general, CEFIA PII data definition and collection could be improved. For example, it was discovered that some installers were reporting higher permit fees than others for similar sized systems in the same town. Some installers may have been including related costs such as permit preparation and labor as part of the reported permit fee cost. The data uncertainties prompted the team to collect permit fee data directly from all 169 CT jurisdictions to obtain a dataset that would inform a permit fee recommendation to the CT legislature. See section 7.2 of this report for details.

CEFIA Hardware and Non-hardware Cost Data

Table 8 and Figure 8 present CEFIA data collected through residential solar PV incentive programs from 2004-2013, including the current RSIP starting in March 2012. Residential solar PV hardware and non-hardware costs are presented by year, with non-Solarize and Solarize data broken out in 2012 and 2013.

Table 8: CEFIA Residential Solar PV Hardware and Non-Hardware Cost Data (2004-preliminary 2013 data)

Year; Non-Solarize vs Solarize	System Size (kW)	Total System Cost ($/W)	PV Module Cost ($/W)	Inverter Cost ($/W)	Hardware Cost ($/W)	Non-Hardware Cost ($/W)	% Hardware	% Non-Hardware	% Module Cost	Installed Capacity (kW)	# Projects Installed
2004	4.23	9.00	4.80	1.45	6.25	2.75	69%	31%	53%	13	3
2005	4.23	8.27	4.86	0.91	5.77	2.50	70%	30%	59%	266	63
2006	4.59	8.82	5.19	0.89	6.08	2.74	69%	31%	59%	496	108
2007	5.66	8.86	5.12	0.79	5.91	2.95	67%	33%	58%	1,229	217
2008	6.56	8.30	5.22	0.73	5.95	2.34	72%	28%	63%	3,140	479
2009	7.14	7.72	4.92	0.62	5.54	2.18	72%	28%	64%	3,355	470
2010	7.27	6.63	4.02	0.70	4.73	1.90	71%	29%	61%	3,178	437
2011	7.13	5.75	3.25	0.74	3.99	1.76	69%	31%	56%	1,568	220
2012	**7.00**	**4.95**	**1.80**	**0.67**	**2.59**	**2.36**	**52%**	**48%**	**36%**	**5,709**	**816**
2012 Non-Solarize	6.93	5.11	1.88	0.66	2.64	2.46	52%	48%	37%	4,864	702
2012 Solarize	7.42	3.91	1.30	0.78	2.24	1.67	57%	43%	33%	845	114
2013	**7.18**	**4.50**	**1.44**	**0.66**	**2.22**	**2.28**	**49%**	**51%**	**32%**	**3,362**	**468**
2013 Non-Solarize	6.88	4.89	1.43	0.59	2.11	2.78	43%	57%	29%	1,968	286
2013 Solarize	7.66	3.86	1.47	0.77	2.38	1.48	62%	38%	38%	1,395	182
										22,316	**3,281**

The following are observations about the CEFIA data in Table 8 and Figure 8:

1. Average system sizes increased from 2004 to 2013, with average system size in 2012 being 7kW.
2. Average total system costs have decreased from 2004 to 2013, most sharply between 2009 and 2012, with the average system cost in 2012 down to $4.95/W, or $34,650 for a 7kW system.
3. Average solar PV module costs decreased overall from 2004 to 2013, though costs increased slightly between 2005 and 2008 possibly due to the polysilicon shortage during these years. In 2013, module costs are beginning to flatten out/ stabilize.
4. Average hardware costs and total system costs have declined steadily from 2004-2013 following the decline in module costs.
5. Average inverter costs have stayed about the same after decreasing from 2004 to 2005 and have become a greater share of hardware as well as total costs as module costs have declined.
6. Average soft costs have been relatively flat. Soft costs have only decreased slightly overall and have increased in some years including from 2011 to 2012. Soft costs are increasing in terms of percent contribution to total cost.
7. From 2004-2011, hardware has been roughly 70% and soft costs have been roughly 30% of installed costs. In 2012, this ratio changed to 52% hardware and 48% soft costs. Preliminary data for 2013 is similar, with 49% hardware and 51% soft costs.
8. Table 8 shows significant cost reduction and most specifically soft cost reduction for Solarize installations

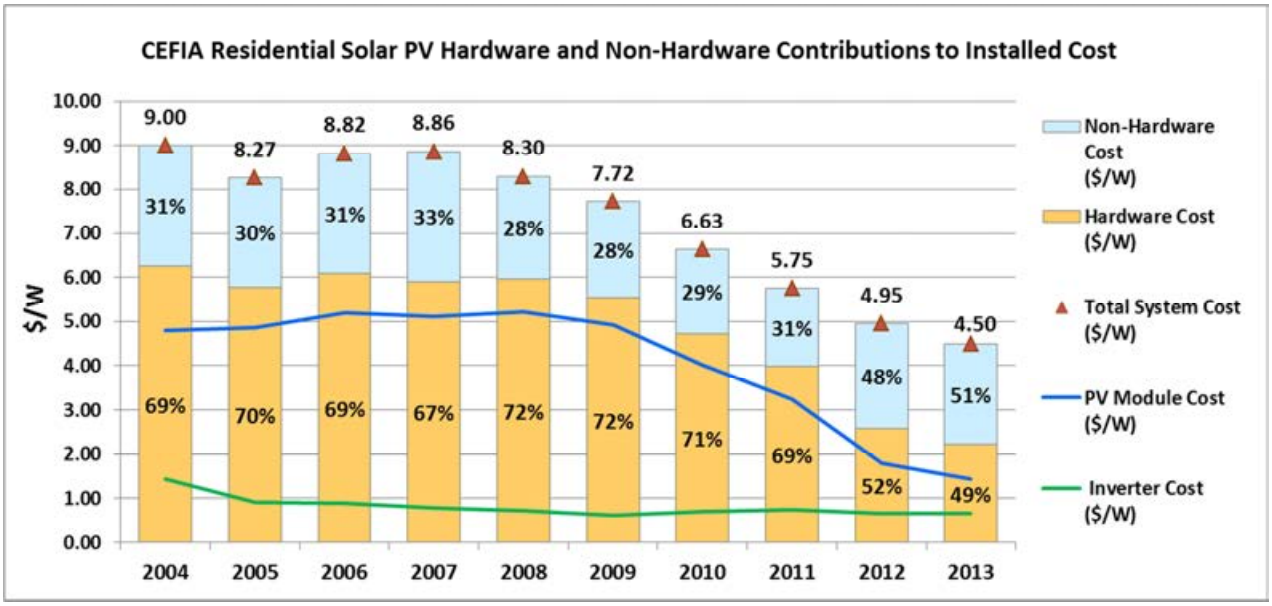


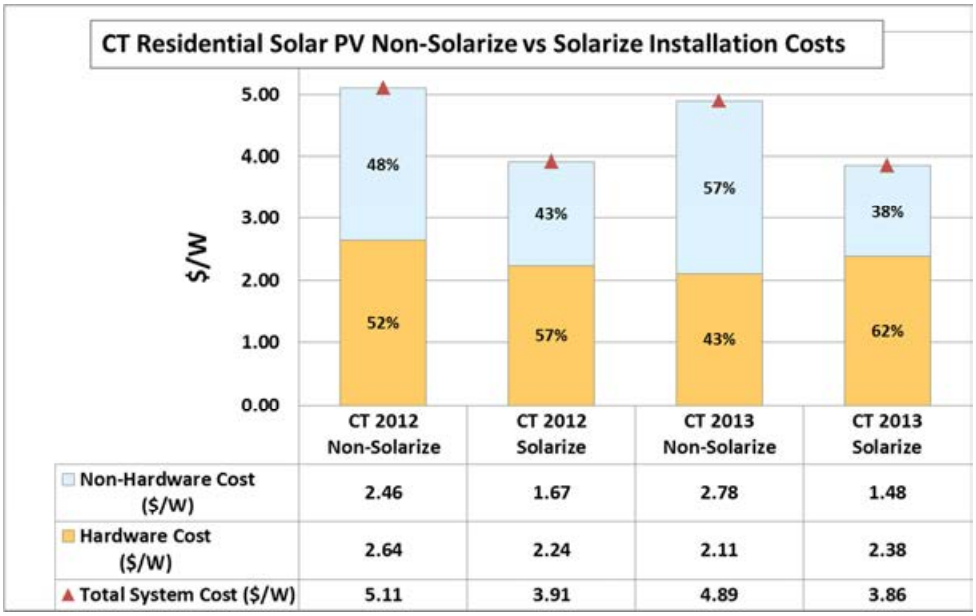
Figure 8: CEFIA Residential Solar PV Hardware and Non-Hardware Contributions to Installed Cost (2004-2013)

Solarize Program Impact on Soft Costs

CEFIA data point to a dramatic reduction in solar PV installation cost for installations deployed through the Solarize Program. Figure 9 shows the difference in overall costs as well as the differences in percent hardware and non-hardware costs for year 2012 and preliminary 2013 data.

The following are some observations about the data:

- Total system costs are higher for non-Solarize versus Solarize installations, $5.11/W versus $3.91/W in 2012 (a 23% reduction), and $4.89/W versus $3.86/W in 2013 (a 21% reduction).[31]



	CT 2012 Non-Solarize	CT 2012 Solarize	CT 2013 Non-Solarize	CT 2013 Solarize
Non-Hardware Cost ($/W)	2.46	1.67	2.78	1.48
Hardware Cost ($/W)	2.64	2.24	2.11	2.38
Total System Cost ($/W)	5.11	3.91	4.89	3.86

Figure 9: CEFIA Non-Solarize versus Solarize Hardware, Non-Hardware and Total System Costs (2012-2013)

- With respect to percent hardware versus percent non-hardware cost, Solarize installations reached $1.67/W in soft costs in 2012 or 43% of total system cost, and reached $1.48/W in soft costs in 2013 or 38% of the total system cost, significantly lower than for non-Solarize installations with soft costs at 48% in 2012 and 57% in 2013.
- The percent reduction in soft costs in 2012 for non-Solarize ($2.46/W) versus Solarize ($1.67/W) installations was 32%. For preliminary 2013 data, non-Solarize soft costs ($2.78) were almost twice as high as solarize soft costs ($1.48), representing a 47% reduction.
- **In 2012, two thirds or $0.80/W of the difference of $1.20 between non-Solarize and Solarize installation costs ($5.11/W versus $3.91/W) could be attributed to a reduction in soft costs.** In 2013, soft cost reductions were 126% of the difference of $1.03/W between non-Solarize and Solarize installations costs ($4.89/W versus $3.86/W). At the same time, hardware costs for Solarize installations in 2013 are actually higher by 26% as compared to non-Solarize installations. Note that 2013 data are preliminary, only including CEFIA data through May 10, 2013. Note also that the Solarize Program allows customers to pay extra for adders such as the use of U.S. made PV modules, so it will be important to assess the impact of adders on Solarize costs.
- Contributions to the Solarize versus non-Solarize cost reduction include reduced customer acquisition cost (from about $0.50/W estimated by CT installers to about $0.14/W) and likely include reductions in installer labor, overhead, profit, and other costs which may be amortized

[31] The $3.86/W price estimate for Solarize 2013 is based on May 2013 data. Solarize Phase 1 results presented in the report "Let's Solarize. Solarize CT Phase 1 Report" indicate that Solarize prices for 2013 reached less than $3.70/W. To access this report and additional information about Solarize, go to http://solarizect.com.

over a large number of installations. As stated previously, it is estimated that soft costs account for 2/3 of the difference in 2012 costs between non-Solarize and Solarize installations. See section 15.0 of this report for further information about the CT Solarize Program and program impacts. The exact non-Solarize versus Solarize numbers presented in this section versus section 15.0 may differ slightly due to the date the CEFIA data was accessed for each separate analysis.

- Lastly, CEFIA non-Solarize total system costs are elevated by $0.09/W due to certain third-party owned systems having higher than average prices.

5.0 Scaling up Solar PV Deployment in Connecticut

5.1 Installed Solar PV Capacity in Connecticut

Public Act 11-80 specifies ambitious targets for deployment of solar energy, including a target to install 30 MW of new residential solar PV by the end of 2022.[32]

Connecticut residential solar PV deployment has increased dramatically over the past two and a half years, as a result of clear and ambitious policy goals, effectively designed and well-managed incentive and financing programs and a tremendously effective Solarize campaign (now in its third phase).

As of June 28, 2013, the end of CEFIA's 2013 fiscal year, approximately 9.3 MW of additional solar PV (1325 projects) had been installed through CEFIA's Residential Solar Investment Program (RSIP) since its inception in March 2012. This additional 9.3 MW brings CEFIA's total to 23.3 MW of residential solar PV capacity (3430 projects) installed with support of CEFIA/CCEF administered ratepayer funds since 2004.

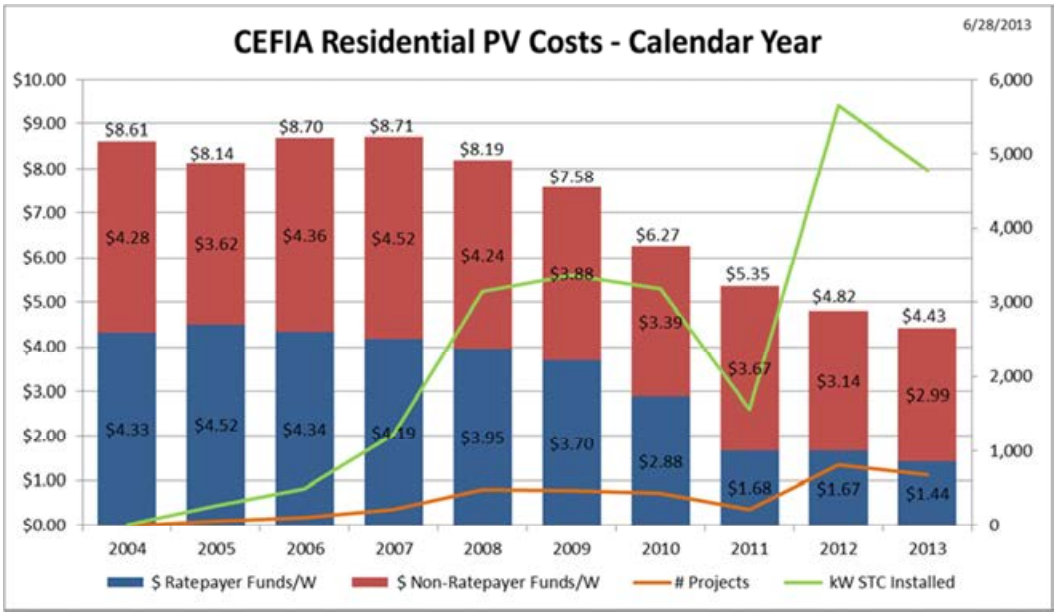


Figure 10: CEFIA Residential Solar PV System Costs Declining, Installation Volume Increasing, Ratepayer Cost Contributions Decreasing (2004-2013)

Figure 10 illustrates the ramp up of residential solar PV installations in 2012 along with decreasing costs and decreasing reliance on ratepayer funds. The ratepayer contribution to the cost of a residential solar

[32] Public Act 11-80, cga.ct.gov/2011/act/pa/2011PA-00080-R00SB-01243-PA.htm, and Conn. Gen. Stat. § 16-245n require CEFIA to establish a residential solar investment program that will result in a minimum of 30 MW of new residential solar PV installations in the state by the end of 2022.

PV system in Connecticut has dropped from approximately half of the cost historically to about one-third of the cost starting in 2011.

How much non-residential solar PV has been installed in Connecticut? Starting in 2001 and phasing out in 2011-2013, CCEF/CEFIA provided rebates for the installation of 254 commercial solar PV projects amounting to 23.6 MW of installed capacity through incentives programs such as the On-Site Distributed Generation (OSDG) Program. As of June 30, 2013, CEFIA's database included only a handful of commercial solar PV installations in 2012-2013, with 19 commercial installations completed in 2012 and one in 2013.

Incentives for commercial and industrial solar PV installations are now provided through the ZREC Program administered by Connecticut Light and Power (CL&P) and United Illuminating (UI). The 2012 ZREC auction resulted in commitments for approximately 26 MW of commercial and industrial solar PV installations anticipated on-line by the end of 2013.

For more information about the ZREC Program, see section 14.10 of this report, and the CL&P and UI websites.[33] Note also that the Commercial Property Assessed Clean Energy (C-PACE) Program provides a financing vehicle for adoption of clean energy including solar PV incentivized through the ZREC Program. For more information about C-PACE, see section 14 of this report on financing, as well as www.c-pace.com.

Adding up CCEF/CEFIA residential and non-residential solar PV installation data through June 2013, estimated CEFIA solar PV installation data from July-December 2013, and ZREC Program commitments to date provides for an estimated 82.3 MW in cumulative installed solar PV capacity in Connecticut (see Table 9).

Table 9: Estimate of CT Cumulative Solar PV Capacity Installed and Committed through 2013 (MW)

Residential and Non-residential Solar PV Installation Data Sources	CT cumulative installed solar PV capacity – 2013 (MW)
CCEF/CEFIA residential solar PV data (2004- June 2013)[34]	23.3
CEFIA residential solar PV data – estimated capacity (July-December 2013)	7
CCEF/CEFIA non-residential installation data (primarily 2001-2011, a few installations completed in 2012-2013)	23.6
ZREC Program 2012 – CL&P commitments for commercial and industrial solar PV (expected on-line in 2013)	21.0
ZREC Program 2012 – UI commitments for commercial and industrial solar PV (expected on-line in 2013)	5.1
Small ZREC Program 2013 – UI commitments for commercial and industrial solar PV (expected on-line in 2013, possibly 2014)	2.3
Total	**82.3**

[33] www.cl-p.com/Home/SaveEnergy/GoingGreen/Renewable_Energy_Credits/ and for UI: UI LREC/ZREC link and UI Small ZREC link

[34] Approximately 9.3 MW contributed from RSIP Program from March 2012-June 2013.

5.2 Solar PV Adoption Patterns

Project team members Marcello Graziano and William Waite from the University of Connecticut School of Business' Connecticut Center for Economic Analysis conducted a spatial distribution analysis to gain insight on patterns of adoption and adoption per capita for solar PV in Connecticut as spatially associated with factors such as community type (e.g., urban, suburban, rural), housing density (a proxy for multi-family versus single family homes), ownership structure (density of renters), and income (median household income levels).

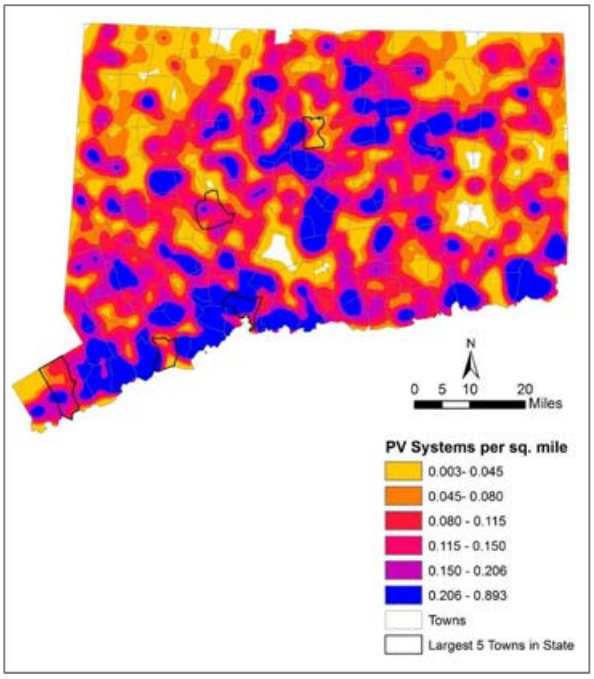


Figure 11: Cumulative Residential Solar PV Installations per Square Mile (with data grouped into quintiles)

Spatial distribution analysis has been well established in geography and other disciplines since the 1960s[35] and has recently come into use in crime analysis, epidemiology and other fields, in particular a type of spatial analysis called hotspot analysis.

A summary and excerpts from the analysis, "Rooftop Solar Adoption Pattern 2004-2012: Hotspots and Density Analysis," is provided here along with a link to the full report.[36] The data used in this analysis were residential solar PV data collected by CCEF/CEFIA through its incentive programs. The analysis used ArcGIS 10.1 and built-in modules for calculating, displaying and testing the results. The present analysis represents the first step towards a larger research effort and will be incorporated as part of a doctoral thesis by the authors. The thesis title is "Adoption of Diffused Renewable Energy Technologies: Patterns and Drivers of Residential Photovoltaic Systems in Connecticut, 2005-2013."The study relied on two methodological approaches, focusing primarily on the second:

1. Kernel Density Analysis (KDA) is an interpolation technique that forecasts the spatial distribution of point-features over a specified surface using actual observations points; and
2. Hot Spot Analysis or Getis-Ord Gi* Statistics (GOG) uses census block group[37] data to identify hotspots where higher (lower) values cluster non-randomly.

KDA uses actual observation points to simulate what the distribution would be in those areas where no observation points occur. The final result is a surface where the density of observation points is shown, with higher values where the observation points cluster together. Figure 11 shows dark areas where there are the most residential solar PV installations per square mile. The darkest areas represent areas of 0.206-0.893 installations per square mile. This first map, however, is misleading as each breakpoint (or change in color) in the data contains 16.67% of the total observations.

[35] Hagerstrand, T. "Innovation diffusion as a spatial process," 1968. cabdirect.org/abstracts/19691800901.html
[36] Full UConn report: ccea.uconn.edu/studies/SpatialStatisticsAnalysis-Hotspots_20130728release.pdf
[37] Block Groups (BGs) are statistical divisions of census tracts, are generally defined to contain between 600 and 3,000 people, and are used to present data and control block numbering. A block group consists of clusters of blocks within the same census tract that have the same first digit of their four-digit census block number. For example, blocks 3001, 3002, 3003,…, 3999 in census tract 1210.02 belong to BG 3 in that census tract. www.census.gov/geo/reference/gtc/gtc_bg.html

Figure 12 shows the same data but with the breakpoints (or changes in color) set at regular intervals each spanning a range of 0.15 in value. The darkest areas have PV system density of 0.75-0.9 solar PV systems per square mile, almost one system per square mile.

Figure 13 highlights the pattern of adoption across the state **with most solar PV systems occurring along the Connecticut River corridor and along the coast around but outside larger urban areas**. Milford, for example, has high solar PV installation density according to this map.

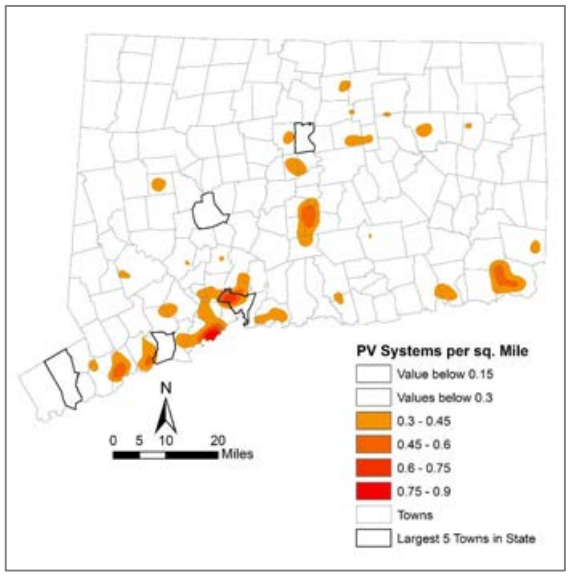


Figure 12: Cumulative Residential Solar PV Installation Data per Square Mile (same-sized data display intervals)

An advantage of KDA lies in the use of actual observed values rather than aggregated data. A disadvantage is that it does not weight or normalize results in terms of population, income, population density or any other socioeconomic variable. Due to this limitation, the UConn analysts used the GOG methodology for the rest of the analysis, allowing for identification of weighted concentrations of solar PV adoption as well as clusters of concentrated areas of PV adoption.

In GOG analysis, the data are aggregated, in this case by census block groups and weighted by population (number of rooftop solar PV systems per thousand residents). The block groups are then analyzed to identify statistically significant clustering among block groups of solar PV adoption data. Positive statistical values (with GiZScore > 1.96) represent clusters of block groups with high adoption (in terms of adoption per thousand people). The reddest colored polygons show the "hotspots" with the highest value clusters or concentrations of solar PV adoption. This spatial representation of solar PV adoption provides another perspective not evident from the KDA spatial analysis.

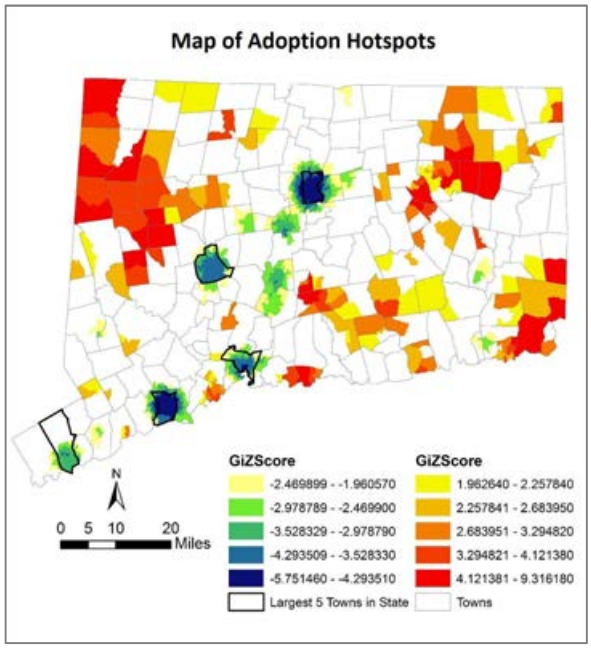


Figure 13: Residential Solar PV Adoption Map with Data Aggregated by Census Block Groups and Weighted by Population

What can be inferred from Figure 13 is that **lower per capita adoption rates cluster together around Connecticut's urban or most developed areas, with low adoption rates decaying towards the suburbs.** The pattern is similar for the five largest urban areas in CT around the cities of Bridgeport, Hartford, New Haven, Stamford and Waterbury. **Higher per capita adoption rates cluster together in rural areas in the northwestern and eastern portions of the state, with a few pockets in lower, central Connecticut. In the urban, developed areas of the state*, low solar PV adoption*** **relative to population is spatially associated with housing density** (high housing density, a proxy for more multi-family versus single family homes), ownership structure (high density of renters versus owners), and income (low median household income levels).

Figure 14 shows patterns of solar PV adoption associated with income levels. ***Solar PV adoption hotspots*** **(weighted for population) are spatially associated with areas that have low housing density, low density of renters, and median household income in the third and fourth quintiles of income (higher income levels but not necessary the highest levels).** The last observation about income levels suggests that once a certain income level is reached, the ability to adopt solar PV is there and then the decision to adopt depends on other factors. If solar PV can be made more accessible to all income levels, homeowners that are not necessarily at the highest income level may be just as or even more likely to adopt PV.

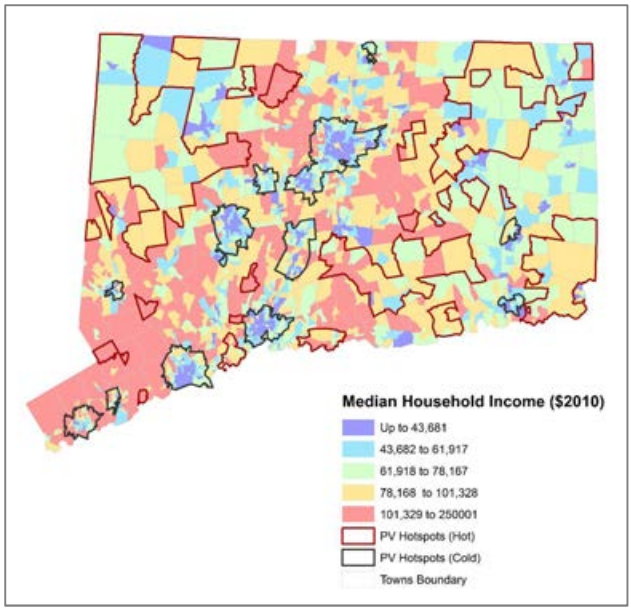


Figure 14: Residential Solar PV Adoption Associated with Higher Income Levels but the Highest Income Levels are not the Highest Adopters

There are many factors impacting solar PV adoption. An example of a factor in the multi-family sector, not yet discussed, is the ability to submeter for a building with tenants. A case study of a relatively high income all-rental building in New Haven discusses submetering considerations.[38] In 2011, a multiagency federal task force issued a report recommending submetering in building design and retrofits wherever there is economic justification.[39]

The lower adoption rates associated with high housing density areas (which likely include more multi-family housing), as well as areas with higher density of renters, points to the importance of policy, legislative and program strategies in supporting solar PV adoption.

5.3 Connecticut's 2013 Legislative Session – Support for Clean Energy

Connecticut's 2013 legislative session resulted in significant new laws and enhancements to existing laws providing another year of landmark legislative support for clean energy deployment, both energy efficiency and renewable energy. Building on the landmark Public Act 11-80 legislation passed in 2011, this year's session has been hailed as another milestone in terms of impactful policy and legislative support for the industry. For example, Public Act 13-61 enacted in 2013, provides for a property tax exemption for commercial and industrial systems, mentioned earlier in this report as being critical to ensuring economic viability in this sector, now supported by C-PACE financing. Without the exemption, the cash flow benefit from avoided electricity costs which makes solar PV and other clean energy improvements feasible would be offset by an increase in property taxes. Residential property tax exemption for clean energy systems has already been law.

The following are links to and highlights of 2013 legislative developments impacting clean energy deployment, along with a link to Public Act 11-80 from 2011 for reference. Additionally, summaries of the below public acts may be accessed from the CT Office of Legislative Research: www.cga.ct.gov/olr/olrpasums.asp or www.cga.ct.gov/olr/sitesearch.asp.

[38] "Building-Related Renewable Energy and the Case of 360 State Street," Sara C. Bronin, UConn - School of Law, Nov.27, 2012, Vanderbilt Law Review, Vol. 65, No. 6, 2012. papers.ssrn.com/sol3/papers.cfm?abstract_id=2181635

[39] NAT'L SCI. & TECH. COUNCIL COMM. ON TECH., SUBCOMM. ON BLDGS. TECH. RESEARCH & DEV., SUBMETERING OF BUILDING ENERGY AND WATER USAGE, at x, 15 (2011).

Table 10: 2013 Legislative Developments Supporting Deployment of Clean Energy (plus reference to PA 11-80)

2011 Legislative Session	
An Act Concerning the Establishment of the Department of Energy and Environmental Protection and Planning for Connecticut's Energy Future. Senate Bill 1243, Public Act 11-80. (cga.ct.gov/2011/act/pa/2011PA-00080-R00SB-01243-PA.htm, and www.murthalaw.com/publications/918-summary-public-act-number-11-80-act-concerning-establishment-of)	• Creation of Department of Energy and Environmental Protection (DEEP). Requires DEEP to develop a comprehensive State Energy Plan and establishes a variety of new programs to promote clean energy and energy efficiency. • Creation of Clean Energy Finance & Investment Authority (CEFIA).
2013 Legislative Session	
An Act Concerning Property Tax Exemptions for Class I Renewable Energy Sources. Substitute Senate Bill No. 203, Public Act No. 13-61. (cga.ct.gov/2013/ACT/PA/2013PA-00061-R00SB-00203-PA.htm)	• Property Tax Exemption – Mandatory commercial and industrial property tax exemption for Class I renewable energy sources.
An Act Concerning the Commercial Property Assessed Clean Energy Program. House Bill 6472, Public Act 13-116. (cga.ct.gov/2013/act/pa/2013PA-00116-R00HB-06472-PA.htm)	• C-PACE Enhancements – Benefit assessment during construction, foreclosure impacts in arrears and benefit assessment on property, mortgage holder consent, and district heating and cooling.
An Act Concerning Implementation of Connecticut's Comprehensive Energy Strategy. House Bill 6360, Public Act 13-298. (cga.ct.gov/2013/ACT/PA/2013PA-00298-R00HB-06360-PA.htm)	• On Bill Repayment – Residential sector financing tool for "clean energy," for which CEFIA is the statewide administrator. Also allows for financing of healthy home measures (e.g., asbestos removal). • Energize CT – Adaptation of the Solarize model to fuel conversions, heating equipment replacement, and energy efficiency in partnership with DEEP and utilities. • Renewable Energy and Efficient Energy Finance Program – $18 million of bond funds and collaboration between DEEP, DECD, and State Treasurer to provide grants, investments and loans for clean energy. • Expansion of Virtual Net Metering (v.n.m.) to state agencies and agricultural customers in addition to municipalities, increases max size from 2MW up to 3MW, allows for class III resources such as cogeneration, allows customers connected to a micro-grid to share credits with up to ten non-state or municipal critical facilities (e. g. hospitals, police and fire stations, and municipal centers).

An Act Concerning Connecticut's Clean Energy Goals. S.B. 1138, Public Act 13-303. (cga.ct.gov/2013/act/pa/2013PA-00303-R00SB-01138-PA.htm)	• Alternative Compliance Payments (ACP) – Redirects ACP from CEFIA back to the ratepayers to alleviate ZREC-LREC long-term costs. Provides consideration for large scale resource inclusion in RPS.

Solutions in Place: Simply Civic

Simply Civic provides a simple, fast and affordable online permitting solution for all of a jurisdiction's permitting needs. The system is now being piloted across the country and in Connecticut allowing the company to refine and improve the permitting system. Simply Civic is free to all Connecticut jurisdictions until December 2014 and at an affordable rate in 2015 and beyond.

6.0 Project Data Collection and Methodology

CEFIA and its project partners collected and analyzed data based on U.S. DOE Solar Metrics questions pertaining to rooftop solar PV soft costs and market barriers in the DOE Rooftop Solar Challenge action areas -- permitting, planning and zoning regulations, interconnection, and financing.

At the outset of the project, each jurisdiction designated an official point of contact who identified the appropriate municipal officials to survey or interview for each topic area. CEFIA and the Center for Business and the Environment at Yale (CBEY) then contacted those individuals by phone and email to initiate data collection and schedule interviews.

Several different types of survey instruments and questionnaires were developed primarily based on DOE Solar Metrics questions, including an online Qualtrics survey implemented by CBEY to collect permitting data. The project team also created various fillable forms and email questionnaires to collect data electronically. Interviews were conducted in person and by phone to collect follow-up permitting data (where clarity was needed or where omissions were made) as well as planning and zoning information from jurisdictions. The project team also collected data from solar PV installers to better understand processes and opportunities for improvement associated with permitting, planning and zoning and interconnection for solar PV. Information on interconnection was collected from the utility companies, CL&P and UI, through several in person meetings conducted by CBEY and CEFIA. Additional information was obtained via research on websites, attendance at webinars and conferences, reading the latest reports and analyses on soft cost related topics, and by consulting with experts in person and by phone. Later in the project, the team collected additional data from each jurisdiction including indicators of a jurisdiction's solar-readiness for display through an online rating system and map.

The data collection, analysis and related research provided the information needed by the project team to identify best practices and opportunities for improvements, and develop recommendations for business process improvements on the local, utility and state levels. The recommended tools and measures are designed to make solar PV installation easier, faster and cheaper in order to make solar PV accessible to more CT residents and business owners.

7.0 Permitting Processes in Connecticut

7.1 Summary of Findings and Conclusions

Improving permitting processes in Connecticut jurisdictions can help to reduce costs for solar PV installers, homeowners, business owners and jurisdictions, and will increase economic activity in the jurisdiction. Jurisdictions in Connecticut have a diverse set of requirements and processes for rooftop solar PV permitting.

The Sun Rise New England team has identified opportunities for improvement in the following aspects of the permitting process, generally applicable to any jurisdiction in Connecticut (more specific recommendations for each of the 12 participating jurisdictions are provided in Appendix I):

1. Information availability
2. Application submission
3. Review and inspection requirements
4. Permit fees

Inefficiencies in each of these areas increase the difficulty and time associated with getting a permit approved, resulting in a slower, more cumbersome and more costly permitting process. In addition, confusion resulting from inconsistent requirements across the state adds to the challenges encountered by installers seeking permits.

7.2 Rooftop Solar PV Permitting – Opportunities for Improvement

Information Availability

Incomplete permit applications from installers were reported to be the most time consuming and frustrating problems facing permitting departments (usually the building department). Although it is installers' responsibility to submit complete applications, it is often difficult for installers to determine what documents and processes are required for solar PV permits. Complete permit application packages reduce the time building department staff must spend on each permit application. Issues include:

- *Lack of Information availability online*—Although many Connecticut jurisdictions post online information pertaining to general permitting processes (including application forms, submission requirements, and contact information), our team did not encounter any CT jurisdictions that post solar PV specific permitting information on their websites. Thus installers have no way of determining which applications and documentation are required for rooftop solar PV permitting.
- *Inconsistent requirements*—Each jurisdiction in Connecticut has its own requirements, guidelines and permitting process. This lack of consistency across Connecticut causes confusion for installers and can lead to missing information in permit applications.

Application Submission

The process of submitting an application for solar PV installations can be labor intensive and confusing for installers working in Connecticut. In addition to unclear permitting requirements, installers are often required to make multiple trips to jurisdictions, submit numerous documents and move applications between several departments in order to obtain approval. Installers across the state have reported these application submission issues:

- *In-person Submission*—Although many jurisdictions enable installers to obtain applications online, only five of the 12 participating jurisdictions surveyed allow permit submission online or via e-mail. Requiring installers to travel just to submit an application in-person results in unnecessary time and expense for installers, ultimately increasing the cost for the jurisdiction's constituent who is adopting solar.
- *Notarized Documents*—Notarizing documents is time consuming, requires additional travel and is an unnecessary extra step in obtaining a permit for solar PV installation.

- *Numerous Department Approvals and Sign-off Sheets*—Some jurisdictions require numerous departmental approvals and signatures for rooftop solar PV installations. Of the 12 jurisdictions surveyed, half require three or more department approvals for a residential and/or commercial solar PV permit. Some jurisdictions require seven or more approvals in order to obtain a permit. Requiring many approvals delays decisions on permit requests and results in more work on the part of the jurisdiction to process permits. The table below shows our 12 partner towns and the number of residential (R) and commercial (C) approvals required for each.

Table 11: Number of Departments Requiring Approval for One Solar PV Permit Application

Number of Departments Requiring Approval

Multiple approvals for a single installation result in additional time and cost for solar PV installers, as well as a more complex and time-consuming process for municipal staff. R refers to residential and C for commercial. Coventry, Middletown and Milford (residential) require approval from only one department, a best practice.

Town	1	2	3	4	5	6	7
Bridgeport							R/C
Cornwall		R/C					
Coventry	R/C						
Danbury			R/C				
Fairfield			R/C				
Greenwich					R	C	
Hampton		R/C					
Manchester		R	C				
Middletown	R/C						
Milford	R	C					
Stamford				R			C
West Hartford		R/C					

Permit Review and Inspection Requirements

Permit application review and inspection of the solar PV systems can be arduous and take up more time than necessary. The biggest factors that slow down this process are:

- *Unnecessary reviews:* Reviews conducted by professional engineers and requiring an engineering stamp of approval can be costly, time-consuming and should not be required on every installation, just those for which it is needed. (Thus one recommendation is to come up with a method for eliminating unnecessary review by a professional engineer).
- *Unnecessary Inspections:* Rooftop solar PV systems are sometimes subject to additional and unnecessary inspections due to lack of familiarity or training to know what is most critical to inspect for.
- *Appointment windows:* Eight out of the 12 jurisdictions surveyed schedule inspections during 30 minute up to four hour time windows. Coordinating these long windows with installers and homeowners can be difficult and time consuming.

- *Multiple Inspection trips required:* Multiple inspection appointments scattered throughout an installation add more time that an installer, homeowner, and inspector must coordinate.

Table 12: Inspection Practices - Specific Appointments versus Windows of Time; Single versus Multiple Inspection Appointments

Town	Specific Appt Time	Window of Time	Single Inspection Appt (Comprehensive, or Specific as noted)	Multiple Inspection Appts[40]
Bridgeport		R/C		R/C
Cornwall	R/C		R (roof penetration pre-install)	C
Coventry		R/C	R/C	
Danbury		R/C		R/C
Fairfield		R/C		R/C
Greenwich		R/C		R/C
Hampton	R/C		R/C	
Manchester		R/C	R/C	
Middletown		R/C	R/C	
Milford	R/C		R/C (structural/ building final)	
Stamford		R/C		R/C
West Hartford		R/C	R/C[41]	

Time Required to Secure a Rooftop Solar PV Permit

Best practices reduce the man-hours required to obtain a permit. Appendix III, question eight captures installers' estimates for what they consider to be fast, average and slow permit process times in CT in terms of man-hours required to secure a solar PV permit (excluding travel time). Residential permit process times in CT range from 10 minutes up to "hours and days," and commercial process times range from 10 minutes up to 30 hours. This data helps target a lean processing time of 10 minutes, certainly for straightforward applications.

Permit Fees

Detailed research on solar PV permit fees for this project, over and above DOE Solar Metrics data collection, focused primarily on residential permit fees, though many of the findings and recommendations translate to commercial permit fees as well. For example, the recommendation to waive or reduce fees to cost-recovery based flat fees is applicable to commercial systems, just with higher numbers involved. Currently, most jurisdictions

Inspection Best Practices: Hampton, Milford and Middletown

Hampton, Milford and Middletown make inspections easier for installers and customers of both residential and commercial solar PV systems by requiring a single instead of multiple inspections and by scheduling specific inspection appointment times instead of a window of time that can be as long as four hours.

[40] See Appendix II, question 48, for more details on number and types of inspections (electrical rough-in, electrical final, roof penetration pre-install, structural/building final) for each of the 12 participating jurisdictions.
[41] West Hartford requires multiple inspection types for commercial systems but does all the inspections in one trip.

in CT use a value-based fee structure for calculating permit fees for both residential and commercial solar PV systems, specified differently jurisdiction by jurisdiction based on the cost of the project (usually specified for the first and then subsequent $1000s).

Permitting fees for residential rooftop solar PV across CT's 169 jurisdictions range from $0 (Manchester and Bridgeport) to approximately $1575, and average $428 for an average sized 7kW, $35,000 residential system in 2012. Fees are higher for costlier systems even though a municipality's work involved in permitting a residential system does not increase significantly with system cost or size. Jurisdictions charging high permit fees for residential solar PV installations may be collecting payments much higher than actual municipal processing expenses. Installers not familiar with a specific town's fee structure may underestimate the fee when providing an estimate to a customer. Constituents may not know that their jurisdiction is making it more difficult to go solar by charging an excessive fee and increasing the overall price they need to pay for their solar PV system.

Figure 15 illustrates the variation in residential solar PV permit fees across CT's 169 jurisdictions in comparison to a recommended $200 flat fee, representing an estimate of average municipal processing costs including permit application review and inspection.[42] A flat $200 permit fee for residential solar PV would, for the majority of Connecticut jurisdictions, save constituents a considerable amount on installation costs. If permit fees were waived or a flat fee no greater than $200 were adopted, CT residents could save on average $228 per installation and almost $1400 in jurisdictions with the highest permit fees.

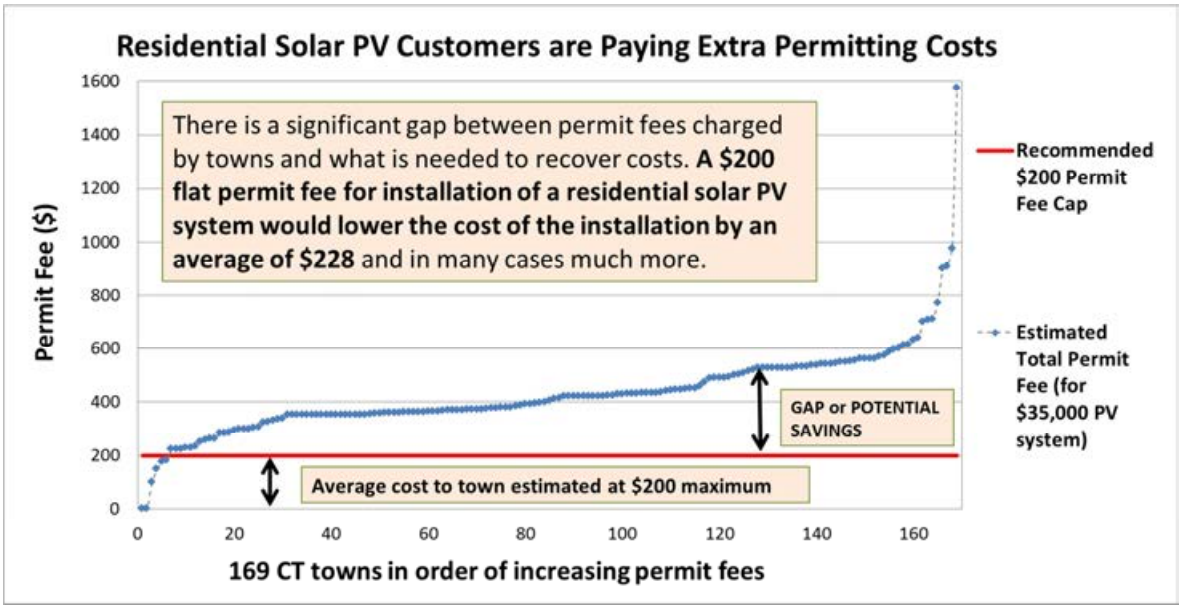


Figure 15: Residential Solar PV Customers are Paying Permit Fees In Excess of Estimated Processing Costs

[42] The cost to a CT jurisdiction for reviewing a solar PV permit application and conducting an inspection was estimated by collecting data directly from jurisdictions on the amount of time required for various aspects of the permit processing, multiplying these time estimates by maximum state of CT labor rates, and adding in travel costs and maximum overhead charges. Based on these calculations, the cost to a jurisdiction was conservatively estimated to be $100-150. A flat fee of no more than $200 is anticipated to cover a jurisdiction's costs.

The following CT jurisdictions have waived fees or adopted a flat permit fee for solar PV and in some cases clean energy systems more broadly:

- Bridgeport and Manchester have waived permit fees for all class I renewable energy systems[43]
- Bethany adopted a $150 flat fee and Chester adopted a $100 flat fee for residential solar PV systems as part of their participation in the Connecticut Solar Challenge[44]
- Durham has a $204.16 flat fee for residential solar PV systems
- Windham reduced its fee by 50% for residential installations put in place by CTech Solar through the Solarize Program.

How do permit fees impact deployment of residential solar PV in CT jurisdictions? CEFIA analysis done for this project of CT solar PV installation and permit fee data indicates that there is a relationship between permit fees and number of installations per capita, in particular, a moderate inverse or negative correlation. Towns with higher permit fees are more likely to have fewer solar PV installations per capita than those with lower fees. Towns with higher numbers of solar PV installations per capita are more likely to have lower permit fees. As more towns waive or adopt lower, flat fees, this correlation will likely bear out more strongly.

In summary, the team identified the following permit fee practices that increase the cost and difficulty of obtaining a rooftop solar PV permit:

- *Value-based fee structure*: Using the valuation-based method of calculating fees can result in high, unpredictable permitting fees.
- *Payment in-person:* Requiring payment of permit fees in-person adds time and cost for installers, increasing cost of installation.
- *Permit fees for public buildings:* Some jurisdictions require permit fees for public buildings including schools and municipal buildings. These fees are an unnecessary cost to installers.

Permit Fee Best Practice: Manchester and Bridgeport

Manchester waived its permit fee for all Class I renewable projects in March of 2012. In December 2012, Bridgeport waived permit fees for Class I renewable energy projects (outside of supporting construction such as “footings and foundations”).

[43] cga.ct.gov/2012/sup/chap541.htm - Sec29-263.htm, "(c) Any municipality may, by ordinance adopted by its legislative body, exempt Class I renewable energy source projects from payment of building permit fees imposed by the municipality."
[44] ctsolarchallenge.com

Figure 16: "Go SOLAR Chester!" Signage for the CT Solar Challenge, Courtesy of Michael Phillips

8.0 Rooftop Solar PV Permitting Recommendations for Jurisdictions

Connecticut's Sun Rise New England team, led by CEFIA, has identified some of the best rooftop solar PV permitting practices in Connecticut and nationwide.[45] All jurisdictions are encouraged to consider these improvements.

8.1 Make Information Available

- **Bring Permitting Online:** Make information and resources pertaining to your solar PV permitting process and fee available and easily accessible via your jurisdiction website. Use online permitting software (see "Adopt Online Permitting" in section 8.2) to bring your process online.
- **Create a Clean Energy Webpage** on your jurisdiction's website. Provide links to resources such as the Sun Rise New England and EnergizeCT websites. EnergizeCT is a state initiative to provide energy-related information and resources.[46] Constituents would also want to know about local clean energy projects and activities, policies and incentives, your clean energy task force (if applicable), and successes and participation in programs such as the Rooftop Solar Challenge, Solarize, the Clean Energy Communities Program, the CT Solar Challenge, and C-PACE.[47] See West Hartford, Greenwich, Cornwall, Coventry, Hampton and Middletown clean energy websites for examples, though each jurisdiction should review their sites for potential updates and additions.[48]

[45] These recommendations are also included in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ and as a stand-alone document in the Permitting Guide tab of the Sun Rise New England – Open for Business website.
[46] energizect.com/SunriseNE and more generally, energizect.com
[47] Rooftop Solar Challenge, eere.energy.gov/solarchallenge; SunShot Initiative, eere.energy.gov/solar/sunshot; Solarize, solarizect.com; Clean Energy Communities Program, energizect.com/communities/programs/clean-energy-communities or ctenergydashboard.com/CEC/CECHome.aspx; CT Solar Challenge, ctsolarchallenge.com; C-PACE, c-pace.com.
[48] Cornwall: cornwallctenergy.org; Coventry: www.coventryct.org/index.aspx?NID=175; *footnote continued…*

- **Promote** your clean energy webpage, timely programs and solar PV adoption with radio and newspaper announcements, newsletters and environmentally friendly signage.

8.2 Streamline Permit Application Submission

- **Adopt the Standardized Solar PV Permit Application:** Clarify requirements and increase consistency across jurisdictions by adopting a standardized rooftop solar PV permit application package as provided in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ on the Sun Rise New England webpage.[49] Incorporate the standardized application into online permitting.
- **Simplify the Application Process:** Make one department responsible for the rooftop solar PV permitting process and reduce the number of steps and unnecessary requirements asked of installers.
- **Adopt Online Permitting:** Adopt an online permitting system[50] to enable applicants to obtain and submit solar PV permit application materials online. Otherwise, allow installers to obtain and *submit* permit application materials through your website, by email, or by regular mail. This change saves installers time-intensive and costly trips to jurisdiction offices.

8.3 Waive or Reduce Permit Fees

- **Waive or Reduce Fees:** Towns may encourage solar installations by waiving solar PV permit fees.[51] If not a full waiver, consider a low or flat fee based on cost recovery instead of a value-based fee structure that may not accurately reflect the cost of solar PV permit review and inspection. Research in CT indicates that it should cost no more than $200, usually less, for a town to permit a small-scale (generally residential) rooftop solar PV installation. Streamlining processes can help reduce costs to jurisdictions so that the fee more than covers a jurisdiction's cost. For examples, Bridgeport and Manchester waive permit fees for all class I renewable energy systems, and Durham has a flat fee for solar PV permits.
- **Allow for Payment Electronically or by Mail:** Allow installers to pay permit fees online, electronically, or by regular mail to save driving time and cost.

8.4 Streamline Review and Inspection Requirements

- **Train Staff:** Require jurisdiction staff involved in solar PV permitting to participate in relevant solar PV training, at minimum by accessing a free online training course comparable to the "Photovoltaic Online Training for Code Officials" offered on the National Training & Education Resource (NTER) website.[52]

Greenwich: www.greenwichct.org/Government/Commissions/Conservation_Commission/Cean_Energy_Community;
Hampton: www.hamptonct.org/committee.htm?id=fhsb77u5;
Middletown: www.cityofmiddletown.com/content/81/750/1840/default.aspx;
West Hartford: west-hartford.com/government/CleanEnergy.htm and www.westhartford.org/living_here/green/west_hartford_clean_energy_task_force.php

[49] energizect.com/SunriseNE

[50] For examples, see: Simply Civic, simplycivic.com; City View, msgovern.com/software/cityview; View Permit, viewpermit.com.

[51] cga.ct.gov/2012/sup/chap541.htm - Sec29-263.htm, "(c) Any municipality may, by ordinance adopted by its legislative body, exempt Class I renewable energy source projects from payment of building permit fees imposed by the municipality."

[52] Photovoltaic Online Training For Code Officials: nterlearning.org/web/guest/course-details?cid=402

- **Remove Excessive Reviews:** Jurisdiction staff should identify and remove reviews that are not critical to safe and efficient operation of a proposed rooftop solar PV system. In particular, unnecessary and costly engineering reviews should be eliminated by specifying criteria and a methodology for determining when these reviews are needed.
- **Waive Building Permit Requirement for Approved Designs:** The ordinance should waive the building permit requirement for certain pre-approved or basic solar models, such as flush-mounted solar panels and/or panels that do not exceed certain size or weight limitations. This waiver could be formulated to be stricter for solar collectors installed in high-wind zones.
- **Simplify the Inspection Process:** The CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ offers resources and suggestions for improving inspection processes such as: (1) When an inspection is required, conduct a single, comprehensive inspection instead of multiple inspections. (2) Schedule specific appointment times for inspections instead of windows of time. This saves everyone, especially residents and business owners, time, money and frustration.
- **Shorten Permit Approval Times:** By Connecticut law, a permitting decision must be made within 30 days.[53] However, a shorter timeframe encourages installers to do business in your jurisdiction and speeds up the time between a customer's intent to generate clean energy and their ability to do so. Consider the best practice of issuing permits in as short a time frame as possible, for example on the "same day" or "over-the-counter" for standard small-scale rooftop solar PV systems that clearly meet your jurisdiction's permit approval criteria.

8.5 Formalize Best Practices

- **Adopt a Solar Friendly Ordinance** using the model elements offered in "Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions," found in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹. Adopting elements of a solar friendly ordinance removes unnecessary barriers to solar energy installation and formalizes your jurisdiction's commitment to making rooftop solar PV permitting easier and less costly for your constituents.

[53] ct.gov/dcs/cwp/view.asp?a=4218&q=305412. The 30 day permit decision time is from the State Building Code, namely the 2005 Connecticut Supplement which includes the 2009 Amendment (effective August 1, 2009) to the 2005 State Building Code. The language of the code amendment also encourages building officials to issue a permit as soon as practicable once the official is satisfied that the proposed work meets all requirements.

8.6 Connecticut Rooftop Solar PV Permitting Guide

The CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ provides all solar PV stakeholders with recommendations and tools to make the solar PV permitting process simpler, easier and more efficient. By adopting the recommendations and tools offered, jurisdictions can reduce their administrative costs, lower installation costs for solar PV installers and property owners, attract business to the jurisdiction and enhance opportunities for local and state solar PV markets to grow. Reducing soft costs makes solar energy more affordable, helping to put solar photovoltaic (PV) systems on more Connecticut rooftops.

The GUIDE ✹ highlights effective rooftop solar PV permitting practices, focusing on the following areas:

- Information availability
- Application submission
- Review and inspection requirements
- Permit fees
- Formalizing solar-friendly practices

The complete guide along with stand-alone forms and templates implementation) will be available in the Permitting Guide tab of the Sunrise New England – Open for Business website.[54]

The contents of the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ include the following:[55]

ROOFTOP SOLAR PV PERMITTING RECOMMENDATIONS FOR JURISDICTIONS
CONNECTICUT STANDARDIZED SOLAR PV PERMIT APPLICATION PACKAGE
ONLINE PERMITTING
TRAINING STAFF IN ROOFTOP SOLAR PV SPECIFICS
OPTIMIZING JURISDICTION REVIEW AND INSPECTION PROCESSES
SAMPLE SOLAR PV SYSTEM FIELD-INSPECTION CHECKLIST
A PERMIT FEE STRUCTURE THAT PROMOTES RENEWABLE ENERGY
FORMALIZE YOUR JURISDICTION'S COMMITMENT TO CLEAN ENERGY
PLANNING AND ZONING RECOMMENDATIONS FOR JURISDICTIONS
ROOFTOP SOLAR PV MODEL ORDINANCE FOR CONNECTICUT JURISDICTIONS
SOLAR SITE DESIGN WORKSHEET FOR A PROPOSED SUBDIVISION
BECOME AN AWARD-WINNING MEMBER OF THE CLEAN ENERGY COMMUNITY!
SOLAR-READY CLEAN ENERGY COMMUNITY CHECKLIST
APPENDIX I – TEMPLATE LETTER TO MUNICIPALITY SUGGESTING USE OF PERMITTING GUIDE

8.7 Model Solar PV Ordinance for Jurisdictions

The Connecticut Rooftop Solar PV Permitting Guide ✹ includes a model solar-friendly ordinance for solar PV installation which may be adjusted for suitability to each town and is provided as a stand-alone, editable document in the Permitting Guide tab on the Sunrise New England – Open for Business website.

[54] www.energizect.com/sunrisene
[55] Note that the topics included in the Permitting Guide may change slightly before the Guide is finalized.

8.8 Online Permitting

An online permitting system saves resources, time and money. Online permitting systems vary but ideally would have most or all of the following characteristics and functionality:

- Be user friendly, with clear instructions on how to use the system.
- Handle rooftop solar PV permitting as well as other types of permitting.
- Provide download options for permitting applications such as the Connecticut Standardized Solar PV Permit Application Package
- Include an upload option for completed permit applications.
- Offer an interactive workflow for inspections, notifications and next steps.
- Display approval-status information.
- Provide downloadable approval documents.
- Allow online payments for jurisdictions that still require a permit fee for Class 1 renewables.

Online permitting systems bring efficiency to permitting processes across jurisdictions. Consistency and transparency allow installers and municipalities to handle higher volumes of permit requests, and enable the state of Connecticut to meet its goal of scaling up solar PV deployment.

The CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ offers examples of online permitting systems in place or being developed for use in Connecticut and across the country. These include Simply Civic, ViewPermit, CityView and CRW Systems Trakit. Featured here is Simply Civic, one of the Connecticut project partners. Descriptions for the other online permitting systems provided as examples here are available in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹.

In June 2012, Simply Civic was awarded funding under the U.S. Department of Energy SunShot Incubator Program to develop a software package designed to reduce the solar PV soft costs arising from administrative processes at the municipal level.

Simply Civic provides jurisdictions with a simple, fast and affordable online permitting solution for solar PV (as well as a jurisdictions' other permitting needs, if desired). The online platform allows permit applicants and building department staff to seamlessly collaborate during the permit application, review and approval processes. Benefits to municipal staff include reduction or elimination of phone calls and emails, automatic tracking and storage of permit applications, potentially fewer incomplete applications due to a more transparent and user-friendly permit application and process, and the possibility of a higher volume of applications processed with the same amount of work, benefiting the local economy. Benefits to installers include reduced or eliminated travel time and expense, potentially fewer questions from the municipality and fewer application resubmissions needed due to a more transparent and user-friendly permit application and process, and the ability to submit more applications for the same amount of work (thereby more business and more profit).

Simply Civic is a Sun Rise New England Project partner, contributing to the project team's goal of making online permitting an option for any of Connecticut's 169 municipalities, including those with limited resources. The Simply Civic platform is available free of charge to Connecticut jurisdictions during an extended pilot period.

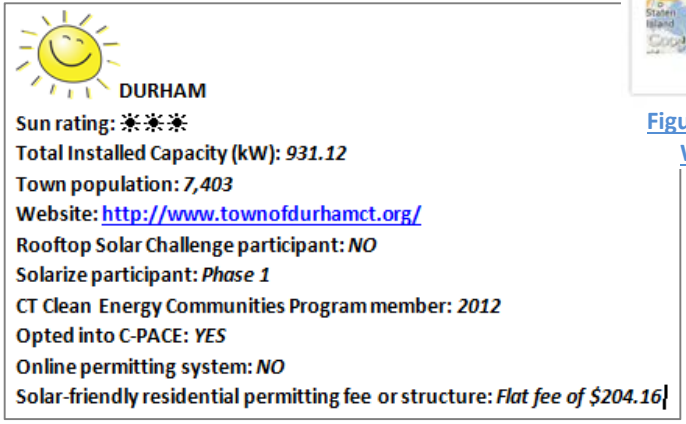
8.9 Solar-Ready Municipality Rating Map – Is Your Town Open for Business?

The Sun Rise New England team created a clickable map of CT jurisdictions presenting information for each jurisdiction that allows installers and solar PV customers to see how the jurisdiction is rated in terms of solar-readiness or solar-friendliness. Version one of the map captures the following variables, and will be expanded to include indicators for endorsement of the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹, adoption of the CT Standardized Solar PV Permit Application Package and other tools and measures and tools recommendations contained in the GUIDE ✹.

The variables currently captured in this version are as follows:

- ✹ Total Installed Capacity (kW)
- ✹ Town Population
- ✹ Website
- ✹ Rooftop Solar Challenge participant: *YES/NO*
- ✹ Solarize participant
- ✹ CT Clean Energy Communities Program member: *YEAR*
- ✹ Opted into C-PACE: *YES/NO*
- ✹ Online permitting system: *YES/NO*
- ✹ Solar-friendly residential permitting fee or structure

Below is the town of Durham's scorecard as an example. The scoring formula will be updated when the list of indicators is expanded.



DURHAM
Sun rating: ☀☀☀
Total Installed Capacity (kW): ***931.12***
Town population: ***7,403***
Website: http://www.townofdurhamct.org/
Rooftop Solar Challenge participant: ***NO***
Solarize participant: ***Phase 1***
CT Clean Energy Communities Program member: ***2012***
Opted into C-PACE: ***YES***
Online permitting system: ***NO***
Solar-friendly residential permitting fee or structure: ***Flat fee of $204.16***

Figure 17: Sun Rise New England – Open for Business Website Solar-Readiness Rating for the Town of Durham

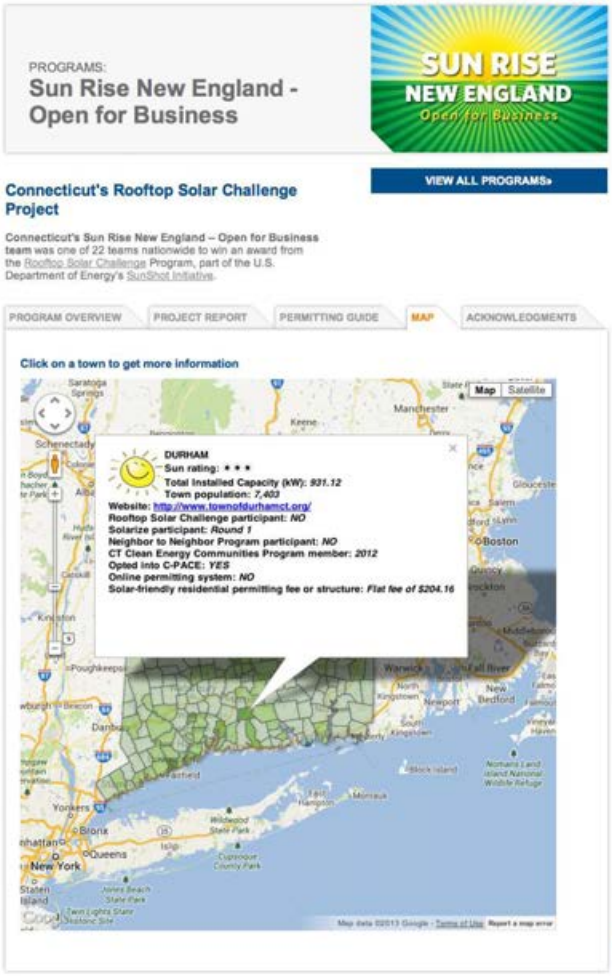


Figure 18: Sun Rise New England – Open for Business Website, Solar-Ready Municipality Rating Map

Figure 19: New Haven Lighthouse Solar PV Installation, Courtesy of Ross Solar Group

9.0 Permitting Recommendations for the State of Connecticut

As presented above, there are a number of ways jurisdictions can streamline the permitting process for rooftop solar PV, reducing the time and expense necessary for installation. The State of Connecticut can play an important role in streamlining these processes.

9.1 Waived Fee or Flat Fee Based on Cost-Recovery Fee Structure with a Cap

The majority of Connecticut jurisdictions do not have a cap on solar permitting fees and instead calculate the permitting fee based on the value of the solar PV system. In order to give installers more certainty when creating project budgets and to ensure a reasonable permitting fee, the Sun Rise New England team recommends that the State legislate a flat, cost-recovery based permit fee structure no more than a specified cap (e.g., $200 for residential solar PV) for those jurisdictions that have not already chosen to waive (or reduce) fees as enabled by Connecticut General Statutes Section 29-263.[56] Research conducted by states across the country including that done by the Connecticut project team supports implementation of a permit fee structure that allows a jurisdiction to recover costs incurred during the permitting process including application review and inspection, but no more than that cost.

A permit fee cap would motivate jurisdictions to optimize and streamline inefficient solar PV permitting processes to keep jurisdiction costs down. However, a cap alone would not bring about desired permit fee reductions. While some jurisdictions would bring their fees down to the permit fee cap, others could raise their fees up to the cap resulting in the statewide average fee remaining largely unchanged. The requirement of either a waived fee, or a *cost-recovery* based flat fee that complies with a cap would result in reasonable permitting fees and processes throughout the state.

[56] cga.ct.gov/2012/sup/chap541.htm - Sec29-263.htm, "(c) Any municipality may, by ordinance adopted by its legislative body, exempt Class I renewable energy source projects from payment of building permit fees imposed by the municipality."

In addition to adopting a permit fee waiver or a capped flat fee, each jurisdiction should be required to post its waived or flat fee amount online to increase transparency.

Legislation has been an effective means in other states such as Arizona, California and Colorado to reduce permit fees and bring about more transparency and fairness in how permit fees are calculated. The project team modeled proposed legislation for CT, and the permit fee recommendation for CT jurisdictions more generally, on elements of the laws passed in three states:

- The California[57] and Colorado[58] legislation are very similar and have four major aspects. First, they acknowledge that there is a state-wide need for certainty regarding solar permitting fees. Second, they restrict municipalities from charging more for a solar permit than the estimated reasonable cost of providing the services. Third, they provide specific limits on the dollar amount that municipalities may charge for a roof-top solar permit ($500 for residential and $1000 for commercial systems, with justified exceptions). Fourth, the laws require municipalities to clearly identify each fee and report them to the applicant in response to the permit application. Note that the California law specifies additional fees of $15 for each kW over 15kW for residential rooftop solar energy systems, $7 for each kW between 51kW and 250kW, and $5 for every kW above 250kW for commercial rooftop solar energy systems.
- Arizona[59] has similar legislation but without a permit cap. The law states that: “any building permit for solar construction must be attributable to and defray or cover the expense of the service for which the fee or charge is assessed. A fee or charge shall not exceed the actual cost of issuing a permit, and a written, itemized list of the individual costs associated with the permit fee shall be provided at the request of the permittee.” Before adopting a standard permit fee, the county or municipality must hold a public hearing with at least fifteen days of public notice.

The proposed legislation for Connecticut combined aspects of the above existing legislation; it became a bill but was not given a public hearing before the end of the 2013 legislative session. The 2013 legislative session, summarized in section 5.3 of this report, was already very successful in terms of increased support for clean energy deployment, including a municipal property tax waiver for commercial and industrial properties, so perhaps the permit fee legislation will be reconsidered in 2014.

Given existing enabling legislation in CT, mentioned above, outreach to waive or reduce permit fees will continue whether it is mandated by legislation or not. This project has created a rating system and map on the Sun Rise New England - Open for Business website which tracks and presents information showing which jurisdictions have adopted permit fee reductions along with other soft cost related measures and tools. Jurisdictions that are solar-friendly and “open for business” will be more likely to attract installers to their communities. See section 8.9 of this report for more information about the rating tool and map.

9.2 Mandatory permit decision deadline

The state currently requires jurisdictions to approve or deny permits within 30 days of a completed application submission. A shorter mandatory limit for solar PV permitting turnaround time will hold jurisdictions accountable for delays and give installers more certainty regarding the installation schedule. Based on feedback from jurisdictions surveyed, the Sun Rise New England team suggests a 14-day decision deadline from the date of a complete application submission.

[57] California Senate Bill 1222: leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120SB1222
[58] Colorado Senate Bill 117: www.leg.state.co.us/CLICS/CLICS2008A/csl.nsf/fsbillcont3/1109D26989FEC52B872573D000791515?Open&file=117_enr.pdf
[59] Arizona House Bill 2615: www.azleg.gov/legtext/48leg/2r/bills/hb2615s.pdf

9.3 Improve the State Building Code and Allow Stretch Codes

The current State Building Code of Connecticut is found on the website of the Office of the State Building Inspector[60] and includes:

- The 2005 CT Supplement which was approved in 2005
- 2009 and 2011 amendments
- Corrections to wind load data for several towns.

The 2005 CT Supplement includes the following model national and international codes:

- 2003 International Building Code (IBC)
- 2003 International Existing Building Code (IEBC)
- 2003 International Plumbing Code (IPC)
- 2003 International Mechanical Code (IMC)
- 2003 International Residential Code (IRC)
- 2009 International Energy Conservation Code (IECC)
- 2005 National Electrical Code (National Fire Protection Association (NFPA) 70)

The current State Building Code of Connecticut is the building code by which the state and all municipalities must abide. Therefore, municipalities may not currently adopt codes that are stricter than the State Building Code. There are many jurisdictions that are making great efforts to become clean energy leaders in the state. The project team recommends that the State of Connecticut create a model "stretch-code" to enable municipalities to adopt more stringent codes that the State Building Code, if desired. A stretch energy code was added to the Massachusetts State Building Code in 2009, allowing municipalities to adopt a specified, more energy efficient alternative code.[61]

Connecticut's State Building Code should be amended to include a provision for "solar ready" construction that requires new homes and non-residential buildings to be built so that roof structures and orientation are built ready for installation of a solar PV system (aside from factors outside of construction such as adjacent buildings and trees). Other states such as Minnesota and California have adopted standards for "solar-ready" new construction.[62] [63]

In CT's 2011 amendment to its State Building Code, Connecticut adopted the 2009 International Energy Conservation Code (IECC), which increased energy efficiency requirements for new residential and commercial construction.[64] Upgrading to the IECC 2012 would significantly further enhance the energy performance of new buildings.

[60] www.ct.gov/dcs/cwp/view.asp?a=4447&q=521446&dcsNav

[61] MA Stretch Energy Code: mass.gov/eopss/consumer-prot-and-bus-lic/license-type/csl/stretch-energy-code-information.html

[62] Minnesota published the "Solar Ready Building Design Guidelines for Minnesota" to be used with the 2006 IBC: www.nextstep.state.mn.us/res_detail.cfm?id=4467

[63] Beginning January 1, 2014 the California Energy Commission will require all new buildings to be solar ready, www.energy.ca.gov/releases/2012_releases/2012-05-31_energy_commission_approves_more_efficient_buildings_nr.html, and energy.ca.gov/title24/2013standards/index.html

[64] ct.gov/dcs/lib/dcs/office_of_state_building_inspector_files/iecc_amendment_9-27-11.pdf

One of the participating jurisdictions in this project suggested that it would be helpful if Connecticut's Building Code provided standard specifications for weight, wind lift resistance and reflectivity of solar PV systems so that municipal approval would simply be a matter of verifying that the system meets the requirements of this code. This might also require changing industry reporting standards to make such information more readily available for all solar panel models. This suggestion reflects the reality that municipalities and installers are slowed down when requirements have not been well-defined or explained and are inconsistent among jurisdictions.

The following are excerpts from Connecticut General Statutes sections 29-252 through 29-254 pertaining to the State Building Code of Connecticut, for reference:

- **Sec. 29-252.[65] (Formerly Sec. 19-395). State Building Code: Adoption, revision and amendments. State Building Inspector: Appointment; interpretations of code. Appeal.** (a) The State Building Inspector and the Codes and Standards Committee shall, jointly, with the approval of the Commissioner of Construction Services, adopt and administer a State Building Code based on a nationally recognized model building code for the purpose of regulating the design, construction and use of buildings or structures to be erected and the alteration of buildings or structures already erected and make such amendments thereto as they, from time to time, deem necessary or desirable… The code shall be revised not later than January 1, 2005, and thereafter as deemed necessary to incorporate any subsequent revisions to the code not later than eighteen months following the date of first publication of such subsequent revisions to the code. *The purpose of said Building Code shall also include, but not be limited to, promoting and ensuring that such buildings and structures are designed and constructed in such a manner as to conserve energy and, wherever practicable, facilitate the use of renewable energy resources…*
- **Sec. 29-253.[66] (Formerly Sec. 19-395e). Code applicable to all municipalities. Ordinance governing demolition of hazardous building.** (a) *The State Building Code, including any amendment to said code adopted by the State Building Inspector and Codes and Standards Committee, shall be the building code for all towns, cities and boroughs.* (b) Nothing in this section shall prevent any town, city or borough from adopting an ordinance governing the demolition of buildings deemed to be unsafe. As used in this subsection, "unsafe building" means a building that constitutes a fire hazard or is otherwise dangerous to human life or the public welfare.
- **Sec. 29-254.[67] (Formerly Sec. 19-395g). Amendments to code. Variations and exemptions.** (a) Any town, city or borough or any interested person may propose amendments to the State Building Code.

9.4 Allow electronic wet stamps

When jurisdictions require engineer or architect approved plans, these plans must be delivered in person because official stamps are required. The State of Connecticut does not allow these required stamps to be submitted electronically. Other states across the United States, including Pennsylvania, New York, Delaware, Maryland, and California allow electronic submission of wet stamps in order to streamline the permitting process. The Sun Rise New England team recommends the State of

[65] www.cga.ct.gov/2011/PUB/chap541.htm#Sec29-252.htm
[66] www.cga.ct.gov/2011/PUB/chap541.htm#Sec29-253.htm
[67] www.cga.ct.gov/2011/PUB/chap541.htm#Sec29-254.htm

Connecticut allow engineer and architect stamps to be submitted electronically thus eliminating the need for installers to deliver these documents in person.

9.5 Education & Training

Building departments are responsible for understanding and enforcing a diverse set of codes and standards. Insufficient funding and manpower makes training extremely difficult for most jurisdictions. In order to help building officials obtain the necessary training, the Sun Rise New England team recommends that the State of Connecticut develop and offer each year several free training sessions for building officials related to rooftop solar PV and other clean energy technologies. An increased awareness and understanding of solar PV systems will help local jurisdictions eliminate any unnecessary requirements in permitting processes. Resources can be found in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ .

10.0 Planning & Zoning

10.1 Data Collection and Methods

Members of the Center for Business and the Environment at Yale (CBEY) research team interviewed planning and zoning officials from each of the participating jurisdictions. The interview questions were developed with guidance from the Yale Center for Customer Insights (YCCI), and were designed to develop an organic conversation concerning the data needed for completing the DOE solar metrics questions.

As for the overall project's data collection effort, for which the P&Z data collection was a part, each town designated an official point of contact for the project who identified the appropriate municipal officials to interview for each topic area (also see section 6.0 for information about the overall data collection process). For P&Z interviews, CBEY contacted the appropriate individuals to schedule interviews, with the project point of contact assisting as necessary. In addition to the primary official, interviews were also attended by the point of contact and/or other municipal staff whose presence was deemed helpful. Where scheduling permitted, interview teams consisted of at least two people, one to ask questions and one to take notes. Interviews were conducted over the phone or in person according to scheduling constraints and the preferences of those being interviewed. Interviews ranged from 30-90 minutes. Some interviews were recorded to facilitate note taking. Officials were asked to provide copies of solar-relevant documentation discussed in the interviews. Notes taken during the interview were used to complete the planning and zoning portion of the DOE solar metrics questions.

Research also included a literature search, review of studies by the Interstate Renewable Energy Council (IREC) and the National Renewable Energy Laboratory (NREL), and review of model ordinances and best practices from other states such as California, New Jersey, New York/Long Island, Pennsylvania and Vermont.

10.2 Summary of Findings and Conclusions

At the state-level in Connecticut, there are several regulations that apply to and encourage rooftop solar PV deployment:

- **Connecticut's zoning enabling act (General Statute 8-2)** enables jurisdictions to adopt regulations, and specifies that: "Such regulations may also encourage energy-efficient patterns of development, the use of solar and other renewable forms of energy, and energy conservation."
- **CT General Statutes 8-23 (a) and (d)** require planning commissions to prepare, amend or adopt a plan of conservation and development for the municipality, and in preparing such plan, consider energy-efficient patterns of development, the use of solar and other renewable forms of energy and energy conservation.
- **CT General Statute 8-25(b)** governing subdivision regulations states: "The regulations shall require any person submitting a plan for a subdivision to the commission under subsection (a) of this section to demonstrate to the commission that such person has considered, in developing the plan, using passive solar energy techniques which would not significantly increase the cost of the housing to the buyer."
- **CT General Statute 7-147f** states "No application for a certificate of appropriateness for an exterior architectural feature, such as a solar energy system, designed for the utilization of

> renewable resources shall be denied unless the commission finds that the feature cannot be installed without substantially impairing the historic character and appearance of the district.

Interviews conducted during this project indicate that these regulations are difficult to enforce. This is likely due to statute language that is not well-defined, such as "may also encourage" and "consider," and the lack of specific guidance on and mechanisms for implementation and enforcement. Section 11.2 of this report provides more information about and recommends publicizing, enforcing and strengthening these existing regulations.

Connecticut statutes do not specifically establish a homeowner's right to light or access to sunlight, nor do they guarantee the right to install a solar PV system that supersedes any restrictive private covenants or local government rules.[68] By contrast, Massachusetts' legislation (M.G.L. chapter 40A §3)[69] disallows any zoning prohibitions or unreasonable regulations of solar installation except, "where necessary to protect the public health, safety or welfare." Sections 11.0-11.1 provide a recommendation for Connecticut to adopt a solar access law to provide a legal framework for protections such as creation of solar easements and protection from private property and local government restrictions on installation of solar PV.

Zoning Best Practice:

Zoning approval for residential rooftop solar PV installations is often granted automatically when a building permit is issued, or the PV systems must meet minimal criteria such as height restrictions. Half of the 12 participating towns do not require zoning involvement or review to issue a permit for residential rooftop solar PV.

Summary of Municipal Survey Data

Zoning approval for residential rooftop solar PV installations is often granted automatically when a building permit is issued, or the PV systems must meet minimal criteria such as height restrictions. For example, permitting for residential rooftop solar PV in the jurisdictions of Cornwall, Greenwich, Middletown, Milford, Stamford and West Hartford either does not entail zoning department involvement or a zoning permit is issued automatically when a building permit is issued. Bridgeport, Coventry, Danbury, Fairfield, Hampton, Manchester and New Haven have minimal zoning requirements that need to be met, namely whether the solar PV system meets height restrictions (sometimes more flexible for solar PV than for other accessory structures)[70] or whether the system is flush mounted to the roof (e.g., Fairfield). The height requirement is in some cases checked by the building department (e.g., Danbury) or by an integrated building and planning and zoning department (e.g., Manchester), so separate review by zoning department staff may not be needed to verify that height restrictions are met. These practices can result in very minimal zoning department involvement.

[68] Connecticut General Statute 47-25. Right to light not gained by adverse possession. No occupant of real estate may acquire, by adverse occupation, the right to keep, sustain or enjoy any window or light, so as to prevent adjoining premises from erecting and maintaining any building thereon. http://www.cga.ct.gov/2013/pub/chap_821.htm#sec_47-25

[69] M.G.L., chapter 40A § 3, malegislature.gov/Laws/GeneralLaws/PartI/TitleVII/Chapter40a/Section3: "No zoning ordinance or by-law shall prohibit or unreasonably regulate the installation of solar energy systems or the building of structures that facilitate the collection of solar energy, except where necessary to protect the public health, safety or welfare."

[70] Solar PV is usually considered an accessory structure from a zoning perspective, meaning it is secondary to the primary structure, for example a house or building.

There is wider variation in the requirements for commercial rooftop solar PV, the requirements are stricter and more numerous, and often extra approvals and reviews are involved, sometimes with special committees or hearings.

In historic or village districts, additional restrictions and reviews are common, though CT statute 7-147f, cited above, specifies that a solar PV installation may not be prevented from being installed unless it substantially impairs the historic character and appearance of the district.

For ground or pole mount solar PV installations, there are usually zoning and other department reviews needed, for example a review to assure that the installation meets wetlands regulation requirements, setback and other requirements (though we encourage exemption or flexibility on such requirements for solar PV installations).

Bridgeport, Manchester and Middletown have adopted solar or clean energy friendly ordinances. Bridgeport and Manchester exempt permit fees for Class I renewable energy installations. Middletown grants a 10% real-estate tax exemption for LEED certified properties through its Tax and Business Incentive Program.

The project team did not run across any municipal solar access ordinances or ordinance provisions, and believes that adoption of such provisions will need to be enabled by adoption of a state solar access law that provides a legal framework for solar access considerations. However, private solar access agreements between commercial developers and solar PV system hosts are currently in use in Connecticut to protect a developer from the risk of a solar PV system losing access to sunlight impacting the energy production of the system.

Many jurisdictions have incorporated support of clean energy adoption into their conservation and development plans, including Bridgeport, Coventry, Greenwich and New Haven, and other towns are updating their plans so that clean energy is encouraged. Several towns including Middletown and West Hartford have a clean energy task force, and Coventry has an energy conservation/alternative energy advisory committee, providing further community-level engagement in support of clean energy.

For a tabular summary of planning and zoning and related data collected from municipalities, based on DOE's Solar Metrics questions, see Appendix IV.

Summary of Installer Survey Responses

The following are excerpts of feedback from installers in response to questions about planning and zoning. See Appendix V to view all responses. Note that a few comments pertain to other topics such as permitting or interconnection.

1. Are there towns in CT which require a planning and zoning (P&Z) permit or P&Z approval to install rooftop solar PV?

- Trumbull, Reading, Fairfield, Newtown - anything west of Highway 95
- Most towns do if you have a ground mount near setbacks or near wetlands for residential. For commercial, you never know what a town could come up with.
- No, but some towns do have a review for commercial sites that are on main streets.
- Yes, towns need more education to feel comfortable letting some things go. We in the electrical industry are used to this kind of process. Other out of state companies are not accustomed to this protocol.

2. Are you aware of any P&Z restrictions/hurdles to rooftop solar PV installation in CT towns (e.g., height restrictions, aesthetic requirements, homeowner association restrictions, restrictions in historic districts)?

- Not yet, condo associations have been slow to adopt solar.
- Historic districts and aesthetic requirements for residential, and aesthetic requirements for commercial sites.
- Some homeowners associations and historic districts have restrictions, but this is usually a minor problem and most approve installations upon review.
- Yes, all exist in one town or another. Most are not onerous except for the separate applications. Chief grievances are treating PV installs flat against the roof as potential height variations; there should be an exception if less than 5 inches are added or if the PV does not extend above the ridge line. Another is treating ground mounts as structures and requiring them to meet setbacks; the ground mounts should be viewed in this case as fences (if under 8 feet or so) so they can be backed neatly up to the property line. If plantings to hide the system are required, fine.

3. Are there improvements you would recommend to P&Z ordinances in CT towns to remove hurdles to rooftop solar PV installation?

- No, but we would like a better inspection process. Hanging wires are not good. We don't want solar to get a bad name from a few reckless installers.
- Does the Department of Transportation (DOT) need municipal approval to install a culvert? CEFIA projects are state level/DEEP projects. Municipalities can tag along for community awareness, but should not hold the strings.

Figure 20: Solar PV Installation in Manchester, Courtesy of Ross Solar Group

11.0 Planning and Zoning Recommendations for the State of Connecticut

Solar rights, broadly defined, are the rights to access and harness sunlight.[71] The practical implications of how solar rights are defined and protected (or not protected) with respect to installation and use of solar energy systems consist primarily of two aspects[72]:

- *Assuring adequate access to direct sunlight for a solar energy system (either active or passive)* including the ability of one property to continue to receive sunlight across property lines without obstruction from another's property (buildings, foliage, or other impediment).
- *Protecting the ability to install a solar energy system on residential or commercial property that is subject to restrictions* including private restrictions (i.e., covenants, conditions, restrictions, bylaws, condominium declarations) as well as local government ordinances and building codes.

The United States has held that there is no common-law right to sunlight. This has required that specific statutory authority be established at the state level to protect the rights of solar users in terms of both their ability to install a solar energy system on their property and after that system is installed to protect their access to sunlight so that the system remains operational. A lack of secure and sustained access to sunlight can impede an individual solar system owner's ability to reap the benefits of his/her investment and can slow solar market growth due to potential customers' real and perceived risks.

[71] The following two articles by Sara C. Bronin, Associate Professor of Law at the University of Connecticut School of Law, provide a treatise on the importance of solar rights as well as a proposed framework for protecting these rights: (1) Solar Rights, Boston University Law Review, 2009, http://ssrn.com/abstract=1479024, (2) Modern Lights, University of Colorado Law Review, 2009, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1479042.

[72] A Comprehensive Review of Solar Access Law in the United States, Suggested Standards for a Model Statute and Ordinance, Colleen McCann Kettles, Florida Solar Energy Research and Education. Report: solarabcs.org/about/publications/reports/solar-access/pdfs/Solaraccess-full.pdf; Online, Narrated Presentation: www.solarabcs.org/about/publications/reports/solar-access/presentations/index.htm

Solar rights can be established and protected through legal frameworks such as state laws, municipal zoning regulations and agreements such as solar easements between property owners. Figure 21, updated in February 2013, was accessed from the Database of State Incentives for Renewable Energy (DSIRE) Solar website.[73] The map shows that 40 U.S. states have solar easement provisions, solar rights provisions, or both solar easements and solar rights and/or the local option to create such provisions. Connecticut is one of a minority of U.S. states that does not have a state level solar access law. To protect the investments of Connecticut solar energy system owners and ratepayer investments in solar energy deployment, CT should work to enact a solar access law, especially in anticipation of increasing rates of solar PV deployment in the state.

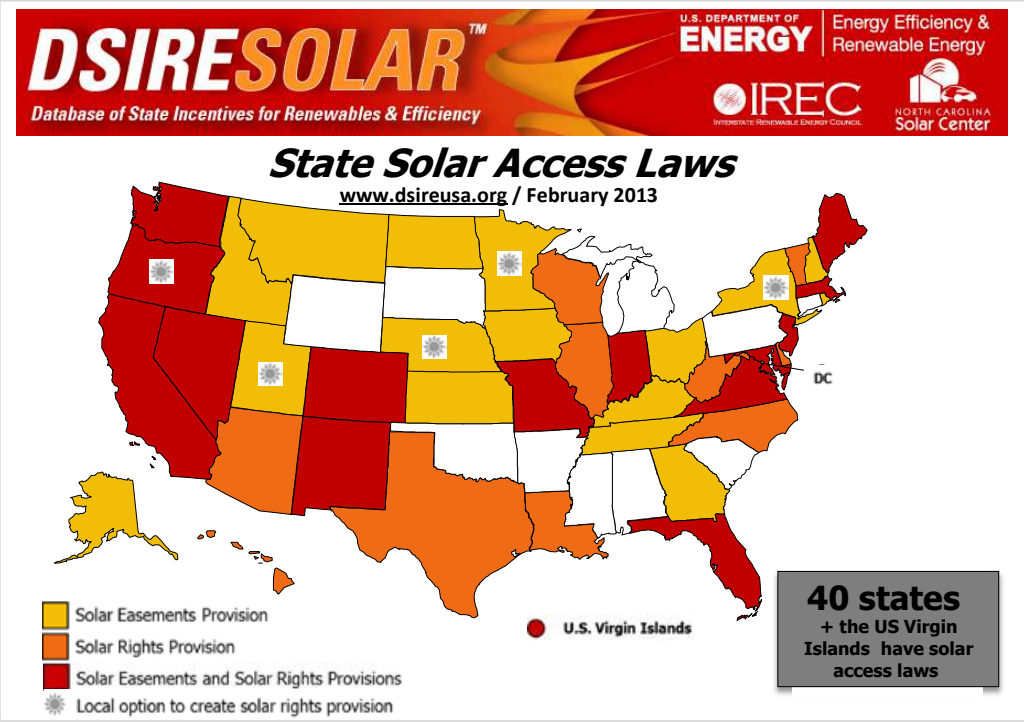


Figure 21: Map of State Solar Access Laws, DSIRE, February 2013

11.1 Adopt a Statewide Solar Access Law

Connecticut General Statute 47-25 states that CT does not protect the right to light.[74] A statewide solar access law would provide a uniform regulatory structure that developers and property owners could rely on to protect their investments. A state law would also support CT's goal to scale up clean energy deployment.

A model solar access law is provided in "A Comprehensive Review of Solar Access Law in the United States, Suggested Standards for a Model Statute and Ordinance,"[75] which draws from exemplary

[73] dsireusa.org/solar/solarpolicyguide/?id=19

[74] Connecticut General Statute 47-25. Right to light not gained by adverse possession. No occupant of real estate may acquire, by adverse occupation, the right to keep, sustain or enjoy any window or light, so as to prevent adjoining premises from erecting and maintaining any building thereon.
http://www.cga.ct.gov/2013/pub/chap_821.htm#sec_47-25

[75] "A Comprehensive Review of Solar Access Law in the United States, Suggested Standards for a Model Statute and Ordinance, Colleen McCann Kettles," Florida Solar Energy Research and Education. Report: solarabcs.org/about/publications/reports/solar-access/pdfs/Solaraccess-full.pdf

provisions in existing solar access laws in Florida, Hawaii, Massachusetts, New Jersey, New Mexico, Oregon, Wisconsin, and the Virgin Islands. Associate Professor of Law at the University of Connecticut School of Law, Sara Bronin, provides a treatise on solar rights and proposes a framework for establishing solar rights in her two articles, "Solar Rights" and "Modern Lights," respectively.[76]

An example state law from the U.S. solar industry's most mature market is California's Solar Rights Act, which was adopted in 1978 and went into effect January 1, 1979. Its enactment contributed to California's strong policy commitment to solar energy. The California bill states: "that the use of solar energy systems will reduce the state's dependence on nonrenewable fossil fuels, supplement existing energy sources, and decrease the air and water pollution which results from the use of conventional energy sources. It is, therefore, the policy of the state to encourage the use of solar energy systems."[77]

California's Solar Rights Act consists of the following California codes of law: California Civil Code Sections 714 and 714.1, California Civil Code Section 801, California Civil Code Section 801.5, California Government Code Section 65850.5, California Health and Safety Code Section 17959.1, California Government Code Section 66475.3, and California Government Code Section 66473.1, which collectively contribute the following key provisions:[78]

- Limits on covenants, conditions, and restrictions (CC&Rs) to Restrict Solar Installations – The Act prohibits CC&Rs, like those enforced by homeowner associations (HOAs), which would unreasonably restrict the use or installation of solar energy systems. (CA Civil Code Sections 714 and 714.1).
- Solar Easements – The Act establishes the legal right to a solar easement, which protects access to sunlight across adjacent properties. (CA Civil Code Section 801). It also describes the minimum requirements needed to create a solar easement. (CA Civil Code Section 801.5).
- Definition of a Solar Energy System – The Act defines which solar energy systems are covered by its provisions. (CA Civil Code Section 801.5).
- Limits to Local Government Restrictions on Solar Installations – The Act discourages local governments from adopting an ordinance that would unreasonably restrict the use of solar energy systems. (CA Government Code Section 65850.5). It also requires local governments to use a non-discretionary permitting process for solar energy systems. CA Government Code Section 65850.5 and CA Health and Safety Code Section 17959.1). Additionally, provisions of the Act require local governments seeking state-sponsored incentives for solar energy systems to demonstrate compliance with certain provisions of the Act. (CA Civil Code Section 714).
- Passive Solar Opportunities in Subdivisions – The Act requires certain subdivisions to provide for future passive and natural heating and cooling opportunities to the extent feasible. (CA Government Code Section 66473.1).

[76] The following two articles by Sara C. Bronin, Associate Professor of Law at the University of Connecticut School of Law, provide a treatise on the importance of solar rights as well as a proposed framework for protecting these rights: (1) Solar Rights, Boston University Law Review, 2009, http://ssrn.com/abstract=1479024, (2) Modern Lights, University of Colorado Law Review, 2009, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1479042.

[77] "California's Solar Rights Act, A Review of the Statutes and Relevant Cases," Scott Anders, Kevin Grigsby, Carolyn Adi Kuduk, Taylor Day, Allegra Frost, Updated December 2012, Energy Policy Initiatives Center, University of San Diego School of Law, www.sandiego.edu/documents/epic/SolarRightsAct_UPDATEDec2012.pdf.

[78] Ibid.

- Allowance for Requiring Solar Easements – The Act allows cities and counties to require by ordinance the dedication of solar easements in certain subdivision developments as a condition of tentative map approval. (CA Government Code Section 66475.3).

Another law on the books in California not included above is the Solar Shade Control Act (CA Public Resources Code § 25980),[79] which provides limited protection to solar energy system owners from shading caused by trees and shrubs on adjacent properties. This law provides for the following protection for access to sunlight (note, however that even 10% shading could prevent a solar PV system from generating electricity depending on how a solar PV system is configured):[80]

> After the installation of a solar collector, a person owning or in control of another property shall not allow a tree or shrub to be placed or, if placed, to grow on that property so as to cast a shadow greater than 10 percent of the collector absorption area upon that solar collector surface at any one time between the hours of 10am and 2pm, local standard time.

Table 13 summarizes examples of solar access laws in leading and nearby states, illustrating the types of protections that can be provided for solar energy. A lot can be done to establish solar access protections in Connecticut, in addition to publicizing, enforcing and strengthening Connecticut's existing laws supporting clean energy deployment (detailed in the next section, section 11.2). A statewide solar access law and improvements to existing laws would better enable Connecticut communities to create and enforce zoning ordinances that protect solar rights.

Table 13: Examples of State Solar Access Laws

Description of Law	Statute Language	Type of Solar Access Law
California – the California Solar Rights Act – authorizes creation of solar easements; limits CC&R and local government restrictions on installation of solar PV systems.	www.sandiego.edu/documents/epic/SolarRightsAct_UPDATEDec2012.pdf (all statute text starts on p.27)	Solar easements, solar rights
Rhode Island – authorizes homeowners to negotiate solar easements.	R.I. Gen. Laws § 34-40	Solar easements
New Hampshire – protects the right of homeowners to obtain solar easements.	New Hampshire Statutes § 477:49	Solar easements
Maine – authorizes the creation of solar easements.	33 M.R.S. §1401	Solar easements
Maine – prohibits municipal bylaws, zoning ordinances, and homeowners' associations from prohibiting or unreasonably restricting homeowners' right to use solar energy devices.	33 M.R.S. §1421	Solar rights
Massachusetts – local governments are authorized to promote solar energy systems through their zoning ordinances, including regulation of street layout and building size and placement. Ordinances establishing systems for solar rights permits are also authorized.	M.G.L. ch. 40A § 9B.; definition of a solar easement found in M.G.L. ch. 187 § 1A.	Solar easements, solar rights
Massachusetts – prohibits local zoning ordinances placing unreasonable restrictions on solar energy systems	M.G.L. ch. 40A § 3.	Solar rights

[79] California's Solar Shade Control Act, California Public Resources Code § 25980: leginfo.ca.gov/cgi-bin/displaycode?section=prc&group=25001-26000&file=25980-25986.
[80] Ibid.

Massachusetts – forbids restrictive covenants (e.g., from developers, neighborhood associations) that prohibit or unreasonably restrict homeowners' right to install a solar system.	M.G.L. ch. 184 § 23C.	Solar rights
New York – provides for the creation of voluntary solar easements.	NY CLS Real Property § 335-b	Solar easements
New York – authorizes local governments to create zoning ordinances specifically for the purpose of facilitating solar access and solar energy systems	NY CLS General City § 20 (24); NY CLS Town § 263; NY CLS Vill § 7-704	Solar easements
Vermont – prohibits municipal bylaws, zoning ordinances, and nongovernmental deed restrictions from prohibiting or unreasonably restricting homeowners' right to install a rooftop solar system.	27 V.S.A. § 544; 24 V.S.A. § 2291a; 24 V.S.A. § 4413 (g)	Solar rights

11.2 Publicize, Enforce, and Strengthen Existing Connecticut Laws and Codes

In addition to enactment of a solar access law, solar clean energy deployment in Connecticut would be supported by publicizing, enforcing and strengthening the following existing state of CT laws. Note that the majority of the laws cited here use language such as "consider" or "encourage" that is not strong enough to require jurisdictions to adopt practices that support solar energy deployment.

Connecticut's zoning enabling act (General Statute 8-2)[81] states: "Such regulations may also encourage energy-efficient patterns of development, the use of solar and other renewable forms of energy, and energy conservation."

CT Gen. Statutes 8-23 (a) and (d) require planning commissions to prepare, amend or adopt a plan of conservation and development for the municipality, and in preparing such plan, consider energy-efficient patterns of development, the use of solar and other renewable forms of energy and energy conservation.[82]

> **Sec. 8-23. Preparation, amendment or adoption of plan of conservation and development.**
>
> **(a)(1) At least once every ten years, the commission shall prepare or amend and shall adopt a plan of conservation and development for the municipality. Following adoption, the commission shall regularly review and maintain such plan.** The commission may adopt such geographical, functional or other amendments to the plan or parts of the plan, in accordance with the provisions of this section, as it deems necessary. The commission may, at any time, prepare, amend and adopt plans for the redevelopment and improvement of districts or neighborhoods which, in its judgment, contain special problems or opportunities or show a trend toward lower land values.
>
> **(d) In preparing such plan, the commission or any special committee shall consider the following:** (1) The community development action plan of the municipality, if any, (2) the need for affordable housing, (3) the need for protection of existing and potential public surface and ground drinking water supplies, (4) the use of cluster development and other development patterns to the extent consistent with soil types, terrain and infrastructure capacity within the municipality, (5) the state plan of conservation and development adopted pursuant to chapter 297, (6) the regional plan of conservation and development adopted pursuant to section 8-35a, (7) physical, social, economic and governmental conditions and trends, (8) the needs of the municipality including, but not limited to, human resources, education, health, housing, recreation, social services, public utilities, public protection, transportation and circulation and cultural and interpersonal communications, **(9) the objectives of energy-efficient**

[81] cga.ct.gov/2011/PUB/chap124.htm#Sec8-2.htm
[82] cga.ct.gov/2011/pub/chap126.htm - Sec8-23.htm

> **patterns of development, the use of solar and other renewable forms of energy and energy conservation,** and (10) protection and preservation of agriculture.

CT Gen. Statute 8-25(b) requires subdivision development regulations to "encourage energy-efficient patterns of development and land use, the use of solar and other renewable forms of energy, and energy conservation." [83] Many towns have taken the first step by adding this language to their subdivision regulations (e.g., Fairfield, Milford). Fewer towns have long-term plans or task forces for renewable energy (e.g., Cornwall, Coventry).

> Sec. 8-25. Subdivision of land.
>
> (b) The regulations adopted under subsection (a) of this section shall also encourage energy-efficient patterns of development and land use, the use of solar and other renewable forms of energy, and energy conservation. The regulations shall require any person submitting a plan for a subdivision to the commission under subsection (a) of this section to demonstrate to the commission that such person has considered, in developing the plan, using passive solar energy techniques which would not significantly increase the cost of the housing to the buyer, after tax credits, subsidies and exemptions. As used in this subsection and section 8-2, passive solar energy techniques mean site design techniques which maximize solar heat gain, minimize heat loss and provide thermal storage within a building during the heating season and minimize heat gain and provide for natural ventilation during the cooling season. The site design techniques shall include, but not be limited to: (1) house orientation; (2) street and lot layout; (3) vegetation; (4) natural and man-made topographical features; and (5) protection of solar access within the development.

CT Gen. Statute 8-25(b) pertaining to subdivision development should be strengthened. The current language only requires developers to "consider" passive solar. This is difficult to enforce, because it is hard to prove developers have not fulfilled this requirement. As a result, most towns don't enforce it. Further, statute 8-25(b) would be more meaningful to enforce if the statute were amended to *require* developers to incorporate passive solar energy techniques into their development plans rather than simply "considering" them. Language in the amendment could require developers to document their use of passive solar techniques for municipal building or planning and zoning departments when they apply for building permits. This would involve developing a more specific list of passive solar features covered by the statute, making some features mandatory for all developments or providing a range of options for developers to choose from and combine. It is expected that there would be some situations where solar would be prohibitively costly or disadvantageous, and exceptions could be granted in those cases.

New subdivisions have a unique opportunity to specifically protect solar access even though there is no overarching state-level solar access law. Subdivisions have the option of creating a covenant or regulation in their bylaws that could prevent any property owner from engaging in construction or landscaping that obstructs another property owner's solar access.

As part of an effort to encourage developers to include solar access considerations in their subdivision regulations, our project team developed a Sample Solar Site Design Worksheet for Proposed Subdivisions (Appendix VII or as a stand-alone form in the Permitting Guide tab of the Sun Rise New England - Open for Business website). This worksheet can be used to enforce *consideration* of passive solar site design under the current law, or it could be modified to enforce *requirement* of solar site design if CT Gen. Statute 8-25(b) is strengthened.

Require New Homes to be "Solar Ready" – In addition to strengthening the requirement to consider passive solar, CT Gen. Statute 8-25(b) could be amended to require that new homes are "solar ready":

[83] cga.ct.gov/2011/pub/chap126.htm#Sec8-25.htm

- Have the structural attributes and integrity capable of supporting a rooftop solar system. New homes meeting such specifications could thus be automatically certified as "solar ready," streamlining the permitting and installation process.
- Require east-west street and building orientation (typically within 30 degrees of the east-west axis) to maximize south-facing roof space ideal for collecting solar energy.
- Have landscaping that complements solar energy systems
- Have dedicated solar easements to protect access to sunlight.

CT Gen. Statute 7-147f which limits the reasons a certificate of appropriateness can be denied to a solar energy system to features that substantially impair the historic character of the district.[84] This statute protects the right of historic property owners to install solar systems. In order to ensure municipalities do not overly restrict solar PV installations for design reasons, greater publication and enforcement of this statute should be pursued.

> Sec. 7-147f. Considerations in determining appropriateness. Solar energy systems (a) If the commission determines that the proposed erection, alteration or parking will be appropriate, it shall issue a certificate of appropriateness. In passing on appropriateness as to exterior architectural features, buildings or structures, the commission shall consider, in addition to other pertinent factors, the type and style of exterior windows, doors, light fixtures, signs, above-ground utility structures, mechanical appurtenances and the type and texture of building materials. In passing upon appropriateness as to exterior architectural features the commission shall also consider, in addition to any other pertinent factors, the historical and architectural value and significance, architectural style, scale, general design, arrangement, texture and material of the architectural features involved and the relationship thereof to the exterior architectural style and pertinent features of other buildings and structures in the immediate neighborhood. **No application for a certificate of appropriateness for an exterior architectural feature, such as a solar energy system, designed for the utilization of renewable resources shall be denied unless the commission finds that the feature cannot be installed without substantially impairing the historic character and appearance of the district.** A certificate of appropriateness for such a feature may include stipulations requiring design modifications and limitations on the location of the feature which do not significantly impair its effectiveness…

As detailed in section 9.3, Connecticut can improve its state Building Code and allow model stretch codes. Related to this, one of the participating jurisdictions in this project suggested that it would be helpful if Connecticut's Building Code provided standard specifications for weight, wind lift resistance and reflectivity of solar PV systems so that municipal approval would simply be a matter of verifying that the system meets the requirements of this code. This might also require changing industry reporting standards to make such information more readily available for all solar panel models. This suggestion reflects the reality that municipalities and installers are slowed down when requirements have not been well-defined or explained and are inconsistent among jurisdictions.

[84] cga.ct.gov/2001/pub/Chap097a.htm - sec7-147f.htm

Figure 22: Solar PV Installation in Cornwall, Courtesy of Lenz Electric

12.0 Planning and Zoning Recommendations for Connecticut Jurisdictions

12.1 Local Policy Recommendations for Removing Zoning Barriers to Solar Energy

The project team offers the following recommendations for municipalities who wish to encourage solar energy deployment in their communities by eliminating planning and zoning barriers to solar PV installation and supporting local constituents who desire to adopt solar.

Make information accessible to those doing business in your jurisdiction about applicable existing state and local laws, regulations and codes impacting installation of solar PV, such as the existing state statutes specified in sections 10 and 11, and about zoning regulations supporting solar PV deployment.

Adopt solar friendly local zoning regulations/ordinances[85] [86] to exempt solar PV installations from zoning review and enable flexibility in zoning restrictions that affect solar.

The following are provisions friendly to solar energy systems:

- **Exempt rooftop installations from zoning review** – Allow all rooftop solar PV installations (or those meeting certain criteria) to be exempt from zoning review during the permitting process.
- **Exempt or allow increased flexibility from zoning requirements for solar energy systems** – The zoning regulations should provide exemptions or increase flexibility for solar energy systems with respect to height, setback, lot coverage and impervious surface limitations. Solar energy systems are usually categorized as accessory structures, and if so, then the jurisdictions' limitations for accessory structures should be reviewed to determine which limitations make sense for solar PV and which are unnecessarily restrictive.

[85] The jurisdiction's zoning authority can adopt a solar-friendly zoning ordinance or regulation. Another mechanism is to adopt a jurisdiction level ordinance that supersedes the zoning ordinance.

[86] If creating an ordinance, the following two general elements are recommended: (1) A statement of findings – The ordinance should begin with a "Statement of Findings" that ties it to the city's comprehensive plan or valid public policy goals, (2) Definitions – The ordinance should ideally include a broad definition of "solar collector" that includes thermal as well as electrical devices.

The following are examples of types of restrictions that solar could be exempted from or restrictions that could be made more flexible:

- Height – Exemptions from height limitations for rooftop solar energy systems, similar to the exemptions given for rooftop appurtenances such as a chimney or spire.[87] Exemptions from accessory structure height restrictions for stand-alone solar energy systems (e.g., ground and pole-mounted systems) are also needed.
- Setback – Stand-alone solar energy systems should be exempt from lot setback requirements (e.g., side and rear yard setbacks) or the setback requirements should be reduced for solar. Lot setback considerations can also impact rooftop solar PV if the structure on which the solar PV is built or will be built to have access to sunlight.
- Lot coverage – Stand-alone solar energy systems should be excluded from counting towards lot coverage, as the contact with the ground is limited only to footings.
- Impervious surface[88] – Stand-alone solar energy systems should be excluded from impervious surface calculations. This is significant as local zoning laws typically set maximum impervious surface or coverage percentages and municipal and state agencies have been inconsistent in determining whether solar panels should constitute an impervious surface. Stand-alone solar energy systems do not completely cap the ground and thereby do not prevent water absorption (important for replenishment of aquifers and to help prevent run-off, soil erosion, flooding and other environmental hazards). Exemption for solar energy systems allows for installation in areas otherwise protected by municipal land use laws that pose strict limitations on impervious surface coverage (e.g., coastal and waterfront areas, forest and conservation areas). For example, a state law was passed in New Jersey in 2010 excluding solar energy systems from being counted as impervious surface.[89]

Also keep in mind that there is still development and innovation in solar energy technology and solar energy system design taking place, so that restrictions left in place or put in place now that do not seem to pose a barrier to deployment of solar energy could become a barrier in the future. Restrictions can be difficult or take a long time to remove and could give a jurisdiction a reputation among solar energy installers that is difficult to change.

- **Establish requirements for historic and village district installations –** Enforce CT Gen. Statute Section 7-147f and develop clear prescriptive standards such as allowing flush mounted solar panels on all existing roofs, installation of roof-mounted solar panels not visible from the street, and permitting rear yard ground mounted solar systems of limited height to be approved with only a no-cost administrative review. Though prescriptive standards can help streamline approval for projects meeting specific criteria, the standards should not be used to exclude projects that meet the requirement of "do not substantially impair the historic character of the district."

[87] Integrating Solar Energy into Local Development Regulations, www.planning.org/research/solar/briefingpapers/localdevelopmentregulations.htm

[88] "Impervious surface" means any structure, surface, or improvement that reduces or prevents absorption of stormwater into land, and includes porous paving, paver blocks, gravel, crushed stone, decks, patios, elevated structures, and other similar structures, surfaces, or improvements. Increases in impervious surface area are often used to characterize and measure land use changes in the process of property development.

[89] "Solar Panels Do Not Constitute Impervious Cover Under New Law," April 2010, njzoningwatch.com/category/highlands/.

Adopt zoning regulations that protect future solar access as well as access to sunlight after investment in a solar energy system (assuming a solar access law is adopted in CT to provide a legal framework).

- Allow for creation of solar easements to protect solar PV system access to sunlight across property lines. An easement applies to properties whose owners have signed a voluntary agreement and typically protects a solar system from obstructions on adjacent properties only.
- Adopt a regulation/ordinance that provides a strategy for protecting solar access such as one of the following two examples, each suited to addressing different development patterns. More details are provided in Appendix VI.
    - First, an ordinance may create a **permitting and recording procedure** by which a home owner who installs a solar system may obtain a permit that prevents their solar access from being impeded by later construction or vegetation growth. Such a permit can then be recorded in the local land records.
    - Second, an ordinance may create a **solar envelope** around each property. Solar envelope ordinances are a more comprehensive form of solar access protection, and preserve a property's access to sunlight even if the property owner has not yet installed a solar collector.

Implement Incentive-Based Green Building Ordinances or ordinance provisions to award points, incentives, or bonuses (such as density bonuses) to developers who include energy efficiency features such as solar systems and solar access in their projects.

Comply with CT's zoning enabling act (CT Gen. Statute Section 8-2)[90] which states: "…regulations may also encourage energy-efficient patterns of development, the use of solar and other renewable forms of energy, and energy conservation."

Comply with CT Gen. Statutes 8-23 (a) and (d)[91] which require planning commissions to prepare, amend or adopt a plan of conservation and development for the municipality, and in preparing such plan, consider energy-efficient patterns of development, the use of solar and other renewable forms of energy and energy conservation.

Comply with CT Gen. Statute Section 8-25(b) which requires subdivision development regulations to consider energy-efficient patterns of development and use of solar. Such ordinances and review processes would consider road and lot orientation, building restrictions and subdivision regulations. See the Solar Site Design Worksheet for a Proposed Subdivision in Appendix VII. This worksheet can be used to document *consideration* of passive solar site design.

Consider the recommendations offered in a report published by the Connecticut Capitol Region Council of Governments (CRCOG), "Sustainable Land Use Regulations. Assessment of Local Land Use Regulations."[92] See Part III, Assessments of Local Land Use Regulations. For each selected municipality and each topic area, the report presents in tabular form where local land use regulations:

- Pose barriers to attainment of sustainable development practices
- Could incorporate incentives to promote sustainable development practices; and

[90] cga.ct.gov/2011/PUB/chap124.htm#Sec8-2.htm
[91] cga.ct.gov/2011/pub/chap126.htm - Sec8-23.htm
[92] "Sustainable Land Use Regulations. Assessment of Local Land Use Regulations," February, 2013. www.sustainableknowledgecorridor.org/site/sites/default/files/CA%20FINAL%203-4-13.pdf

- Have regulatory gaps or untapped opportunities to better promote sustainable development practices.

Towns participating in this Sustainable Land Use Regulation Project were Avon, Bloomfield, Ellington, Enfield, Farmington, Hartford, Manchester, Simsbury, Tolland, Vernon, Windsor, and Windsor Locks (see Figure 23).

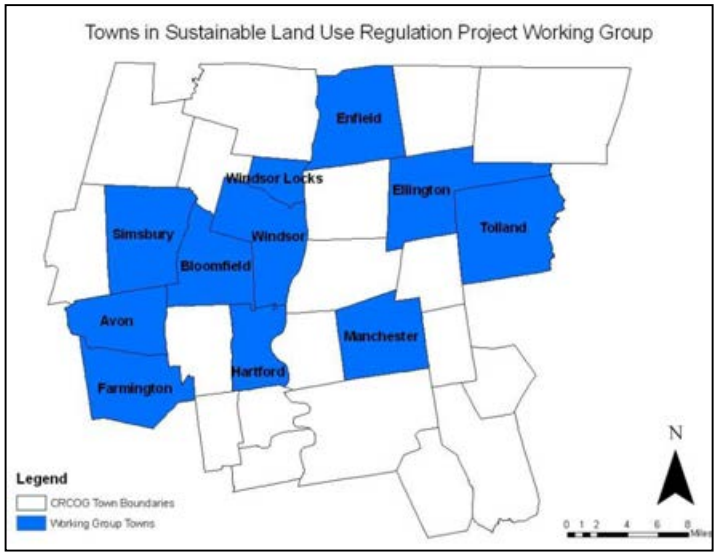


Figure 23: CT Capitol Region Council of Governments (CRCOG) Towns in Sustainable Land Use Regulation Project Working Group

13.0 Interconnection

13.1 Connecticut Context

Connecticut Light and Power Company (CL&P)[93] and The United Illuminating Company (UI)[94] are Connecticut's two major utility companies, both of which participated as partners on this project. CL&P is the state's largest utility with 1.2 million customers in 149 cities and towns. CL&P is a Northeast Utilities (NU) company. NU operates New England's largest utility system serving more than 3.6 million electric and natural gas customers in Connecticut, Massachusetts and New Hampshire. Companies that are part of NU include CL&P, NSTAR Electric & Gas, NU Transmission, Public Service of New Hampshire, Western Massachusetts Electric Company, and Yankee Gas Services Company.

Figure 24: CL&P Service Territory Map

Figure 24 shows CL&P's service territory map. The areas shaded in grey are those jurisdictions not serviced by CL&P, most of which are serviced by UI.

UI is Connecticut's second largest utility, with 325,000 residential, commercial and industrial customers in the Greater New Haven and Bridgeport areas. UI's parent company is UIL Holdings Corporation. UIL Holdings Corporation is an energy delivery company serving approximately 706,000 electric and natural gas utility customers in 66 communities across two states, Connecticut and Massachusetts. UIL Holdings is the parent company for UI, The Southern Connecticut Gas Company (SCG), Connecticut Natural Gas Corporation (CNG), and The Berkshire Gas Company (Berkshire Gas, serving natural gas customers in western Massachusetts).

Figure 25: UI Service Territory Map

The map of UI's service territory is shown in Figure 25.

As of May 15, 2013, CL&P has nearly 3300 distributed generation (DG) systems and UI has 525 systems interconnected to the grid and operating safely in Connecticut. These include solar PV systems, as well as fuel cells, combined heat and power systems, wind installations and other distributed generation.

Twelve jurisdictions participated in this project, representing the CL&P and UI territories as follows:

- **CL&P:** Cornwall, Coventry, Danbury, Greenwich, Hampton, Manchester, Middletown, Stamford, West Hartford
- **UI:** Bridgeport, Fairfield, Milford

In addition to CL&P and UI, Connecticut also has municipal electric distribution companies[95] including: Bozrah Light & Power, Groton Utilities, Norwich Public Utilities, South Norwalk Electric Works, and Wallingford Department of Public Utilities (DPU). There is also a Mohegan Tribal Utility Authority. A

[93] www.cl-p.com
[94] www.uil.com
[95] www.ct.gov/pura/cwp/view.asp?a=3352&q=405244

cooperative agency, the Connecticut Municipal Electric Energy Cooperative (CMEEC),[96] was formed by the state's municipal electric utilities.

The Public Utilities Regulatory Authority (PURA)[97] is statutorily charged with regulating the rates and services of Connecticut's investor owned electricity, natural gas, water and telecommunication companies and is the franchising authority for the state's cable television companies. PURA also keeps watch over competitive utility services to promote equity among the competitors while customers reap the price and quality benefits of competition and are protected from unfair business practices.

PURA replaced the former Department of Public Utility Control (DPUC) and along with the Bureau of Energy and Technology Policy, is part of the Energy Branch of Connecticut's Department of Energy and Environmental Protection (DEEP). DEEP was created in July 2011 and brings together the state's Department of Environmental Protection (DEP), the Department of Public Utility Control (DPUC) and an energy policy group that had been based at the Office of Policy and Management.

Thus, PURA regulates CL&P and UI, both investor-owned utilities, but not Connecticut's municipal utility companies. All filings submitted by CL&P and UI are processed by PURA in accordance with applicable statutes and regulations, and address issues such as: distribution, transmission and generation rates, wholesale procurement of electricity, energy efficiency, conservation and load management, cost-of-service, rate design, revenue requirements, metering accuracy, and the safety and reliability of the electric distribution system. In addition, PURA is responsible for the licensing of electric suppliers, registration of electric aggregators, and the oversight of renewable energy and renewable portfolio standards.[98]

13.2 Utility Participation in CT's Rooftop Solar Challenge

As partners on this project, CL&P and UI supported the Sun Rise New England team by explaining how interconnection of distributed generation works in Connecticut, how they work to ensure customer safety while also enabling interconnection of an ever-increasing number of distributed generation systems, what improvements they have made to their processes and their thoughts on potential areas for further improvement. CL&P and UI managers and staff were very generous with their time and explanations, providing multiple in-person interviews with CBEY and CEFIA team members and sharing information to assist the team in identifying possible areas of improvement to the interconnection process, especially as it would impact solar PV installation. Requests for follow up information and review of information were always provided very promptly.

In addition to interviews with the utility companies, CEFIA, CBEY and Solar Connecticut collected installer feedback from open-ended survey questions that were emailed to solar PV installers. A summary of the feedback is provided in a later section, section 13.14, of this discussion on interconnection.

While the goal of the Sun Rise team was to identify possible areas for improvements that would result in soft cost savings for solar PV installations, the project team recognized that many improvements have been proactively and steadily implemented over the past years. While the common, PURA-approved interconnection guidelines are implemented differently in terms of specific administrative processes between CL&P and UI, the project team found that both utilities have impressive staff who are experienced, knowledgeable and very efficient in their understanding of and implementation of the distributed generation interconnection guidelines.

[96] www.cmeec.com/whoiscmeec.htm
[97] www.ct.gov/pura/cwp/view.asp?a=3157&q=404410&puraNav_GID=1702
[98] www.ct.gov/pura/cwp/view.asp?a=3356&Q=405992&puraNav_GID=1702

13.3 Connecticut's "Freeing the Grid"[99] Report Card

Connecticut is proud to be steadily improving its "Freeing the Grid" report card, with utilities making strong efforts in many areas to positively impact deployment of distributed generation. Connecticut's "Net Metering" grade in 2013 is an A, and has been since 2009. Connecticut also scored well on "Interconnection," with a respectable B going back to 2010, having made tremendous progress since scoring a D back in 2009. Connecticut would need to make further improvements in interconnection to make an A.

Figure 26: Connecticut's Freeing the Grid Report Card on Net Metering and Interconnection

13.4 Net Metering

Connecticut ranks among the nation's leaders with respect to net metering.[100]

Connecticut General Statute Section 16-243h101 changed the way customers who generate electricity from Class I renewable resources with a capacity of 2 MW or less are reimbursed for their net kWh production. Beginning in October 2007, instead of being paid an energy only amount for net kilowatt-hours at the end of a billing cycle, customers operating Class I renewable generation are required to bank or rollover their net kilowatt-hours to be used to offset the full retail value (i.e., delivery and generation rates) of their future electric consumption. This structure significantly increased the customer's reimbursement for the net energy produced by their system. At the end of each annualized period, the electric distribution company or electric supplier shall compensate the customer-generator for any excess kilowatt-hours generated, at the avoided cost of wholesale power.

For example, at present, CL&P's residential retail charges total about $0.16 per kWh, one of the highest in the United States, and more than double the past wholesale average energy reimbursement payment. The reimbursement mechanism established through Conn. Gen. Stat. 16-243h significantly increases the financial benefit of owning Class I renewable generation.

In Connecticut, there is no stated limit on the aggregate capacity of net-metered systems in a utility's service territory.

13.5 Virtual Net Metering

An enhancement to Connecticut's net metering law is virtual net metering, included in Connecticut Public Act No. 11-80 (PA 11-80), effective July 1, 2011.[102] Under this law, municipalities are eligible for virtual net metering, which allows them to share the billing credit among their electric accounts. For example, a town could install a solar PV system on the roof of a school and share the billing credits the system produces with a fire station. This increases the likelihood that the customer will fully utilize its credits (paid at the retail rate) during a year, and therefore not have any remaining credits at the end of the year, for which it would be paid at the wholesale rate.

The new law, PA 13-298 broadens eligibility for virtual net metering in several ways. It opens the option to state agencies and agricultural customers and increases the maximum size of the renewable resource from two up to three megawatts. It allows virtual net metering for class III resources such as

[99] Freeing the Grid 2013. Best Practices in State Net Metering Policies and Interconnection Procedures, freeingthegrid.org.
[100] www.ctenergyinfo.com/dpuc_net_metering.htm
[101] www.cga.ct.gov/2011/pub/chap283.htm#Sec16-243h.htm
[102] www.cga.ct.gov/2011/act/pa/2011PA-00080-R00SB-01243-PA.htm

cogeneration, as well as class I resources. It allows municipal and state agency customers to lease the renewable resource or enter into a long-term contract for it.[103]

The new law further enhances the value of distributed generation by allowing municipal or state accounts as well as agricultural accounts connected to a micro-grid to share their credits with up to ten non-state or municipal critical facilities (e. g. hospitals, police and fire stations, and municipal centers).

13.6 Interconnection

In December 2007, the Connecticut Department of Public Utility Control (DPUC), now PURA, approved revised interconnection guidelines [104] for distributed energy systems up to 20 megawatts (MW) in capacity. Connecticut's interconnection guidelines apply to the state's two investor-owned utilities, CL&P and UI, and are modeled on the Federal Energy Regulatory Commission's (FERC) interconnection standards for small generators.[105] [106] The most recent revision to the guidelines was made in 2010.

Connecticut's guidelines include a standard interconnection agreement and application fees that vary by system type.[107] Connecticut's interconnection guidelines, like FERC's standards, include provisions for three levels of systems:

- **Certified Inverter:** projects 10kW and less (application fee: $100)
- **Fast Track:** projects greater than 10kW and up to 2MW (application fee: $500)
- **Study Process:** complex projects over 2MW (application fee: $1000 plus study fees). The interconnection guidelines include "additional process steps" for generators over 5 MW.

Connecticut's guidelines differ from the federal standards in several ways:

- Connecticut customers are required to install an external disconnect switch.
- Customers must indemnify their utility against "all causes of action," including personal injury or property damage to third parties.
- Customers are required to maintain liability insurance in specified amounts based on the system's capacity.
- In addition, the utilities were required to collaboratively submit to the PURA a status report on the research and development of area network interconnection standards. This report was completed in December 2009, and the PURA reached a final decision (03-01-15RE02)[108] on the docket. The PURA has determined that the utilities can interconnect inverter-based generators (up to 50 kW) on area networks.

---

[103] PA 13-298: www.cga.ct.gov/2013/ACT/PA/2013PA-00298-R00HB-06360-PA.htm

[104] Docket No. 03-01-15RE01, DPUC Investigation into the need for Interconnection Standards for Distributed Generation, December 5, 2007 (includes language from Docket No. 03-01-15 which made a decision on the EDS). www.dpuc.state.ct.us/dockhist.nsf/(Web+Main+View/All+Dockets)?OpenView&StartKey=03-01-15RE01

[105] FERC's interconnection standards are applicable to generator interconnections subject to FERC jurisdiction, whereas CT's interconnection guidelines apply to state-jurisdiction interconnections, which typically occur at the distribution level. FERC standards apply primarily to facilities that interconnect at the transmission level. However, FERC interconnection standards for small generators serve as a useful model for state-level standards. www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US06R

[106] www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CT06R

[107] www.cl-p.com/generatorInter/Generator_Interconnection/ and UI website Generator_Interconnection

[108] Area networks are low voltage electrical systems served by multiple transformers located in densely populated metropolitan areas to provide large numbers of customers with highly reliable electrical service. www.dpuc.state.ct.us/dockhist.nsf/8e6fc37a54110e3e852576190052b64d/6bafa029ff9f34f785257751005109 87?OpenDocument

Connecticut's guidelines address requirements for study fees and include technical screens for each level of interconnection. Utilities and customers must follow general procedural timelines.

13.7 Interstate Comparison Table

The table on the following pages compares interconnection policies across five states as well as the 2009 IREC model interconnection procedures[109] based on application review time, application fee, insurance requirements and external disconnect switch requirements. IREC's model procedures have been used by states across the country to improve interconnection laws and policies pertaining to distributed generation. For the purposes of understanding how CT's interconnection guidelines compared to those in other states, the team compared two New England states (Massachusetts and Maine) and the two other tri-state area states (New York and New Jersey) with Connecticut policies. Please note that the data in these comparison tables are for research and comparison purposes and may have already or is expected to change so it is best to refer directly to relevant state websites.

The five-state comparison illustrates differences in interconnection standards and procedures, useful but also not providing the full story, explained as follows:

- **Connecticut's interconnection standard allows up to 10 days to verify application completeness, and 15 days for application review for systems that are 10kW and less.**

  Two of the other four states have 3 and 5 day timeframes for verifying completeness, and the other four states allow only 10 days for application review. However, CL&P data shows that their median time frames are much faster than the CT guidelines require. *We thus shouldn't assume that the maximum timeframes allowed in the guidelines reflect actual timeframes.*

  CL&P's data for systems of size 10 kW and smaller, from January through June 2013, shows efficient timeframes for processing interconnection applications:

  - Out of 506 applications received, 468 have been successfully interconnected.
  - Average time to review an application for completeness is 2.5 business days, as compared to 10 days provided in the guidelines.
  - The median timeframe for application approval including net meter installation and approval to energize a project (without a witness test) is 3 business days, as compared to 15 days provided in the guidelines.
  - For systems in which a witness test is conducted, the median timeframe is 9 days.
  - Only 33 witness tests were conducted, while 435 were waived, reflecting that witness tests were done on 7% of applications for interconnection. CL&P waives the witness test for experienced installers and to those whom they have witnessed do about three successful installations.

  In summary, the requirements are less stringent than the other five states but this does not imply that the Connecticut utilities use the allotted time. The impression from the interviews conducted was that the interconnection staff work quickly and efficiently, and with large workloads. Process and system improvements that help with ever-increasing workloads may be beneficial, so that efficiency can be maintained even as volumes increase. In fact, CEFIA anticipates that residential solar PV additions are expected to double in fiscal year 2014 (starting July 1, 2013) as compared to the number of systems installed in fiscal year 2013.

[109] www.irecusa.org or www.irecusa.org/publications

- **Connecticut charges a $100 application fee for systems that are 10kW and less. Maine charges $50 while the other three states do not charge fees for small systems.**

  We spoke to the CT utilities about the fee and learned two things. The $100 does not cover the utility's review cost for this size system. In addition, not charging at least a nominal fee can result in "frivolous" interconnection applications so that serious applicants may have to wait longer or their interconnection projects may be impacted by inactive projects.

- **Connecticut charges a $500 fee for fast track systems that are less than 2 MW. New York charges $350 while in the other three states the fee depends on the size of the project.**

  While some installers have expressed that this $500 fee is too high, Connecticut's flat fee would be less expensive for systems over a certain size. For example, Massachusetts charges $3/kW with a minimum of $300 and a maximum of $2500, so a system of size greater than or equal to 167 kW would cost at least $501 in MA. In CT, a system of size up to 2MW would still cost $500. It would be interesting to research further how fee amounts and structures impact aspects of deployment such as sizes of installations. A flat fee for anything less than 2 MW does not penalize larger system sizes.

  An administrative aspect to consider in adopting a fee that depends on system size is that a more complex fee can lead to more mistakes and confusion in terms of installers submitting the correct amounts. Submission of the fee is what initiates the interconnection process, so an incorrect payment could delay a project.

  Changing the tier sizes or adding a tier may help make fees more reasonable for systems that are over 10kW in size but not over a larger size cut-off, say 100kW.

- **Connecticut requires proof of insurance for systems of size 100kW and less, whereas other states waive this proof for most systems, or at least smaller systems.**

  The insurance requirement for smaller systems is satisfied by standard homeowner's insurance. CL&P and UI have removed the requirement to renew proof of insurance annually for systems 10kW and less.

- **Connecticut's interconnection standard requires an external disconnect switch for all systems.**

  Some states do not include this requirement in their interconnection guidelines but leave it up to utility discretion, such as in Massachusetts. The project team contacted Western Massachusetts Electric Company, which is an NU company, and they do require the switch, so the lack of a state-level requirement does not necessarily mean that there is no requirement.

Table 14: Interconnection Guidelines - Comparison among Five States

IREC 2009 Model Interconnection Procedures	Connecticut CL&P and UI DG Guidelines	New Jersey	New York	Massachusetts	Maine
Inverter-Based Generating Facilities 25 kW and Less	**Inverter-Based Generating Facilities, 10 kW and Less**	**Inverter-Based Generating Facilities 10 kW and Less**	**Inverter-Based Generating Facilities 25 kW and Less**	**Single-Phase Inverter of 10 kW or Less, or Three-Phase Inverter of 25 kW or Less**	**Inverted-Based Generating Facilities 10 kW or Less**
Online application requirement **$0-20 fee** **3** days to evaluate application for completeness **7** days to review the application	**$100 fee** (plus potential study fees) **10** days to evaluate application for completeness **15** days to review the application	**$0 fee** **3** days to check application for completeness and respond to applicant via email **10** days to review the application	**$0 fee** **5** days to evaluate application for completeness **10** days to review the application	**$0 fee** (more for spot networks) **10** days to evaluate application for completeness **10** days to review the application	**$50 fee** **5** days to check application for completeness **10** days to review the application
For Generating Facilities Greater than 25 kW and Less than 2 MW	**Fast track for projects up to 2MW**	**For Generating Facilities 2 MW and Less**	**For Generating Facilities 2 MW and Less**	**For All Other Facilities**	**For Generating Facilities 2 MW and Less**
Online Application **$50 fee plus $1 per kW** of generating capacity **3** days to evaluate application for completeness **15** days to review the application	**$500 fee** plus study fee if don't qualify for fast track **10** days to evaluate application for completeness. **15** days to process application through initial screens	**$50 fee plus $1 per kW** of generating capacity **3** days to check application for completeness and respond to applicant via email. **15** days to review the application	**$350** application fee **5** days to check for completeness **15** days to review the application	**$3/kW: min. $300, max. 2,500** **10** days to evaluate application for completeness **10** days to review the application	**$50 fee plus $1 per kW** of generating capacity **5** days to evaluate application for completeness **15** days to review the application

Table 15: Interconnection Guidelines - Comparison among Five States (continued from Table 14)

IREC 2009 Model Interconnection Procedures	Connecticut: CL&P and UI DG Guidelines	New Jersey	New York	Massachusetts	Maine
Insurance Requirements	**Insurance Requirements**	**Insurance Requirements**	**Insurance Requirements**	**Insurance Requirements**	**Insurance Requirements**
No insurance required for inverter-based systems less than 1 MW	$300,000 in coverage required for systems less than 100 kW	Additional insurance is not required, unless agreed to by the applicant	Insurance not required	Insurance is not required for facilities that are less than 60 kW and eligible for Class I Net Metering	No insurance required for inverter-based systems less than 1 MW
External Disconnect Switch	**External Disconnect Switch**	**External Disconnect Switch**	**External Disconnect Switch**	**External Disconnect Switch**	**External Disconnect Switch**
Cannot be required if all the necessary conditions are met.	Required for all systems	Cannot be required if all the necessary conditions are met.	Not required for inverter-based systems less than 25 kW	Electric distribution company (EDC) discretion	Cannot be required if system complies with IEEE 1547 and UL 1741
Freeing the Grid 2012 Interconnection Grade	**Freeing the Grid 2012 Interconnection Grade**	**Freeing the Grid 2012 Interconnection Grade**	**Freeing the Grid 2012 Interconnection Grade**	**Freeing the Grid 2012 Interconnection Grade**	**Freeing the Grid 2012 Interconnection Grade**
A Standard	B	A	B	A	A

13.8 Interconnection Recommendations

The Sun Rise New England team identified the following opportunities for improvements to interconnection in Connecticut, from the perspective of facilitating interconnection of solar PV systems, and distributed generation generally. In addition, IREC has released a 2013 update to its Model Interconnection Procedures[110], a useful reference, along with consideration of best practices observed in other states and understanding what makes those practices possible, and lastly and most importantly – utility experience here in Connecticut and collaboration with other Connecticut utilities and organizations working towards common goals. Note that the CT utilities are currently participating in a FERC docket that may revise the FERC Small Generator Interconnection Procedures (SGIP); state interconnection rules including CT's are generally modeled on the FERC rules.

13.9 Recommendations for Interconnection Guidelines

Remove the annual requirement to show proof of insurance and consider waiving the insurance requirement altogether – Currently, the insurance requirement for systems up to 10kW is satisfied by standard homeowner's insurance. CL&P and UI have both removed the requirement to renew proof of insurance annually for systems up to 10kW in size. This is easy to justify as there are electronic devices in houses and buildings that have been certified to be safe such as UL-certified inverters.

Consider removing the proof of insurance requirement for systems that are UL certified and are under a larger, specified size such as 100kW for which $300,000 of liability insurance is required, or alternately up to 1 MW for which $1 million of liability is required.

The customer's insurance coverage for their structures should be sufficient, and the customer should be able to decide how they wish to account for any additional risk. Waiving this insurance requirement would alleviate an administrative burden to the utility and the installer.

Consider replacing the 10kW with an up to 25kW certified inverter guideline – Making this adjustment would allow the majority of residential and commercial systems to take advantage of a faster process and a lower fee. Under the current tier sizes, an 11kW system would have a $500 interconnection fee just because it is over 10kW in size. On the other hand, note that states whose certified inverter guidelines extend up to 25kW generally include additional considerations in the review process, so there can be a trade-off here. Additionally, the tier sizes should be reviewed every two years or in a time period that reflects rapid developments (including system size increases) in distributed generation.

Consider reducing interconnection fees where possible:

- For inverter-based systems up to 10kW (perhaps up to 25 kW), consider reducing the $100 fee. There may be ways to streamline processes to reduce the cost to the utility, or ways to recapture or justify the cost.
- For systems greater than 10kW (potentially > 25kW) and up to 2 MW, consider adding a tier size, for example for systems of size 25-100kW, so that systems of size 25kW-2MW are not all charged $500. It would be helpful to better understand what a cost-recovery fee would be, and if it is high, whether there are ways to streamline the process to lower costs, or understand how some utilities are able to justify and afford fee levels that do not fully recover their costs (e.g., via other benefits).

Require utility reporting of application acknowledgement, review and approval periods to PURA to assure that time periods for both utilities are reasonable. Note that reducing the official, required turnaround times has the tendency to increase eligibility requirements for those submitting applications subject to those turnaround times, as many states have done, so reducing these times in the guidelines has potential cost versus

[110] www.irecusa.org/wp-content/uploads/2013-IREC-Interconnection-Model-Procedures.pdf

benefit. Requiring utilities to report these turnaround times may just as or more effective than updating the official turnaround times.

Reconsider necessity of the external disconnect switch requirement.

- Small inverter-based systems automatically disconnect from the grid during outages and can also be manually disconnected from the grid through other mechanisms. The EDS may be a redundant safety feature. This issue is discussed in detail in the next section, section 13.10.

13.10 External Disconnect Switch

The utility-accessible (UA) alternate current (AC) external disconnect switch (EDS) for distributed generation, including photovoltaic (PV) systems, is a hardware feature that allows a utility's employee to manually disconnect a customer-owned generator from the electricity grid. Proponents of the EDS contend that it is necessary to keep utility line workers safe when they make repairs to the electric distribution system. Opponents assert it is a redundant feature that adds cost without proving tangible benefits.[111]

Modern small commercial and residential PV systems include UL-listed[112] components that meet rigorous standards. The National Electrical Code (NEC) requires that an inverter de-energize its output upon loss of utility voltage and remain in that state until utility voltage has been restored. Modern electronic inverters are reliable, intelligent, and comprehensively tested to ensure that they do not feed back to the grid during outages.

Arguments made for why the EDS should not be required include:

- Inverters drop off-line during an outage.
- Linemen usually don't have time to use an EDS when restoring an outage.
- If there is an issue with the PV system, the DC switch can be locked or "red-tagged."

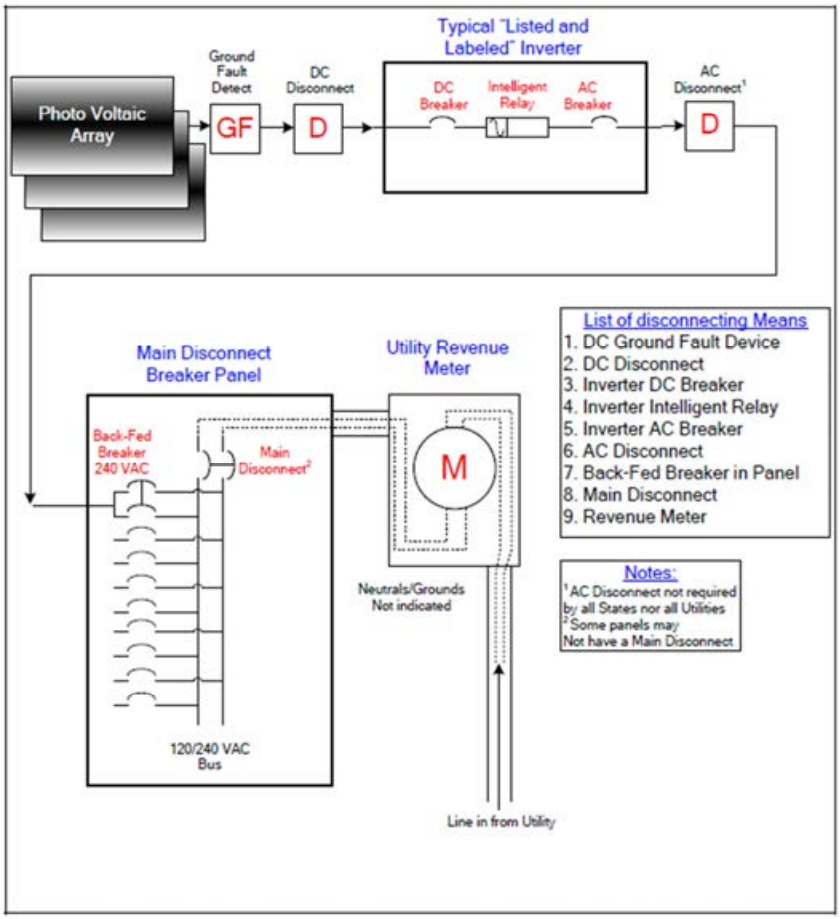


Figure 27: Utility Accessible Alternate Current External Disconnect Switch

[111] M.H. Coddington et al., Utility-Interconnected Photovoltaic Systems: Evaluating the Rationale for the Utility-Accessible External Disconnect Switch, National Renewable Energy Laboratory, NREL/TP-581-42675, January 2008, available at: www.nrel.gov/docs/fy08osti/42675.pdf.

[112] UL 1742 applies to inverters. Based on IEEE 1547 requirements, the UL-listed inverters for PV systems require the inverters to disconnect automatically from the grid.

- IEEE 1547, UL 1741 and the NEC do not require an EDS.
- If the utility is allowed to require the EDS, then this should be added to the switching procedures.

Figure 27 shows that the EDS[113] or AC Disconnect for a solar PV system, as usually installed, has multiple disconnecting mechanisms serving the same purpose as an EDS.

While those focused on reducing time and cost of solar PV installation emphasize the redundancy of the EDS, some utility companies express reasons why it should be maintained as a requirement. One utility representative shared the perspective that the EDS marks the boundary between where the responsibility of the utility ends and where the responsibility of the homeowner starts. Certainly, if one thinks of the EDS as being replaced by multiple other mechanisms, from a functional perspective, then is there another clear line of demarcation, say the inverter?

Another perspective on this issue which Connecticut has to offer is that from the most recent PURA (at the time DPUC) ruling when PURA was asked by Aegis, an installation company, to remove this requirement. Aegis made the point that generators have other means of ensuring isolation and also that induction generators are incapable of starting up on their own and inadvertently energizing circuits.

The project team asked PURA about how the decision on this issue came about, and PURA shared that there was at the time considerable debate on the issue, and much thought put into a decision in favor of preserving the EDS requirement. The explanation provided in Docket No. 03-01-15RE01, DPUC Investigation into the need for Interconnection Standards for Distributed Generation, December 5, 2007, was as follows:

> **The disconnect switch is a mechanical device used to isolate the generator's electrical facilities. The disconnect switch is used to either isolate the generator from the Company's facilities for safety reasons, or to isolate the generator from the customer's facilities to enable work on the customer's facilities without de-energizing the customer's loads.** The Revised Guidelines require that an external disconnect switch be provided at the point of interconnection that is easily accessible to Company personnel that can be opened for isolation, for any generating facility rated greater than 1 kW. (Revised Guidelines, Section 3.3.2). The Existing Guidelines require a disconnect switch for all generator interconnections; therefore, the Existing Guidelines relax the disconnect switch requirement for very small generators.
>
> **In the Initial Decision, the Department concluded that the disconnect switch requirement is reasonable, and stated its belief that Company workers should have positive confirmation and control over isolation devices to ensure electrical facilities cannot be energized during maintenance.** (Initial Decision, p.5).
>
> SunEdison notes that some jurisdictions have eliminated the need for an external disconnect switch for certain types of generating facilities, notably, inverter based generation (which is commonly used for solar and wind based generators). Instead, other jurisdictions allow removal of the revenue meter as a means of disconnection. (SunEdison Written Comments, pp. 12-13).
>
> The EDCs oppose removing the disconnect switch requirement. According to the Companies, removal of the revenue meter as an alternate means of disconnection poses a substantial safety hazard. The EDCs report that they have had numerous instances of electrical flashes and broken meter socket jaws upon meter removal, presenting both safety issues for employees and property damage liability issues for the Companies. Further, the Companies state that the majority of states still require a disconnect switch. (UI Reply Brief, p.7; CL&P Brief, pp.3-4; Tr. 9/25/07, pp.130-131).

[113] M.H. Coddington et al., Utility-Interconnected Photovoltaic Systems: Evaluating the Rationale for the Utility-Accessible External Disconnect Switch, National Renewable Energy Laboratory, NREL/TP-581-42675, January 2008, www.nrel.gov/docs/fy08osti/42675.pdf.

> The Department reaffirms its conclusions from the Initial Decision on this matter. No new facts have been presented in this case, other than that some other jurisdictions have removed the requirement, which may have the effect reducing utility worker safety to accomplish energy policy goals. The Department believes that the disconnect switch requirement is necessary for worker protection.

With arguments for and against the disconnection switch, the team's recommendation is to reconsider the necessity of the external disconnect switch requirement; PURA would need to agree to reopen the discussion.

13.11 Utility Strengths and Best Practices

The interconnection guidelines do not establish all of the interconnection application procedures, leaving implementation processes and practices up to the utility. **The following are examples of CL&P and UI's strengths and best practices:**

- CL&P developed and currently uses an online interconnection application submission and tracking system which provides both installers and solar PV customers a convenient means to check the status of their interconnection application.
- CL&P and UI have helpful websites which provide information and documentation on interconnection requirements and processes.
- CL&P and UI have both removed the annual requirement to provide proof of insurance for systems up to 10kW in size.
- CL&P waives most witness tests for inverter based systems under 10 kW in size, typically after three successful tests with the same installer. The waived witness test results in tremendous time and cost savings. Additionally, CL&P does not charge for those witness tests it does conduct for this system size.
- CL&P shows their median times to interconnect inverter based systems of size 10kW or smaller to be very reasonable, as follows:
    - 4 days in 2012, 3 days in the 1st quarter (1Q) of 2013, and 2.5 days in the first half of 2013, as compared to 10 days as required in the interconnection guidelines
    - The median timeframe for application approval including net meter installation and approval to energize a project is 3 business days without a witness test (9 days with witness test), as compared to 15 days in the guidelines
- Both utilities have processes in place to coordinate with town building inspectors as to when systems have passed municipal inspection and are ready for interconnection to the grid:
    - CL&P: To handle the variation in processes for over 140 towns in CL&P's service territory in terms of notifying the utility when municipal building permits are approved, CL&P worked with the municipalities to create a common process across all of the towns.

Utility Best Practices:

CL&P has an online interconnection application submission and tracking system, waives witness tests for experienced installers (and waives witness test fees for systems up to 10kW), and has reduced median time to approve and energize a project to 3 business days.

Both CL&P and UI have waived the annual requirement for proof of insurance for systems up to 10kW.

UI adopted a best practice by now requiring only one meter for a solar PV system instead of two, saving approximately $500 per project in equipment and labor cost for the second meter.

As of 10 years ago, the towns all handled permit approvals and notifications to the utility differently. CL&P worked with the towns to develop a process by which an installer submits a permit application to the town and an interconnection application to CL&P. CL&P creates a work request number which is provided to the municipal building inspector. Once the inspection is done and the permit is approved, the inspector notifies the utility using the work request number. This process saved all parties a tremendous amount of time because it was consistent and clear for all the

towns. Three years ago, this process was further improved with online and electronic means put in place to handle about 90% of the requests and communications. As of one year ago, 100% of requests and communications are processed electronically.

- UI: At a high level, UI's process for coordinating with municipalities and installers is similar and reaches the same outcome. Ultimately, the municipal inspector contacts UI via an automated telephone notification system to inform UI when the PV system has passed inspection. This information is relayed to UI's distributed generation team for next steps. The biggest differences are due to the UI process not being online or fully electronic, resulting in several process flow steps that rely on phone calls or emails. Though this process currently works very well, it does rely on incredible diligence of staff, and could be made even better in the long run with more reliance on technology to make staff's work easier. An online or electronic system, for example, similar to what CL&P has, could be particularly helpful as the volume of DG applications such as those for solar PV systems increase.

- Installers new to Connecticut are invited to train with the utilities to help them understand the interconnection processes, saving everyone time in the long run. The utilities see themselves as shepherding installers through the interconnection process.
- Interconnection staff at both utilities are highly qualified, knowledgeable and experienced in the processes and subject matter of their roles. The staff have strong technical skills and know their jobs inside and out.
- The utilities track a lot of useful information about the systems that are installed as well as metrics pertaining to administrative processes.
- Both installers and distributed generation system customers are surveyed regularly to solicit feedback on how the utility can better provide service.

13.12 Utility Practice Recommendations

Opportunities for improvement at the utility practice level include:

- **Develop online application, and online fee payment** – This would streamline the application process and shorten the waiting period. CL&P has an online interconnection application submission and online tracking system in place. UI does not yet, but mentioned that it's something one would naturally consider. Neither company offers an online payment option for the interconnection fee. Allowing for online payment is not a simple matter primarily due to utility billing system complexities. At this time, payments can be sent in by check in the regular mail.
- **Require only a single net meter (only applied to UI who had implemented this change as of May 2013 or earlier)** – As observed by "Freeing the Grid" in their report assessing interconnection and net metering across all U.S. states, a common area of improvement for utility companies are improvements to billing systems. For example, UI until very recently required two meters for a solar PV system in order

to determine "net" use because of how the existing billing system is structured. Billing systems can be expensive and arduous to change, especially with a large number of customers. The consequence of requiring an extra meter was that the solar PV customer would ultimately pay an extra $270 to the installer to cover the second meter (extra equipment) plus added installer labor cost. As of the writing of this report, UI found a solution to remove the need for two meters. This will save about $500 per system installed in UI territory.

- **Consider waiving witness tests for repeat installers for inverter based systems under 25kW (CL&P already does this for systems up to 10kW in size)** – For inverter-based systems under 25 kW, utilities could consider waiving the system witness test if they have worked with a particular installer in the past and are confident in the installer's ability to install the particular system, saving both the installer and utility time and resources, ultimately benefiting customers of distributed generation. CL&P has applied this practice already for systems up to 10kW by waiving witness tests for installers after about the third witness test conducted with an installer. Also, CL&P does not charge a witness test fee for these tests with new installers.
- **Continue to develop and enhance guidance and resources for installers to help them better understand processes and application requirements, leading to more complete applications.** As with permitting, installers providing incomplete applications is a significant source of delays. The practice of training new installers, as mentioned above, is beneficial, as would any additional tools and measures to increase clarity in communicating process expectations and technical requirements for all review tracks.
- **Standardize procedures for systems that fail fast track screens (CL&P and UI already working on this)** – For systems that are large and/or technically complex, it would be helpful if the utilities provided as much guidance as possible to help installers understand the scope of studies needed to address the failure of certain screens. What will it take to assure that the system is consistent with safety, reliability and power quality standards? Each time the utility and installer work together on an interconnection that is complex, it would be beneficial to apply the lessons learned in an effort to continue simplifying, formalizing and communicating processes for more complex systems as effectively as possible.
- **Examine the effectiveness of the coordination between utilities and municipalities to see if it is working as intended, and correct any inefficiencies.** Take initiative to reach out to jurisdictions to optimize communication between building inspectors who are approving solar PV permits and communicating this information to the utility. CL&P has an online system in place for building inspectors to provide communications about permit approvals. UI has an automated phone system and could consider adopting an online system similar to what CL&P has implemented. The more this communication is made easy and standardized for all parties, the less delay incurred.

13.13 Recommendations for PURA

The interconnection guidelines adopted by CL&P and UI do not apply to the municipal electric companies, for which this project did not conduct research. It would be useful to know what standards, requirements and processes the municipal utilities operate by, what installers' experiences are in these towns, and whether there are any best practices.

Recommendation:

- **Encourage adoption of the interconnection guidelines by all utilities in Connecticut** – PURA could encourage adoption of the interconnection guidelines adopted by CL&P and UI by all of Connecticut's utilities. This would help standardize interconnection across all CT jurisdictions.

13.14 Data Collected -- Utility Interviews and Installer Survey Responses

CL&P Interview Highlights

- Online interconnection application, but no online payment option
- Typically a small project would only take a day or two to review
- Application approval sent by email to homeowner and installer
- Don't do utility inspection for small projects—rely on town building departments; have right to inspect but waive it after they've done a new installer 3 times; usually working with same cast of characters
- Building inspector will be able to input number to submit approval online to CL&P (only a handful of the 144 towns don't use online system and instead submit approval by fax)
- Can check status of interconnection online using work request number and town name
- With new installer will schedule a "witness test" within 10 days, send out a technician to test to make sure inverter cuts off when there's loss of power, make sure equipment is not back-feeding, and make sure it's configured in the right way. Do this about 3 times with a new installer and then no witness tests after that. No witness test fee if system 10 kW or smaller.
- How can the interconnection process be improved? In Connecticut we need, as California has done, a system for when systems fail fast track system screens. Would help to have a defined scope of what studies will be needed based on which screens a project fails; CL&P is working to develop this with UI.

UI Interview Highlights

- 2010 interconnection guidelines are currently in the process of being updated
- Net metering requires two separate meters, one measuring the power flowing into the house from the grid and one measuring the net export of surplus generated power to the grid.
    - There are two ways to accommodate the required second meter:
        - Have the homeowner's electrician install a second meter socket
        - Have UI install an adapter in the original socket that allows a second meter to be connected. This costs $270.00 and only works for systems of 200 amps or less.
    - The meters themselves could be wired so that a single meter could handle both inflow and outflow of power, but the UI billing system can't handle it. Hence the two-meter requirement.
- No online application but supporting documents such as site plans and insurance documents can be sent electronically.
- The installer receives an email confirming receipt of the application within three business days.
- UI never waives the right to conduct witness tests the way CL&P sometimes does. This is because UI has a much smaller territory than CL&P, so it's not such a stretch for them to personally inspect every PV system.
- UI works with the same installers (about a dozen in the area) over and over and knows them well.
- Installers should submit the application as early as possible even if it's incomplete. That way they can get help with any parts that give them difficulty. Installers who wait to the last minute make UI look bad to the customer if the customer thinks the installer submitted the application much earlier.

- Ideally UI would like to receive an application before the system is installed so any changes can be made to the plans rather than to the physical system.

Summary of Installer Survey Responses

The following is a summary of installer survey responses -- see Appendix VIII for full questions and answers. Note that some responses include comments about the permitting process, which is a municipal rather than a utility process.

- I have no issues with the process. I would like to see more representatives to keep up with the load. I suggest having the clearance desk reps assigned to certain areas
- CL&P online tracking of application status is good
- Making all processes electronic will help speed things up
- Witness test scheduling is a large time expense
- Category 2 process takes too long and is too expensive
- The entire permitting and interconnection process is time consuming and expensive, much more so with systems over 10kW.
- The utility requires a printed, mailed copy of paperwork and a check. Need faster and simpler process.
- Well run program, modest cost ($100 for 10 kW and under), inspections waived after a few passes
- The process is time consuming and expensive, much more so with system over 10kW.
- Application fees are in the $200-$500 range. Biggest expense is time for witness tests and scheduling.
- Some are advocates of removing the utility disconnect requirement (as inverters are 1741 listed). I'd leave that decision to safety studies.
- Category 2 is $500 for interconnection and $550 for witness test (both too much)
- Town inspectors have to do an online submittal in a timely manner -- this is weakest link
- Coordinating with town building inspectors is time consuming, and they usually don't know enough about electrical parts
- Main issue is building inspectors being ill prepared for the task of reviewing solar systems
- Let's build a centralized state level permitting process so we only have one inspector. Provide the municipality a token amount, say $100, to verify that the house is constructed to code. This information should be on file so that towns don't have to go to the site. Use SunShot funds to build this process and fees to installers will help maintain it.
- Implement a permitting and interconnection process as they have in Vermont.[114]

[114] www.renewableenergyworld.com/rea/news/article/2011/05/vermont-enacts-first-in-nation-solar-registration

14.0 Financing

14.1 Connecticut's Innovative Financing Mechanisms

The Clean Energy Finance and Investment Authority (CEFIA) develops numerous innovative financing mechanisms for Connecticut residents that increase affordability and accessibility of rooftop solar PV installations and increase demand while lessening dependence on ratepayer dollars by leveraging private capital. New products/programs were released in the Spring and Summer of 2013 that will enable the residential, municipal and commercial sectors to access financing for clean energy including rooftop solar PV.

14.2 Green Bank Financing Model

CEFIA was created by the Connecticut General Assembly in 2011 as the successor organization to the Connecticut Clean Energy Fund (CCEF). As the nation's first "green bank," CEFIA leverages public and private funds to drive investment and scale up clean energy deployment in Connecticut.

Green bank loans can facilitate lower cost financing from third-parties enabling greater access to capital for households interested in solar PV. The Rooftop Solar PV "Green Bank" Financing Model[115] allows users to stipulate financing cost assumptions as well as revenue source assumptions in order to model scenarios in a given state or region. ***This model quantitatively shows how a combination of lowered installation costs and green bank loans can lower the price paid by consumers for clean electricity to at or below the existing retail price as a result of lower cost debt in the capital structure.***

According to the model, various combinations of green bank loans lower the price of solar electricity enough to be competitive with average Connecticut electricity prices (see Table 16). The model uses the installed cost of PV, regional capacity factors (i.e., solar insolation levels), state policies and incentives, and the capital structure to determine the resulting retail cost, equity returns, and installed capacity for a given level of green bank debt.

Table 16: Retail Price ($/kWh) as a Function of Solarize Installed Cost Levels and Green Bank Loans
(*base case retail price before any green bank loans)

Installed Cost ($/W)	% Green Bank Debt in Capital Structure				
	0%	10%	20%	30%	40%
4.5	0.210*	0.187	0.163	0.140	0.117
4.0	0.174	0.154	0.133	0.112	NA
3.5	0.139	0.121	0.103	0.085	NA
3.0	0.103	0.088	0.072	0.057	NA

Other Assumptions:	
Developer Equity Return	15%
Tax Equity Return	12%
Total Leverage	40%
Commercial Debt Interest	6%
15-Year RECs	$0.030/ kWh
6-Year State Incentives	$0.225/ kWh

The shaded cells in Table 16 are those with retail price less than the average 2013 CT retail price of $0.158 (a weighted average of 80% of CL&P's retail price and 20% of UI's retail price, reflecting service territory sizes). For example, at an installed price of $4.0/W with 0% green bank debt, the cost of electricity is $0.174, higher than grid electricity. The same installed cost of $4.0/W with 10% green bank debt brings the electricity cost down to $0.154, lower than grid electricity and resulting in favorable economics. The higher the level of green bank debt, the lower the resulting cost of electricity.

This model can be used by any state and is publicly available via CEFIA online at www.ctcleanenergy.com/RooftopSolarPVModel.

[115] Rooftop Solar PV "Green Bank" Financing Model sponsored by CEFIA, the Coalition for Green Capital (CGC) and the Brattle Group.

14.3 Financing Programs

CEFIA is putting the Green Bank Financing Model in practice through several financing programs. The increased availability of longer term, low interest debt results in the need for fewer subsidies, energy savings that exceed debt service and greater access and affordability of rooftop solar PV to Connecticut residents.

Table 17: Roadmap to Residential Rooftop Solar PV Financing in Connecticut

Program	Type	Term (Years)	Interest Rate (%)	ARRA[116] ($MM = $ million)	CEFIA ($MM)	Private Capital ($MM)
CT Solar Lease[117]	Lease	20	N/A[118]	$3.5MM	$9.5MM	$52MM ($28MM debt, $24MM tax equity)
Smart-E Loans	Loan	5	≤ 4.49	$2.5MM	$0	$28MM
		7	≤ 4.99			
		10	≤ 5.99			
		12	≤ 6.99			
CT Solar Loan	Loan	15	6.49	$0.3MM	$1.5MM	$3.5MM
Capital Competition	Loan	20	2	$0	$1MM	TBD
Total				$6.3MM	$12.0MM	$83.5MM

CEFIA has been working to further drive down installed costs with programs such as Solarize and the Rooftop Solar Challenge, while increasing the availability of low cost financing from the private market in order to realize financed installations that are cash flow positive from the outset.

Table 18 provides a comparison of solar financing options assuming a Solarize price of $3.50/W for a 7kW system. Based on this pricing example, the CT Solar Lease is cash flow positive from the outset (see the next section for details).

Table 18: Comparison of Financing Options

(for a 7kW system installed at Solarize price of $3.50/W)	Smart-E Loan (12yr)	CT Solar Loan	CT Solar Lease
Down Payment Required	$0	$1,263	$0
Loan Amount	$15,925	$15,150	N/A
Est. 1st Month Payment	($164)	($132) ($87 post re-amortization)	($72)
Est. 1st Month Net Cost	($58)	($27)	$34
Wealth Created (5% discount rate)	$9,720	$10,046	$5,589

[116] CEFIA is using repurposed ARRA-SEP funds as credit enhancements (i.e. loan loss reserves) for various financing programs for rooftop solar PV. For the CT Solar Loan, the amounts shown for ARRA, CEFIA and Private Capital are an estimated split for the $5MM total facility

[117] This lease is version two, following on the lease offered by CCEF, CEFIA's predecessor organization.

[118] There is a 2.9 percent annum escalator which the consumer does not see as an interest rate.

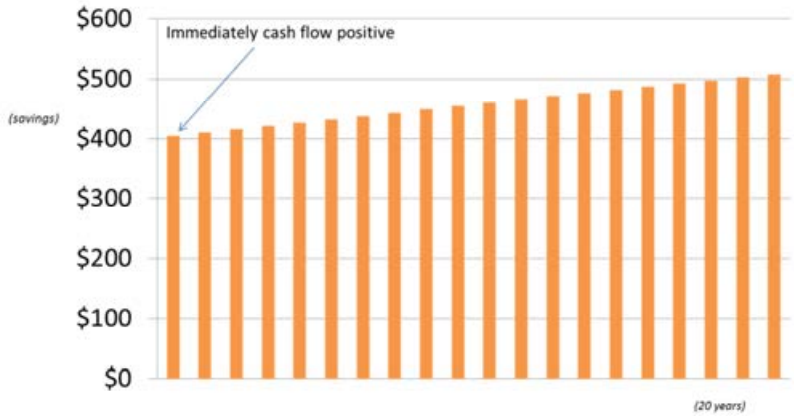
14.4 Energize Connecticut Solar Lease

CCEF launched the award-winning Connecticut Solar Lease (version one) in 2008 for PV systems in one to four unit owner-occupied residences in Connecticut. The program provided 855 leases to residents in just over three years demonstrating "high borrower fidelity rates."[119] It also included energy assessments and coupons for energy efficiency from solar REC revenue. The new version, Version 2.0, released July 2013, includes more private investment, including debt providers, thus lowering the overall cost of capital going into the structure and reducing reliance on ratepayer funds. These financing mechanisms will "right-size" and lower the payback period of a solar PV system and expand its data collection requirements on hardware and non-hardware costs.

CT Solar Lease provides over $50 million in capital for an expected 1500 residential solar PV systems, 400 residential solar thermal (hot water) systems, and 40 municipal solar energy systems. The program is expected to result in the return over time of all Connecticut ratepayer funds used to subsidize the installations, plus provide a two percent return. Twenty-year leases will be available for residential and commercial solar PV energy systems and 15 year leases for solar hot water systems. Monthly payments will be based on installed cost with a 2.9 percent per annum escalation in the lease payment with an option to purchase the system annually after the fifth year and at the end of the lease (year 20). Leases with fixed rates are available for higher monthly prices. The program is available to all customers with a minimum FICO score of 640, making the product accessible to 87% of Connecticut's single family homeowners.

AFC First Financial will service the leases including processing of all applications and maintaining data. AFC First Financial successfully partnered with CEFIA as the servicer for Solar Lease 1, and has experience with many other clean energy programs, including Pennsylvania's Keystone HELP, for energy efficiency.

Figure 28 provides an example of annual cash flow for the CT Solar Lease over a 20 year term under the Solarize price assumption of $3.50/W for a 7kW system. This lease product is immediately cash flow positive.[120]



Term Length	20-year
Not-to-Exceed Rate	N/A
Down Payment Required	$0
Est. Monthly Payment (1st Month)	($72)
Est. Monthly Savings (1st Month)	$34
Month of First Positive Cash Flow	Immediate

Figure 28: CT Solar Lease Representative Cash Flow

14.5 Energize Connecticut Smart–E Loans

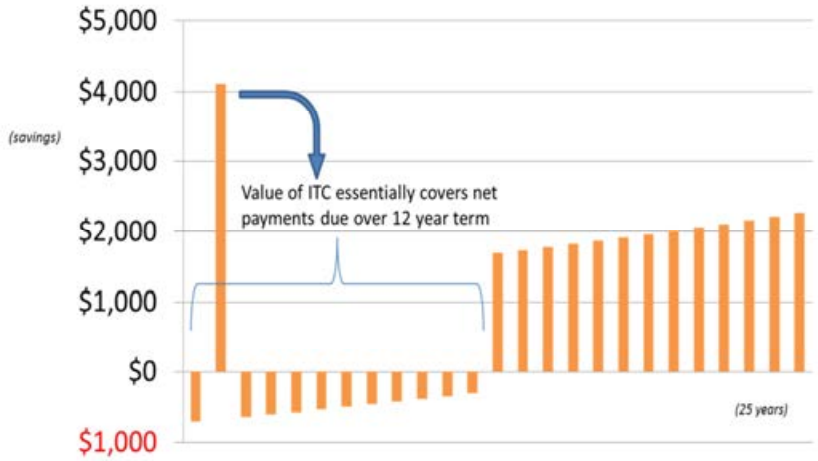
CEFIA's Smart-E Loan Program offers long-term, low-interest financing through participating lenders to help Connecticut residents access home energy upgrades, including rooftop solar PV. Affordable, simple and easy to

[119] Bethany Speer. Connecticut's Solar Lease Program Demonstrates High Borrower Fidelity. NREL, October 2012.
[120] This example calculation as well as those for the loan products are based on inclusion of a Residential Solar Investment Program (RSIP) incentive/rebate level for solar PV that is at "step 3" in an incentive structure designed to decline gradually. See section 14.10 for more details about the RSIP.

access, Smart-E loans enable the implementation of energy upgrades that result in environmental benefits, cost savings and home improvement to Connecticut residents. Participating local credit unions and community banks are providing up to $28 million in capital for projects undertaken by contractors for energy upgrades, supported by CEFIA's $2.5M Loan Loss Reserve. Unsecured loans of up to twelve years are provided to qualifying residential borrowers to finance comprehensive, qualifying renewable energy improvements (i.e. rooftop solar PV installations), including fuel conversion, renewable energy and efficiency measures.

The program is open to 1-4 unit owner occupied residences or condominiums if individually metered, subject to credit approval. Residences must be serviced by The United Illuminating Company, Connecticut Light and Power, or the Connecticut Municipal Electric Energy Cooperative[121] for electric; and Southern Connecticut Gas, Connecticut Natural Gas, or Yankee Gas for gas.

Figure 29 provides an example of annual cash flow for the Smart-E Loan over a 12 year term under the Solarize price assumption of $3.50/W for a 7kW system. The value of the federal investment tax credit (ITC) is equivalent to the net payments due on the Smart-E Loan over the 12 year term.[122]



Term Length	12-year
Not-to-Exceed Rate	6.99%
Down Payment Required	$0
Loan Amount (7 kW @ $3.50/W)	$15,925
ITC Value	$4,778
Est. Monthly Payment	($164)
Est. Net Cost (1st Month)	($58)

Figure 29: Smart-E Loan Representative Cash Flow

14.6 Energize Connecticut Solar Loan Powered By Sungage

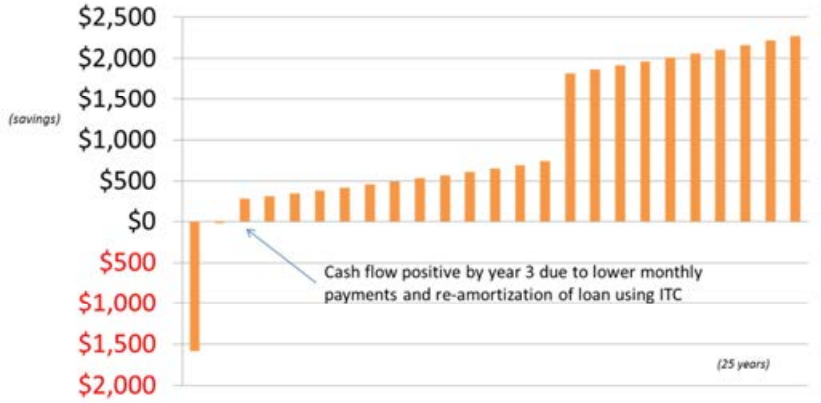
The Energize Connecticut Solar Loan is administered by Sungage, Inc. (Sungage), a financial services company committed to helping more people own solar PV. Sungage developed an innovative loan structure specifically targeted at residential solar PV system ownership. The loan structure enables CEFIA to promote solar ownership in Connecticut with a $300,000 Loan Loss Reserve (LLR) from repurposed ARRA-SEP funds and a subordinated debt term loan component of up to $1,500,000. Homeowners with FICO scores greater than 680 are able to access the Energize Connecticut Solar Loan program and take advantage of the Investment Tax Credit (ITC), previously out of reach for those who could not afford the entire upfront cost of PV installations. The standard loan rate is 6.49%, and rises to 9.99% if the homeowner does not use most of the ITC to pay down the loan (via a Tax Credit Recapture and Reamortization provision). The individual loan tenor is 15 years.

[121] www.cmeec.com/whoiscmeec.htm

[122] The federal ITC benefit amounts to 30% of the installed system cost, calculated after subtracting out the incentive amount. A solar PV system owner in the scenario in Figure 29 would receive a tax credit from the federal government in the amount of $4778 (unless part of the amount was carried forward), equivalent to 12 years of Smart-E loan payments.

CEFIA's LLR and subordinated debt term loan will support $3,500,000 of private capital.[123] The long-term structure (once the subordinated component reaches a "steady state") leverages private capital to public funds at a rate of nearly 3:1. Sungage provides contractor training, financing tools and administration of the program. Funds management and loan application / administration responsibilities are handled by LeaseDimensions, an established major consumer loan administrator whose client list includes GE Capital, Volkswagen Credit, Coca-Cola, Hewlett-Packard and Ford Credit.

Figure 30 provides an example of annual cash flow for the CT Solar Loan over 25 years (with 15-year financing) under the Solarize price assumption of $3.50/W for a 7kW system. The loan is cash flow positive by year three due to lower monthly payments and re-amortization of the loan using the ITC.[124]



Term Length	15-year
Not-to-Exceed Rate	6.49%
Down Payment Required	$1,263
Loan Amount (7 kW @ $3.50/W)	$15,150
ITC Value	$4,924
Est. Monthly Payment (1st Month)	($132)
Est. Net Cost (1st Month)	($27)

Figure 30: CT Solar Loan Representative Cash Flow

For more information about these financing products, see the EnergizeCT website: www.energizect.com/residents/programs.

14.7 Capital Competition Program

CEFIA worked with the Coalition for Green Capital (CGC) to issue a Request for Proposals (RFP) for a pilot program to invest $1 million of ratepayer funds in a 20-year low interest (e.g., 2%) loan to identify an installer, financier, or third-party that can maximize the deployment of residential rooftop solar PV per dollar of ratepayer funds at risk without the use of subsidies. CEFIA will be purchasing (and then selling) the RECs from these installations at a price that will amount to a lower subsidy than if these installations were provided with RSIP rebates. A successful pilot would encourage CEFIA to offer another RFP for $5-10 million, to be expanded in partnership with other state or city level green banks to attract additional low cost capital.

14.8 Commercial Property Assessed Clean Energy (C-PACE) Financing

C-PACE is a finance mechanism that allows commercial, industrial and multifamily property owners to access up to 100% low-cost, fixed rate, long-term financing for energy efficiency and renewable energy improvements and repay the loan through placing a voluntary assessment on their property tax bill, similar to a water/sewer tax assessment. Property owners pay for the improvements over time (up to a period of 20 years) through this additional charge on their property tax bill, and the repayment obligation transfers automatically to the next owner if the property is sold. Capital provided under the C-PACE program is secured by a lien on the property, so low-interest capital can be raised from the private sector with no government financing required. The state of

[123] The $3.5M is pending based on the participation of a proposed Senior Lender. In lieu of a Senior Lender, CEFIA invested $1,500,000 of ratepayer capital in order to jumpstart the program.
[124] Notes: (1) Assumes a dealer fee of $750, (2) Estimated monthly payment drops to $87 after re-amortization of ITC proceeds.

Connecticut passed legislation enabling CEFIA to offer C-PACE financing. However, each city or town must still opt into the C-PACE program and agree to assess, collect, remit and assign benefit assessments to CEFIA.

When low cost, long-term C-PACE debt is used to finance the costs of installing a rooftop solar PV system, lower levels of incentives are needed to make the project viable at current electric rates. For example, as shown in the table below, when 70-percent debt is assumed to finance a project that costs $3/W, the project can be financed with a Zero Emissions Renewable Energy Credit (ZREC) price of as little as $58/MWh while still maintaining a net present value greater than zero. This price is significantly lower than the average clearing price from the 2012 auction of $135/MWh. The addition of C-PACE debt to the current level of incentives could result in more than twice the number of clean energy projects.

Table 19: Net Present Value given varying ZREC Prices

(*2012 ZREC clearing price)

REC Value	$60	$65	$75	$95	$115	$135*
Net Present Value ($)	3,702	18,124	32,546	46,968	61,391	75,813

Assumptions:

System Cost: $3/W
C-PACE Debt: 70%
Financing Term: 20 Years
Financing rate: 5.5%
Avoided Electricity Cost: $0.12 kWh

14.9 Zero Emission Renewable Energy Credit (ZREC) Program

In July 2011 the Connecticut legislature created the Zero Emission Renewable Energy Credit (ZREC) Program.[125] The program requires Connecticut's two investor owned utilities, Connecticut Light & Power (CL&P) and United Illuminating (UI), to enter into 15-year contracts through a "market-driven RFP bidding process and small tariff" with electric generation facilities larger than 100 kilowatts (kW) but not larger than one megawatt (MW) that are zero emission. Systems based on technologies such as solar, wind, hydro or other zero emission energy systems fit the bill. There is a similarly-structured Low-Emission Renewable Energy Credit (LREC) Program applicable to low-emission energy technologies such as fuel cell systems and low-emission biomass facilities. For more details, see the CL&P and UI websites.[126]

Utilities are authorized to spend up to $8 million on ZREC contracts annually. The first auction under the ZREC Program, held in 2012, was oversubscribed by a factor of 2.75, had an average price of about $135 per ZREC, and resulted in approximately 26MW of commitments for commercial and industrial solar PV installations. The statutory price cap for one ZREC in 2012 was $350. The Public Utilities Regulatory Authority (PURA) may reduce the price cap annually by 3-7%.[127]

14.10 Residential Solar Investment Program (RSIP)

Even with the innovative green bank financing model, states currently need some incentives to deploy rooftop solar PV until the cost of installing solar PV decreases further. The existence of incentive programs such as the ZREC Program and RSIP make rooftop solar PV projects financed through the "Green Bank" Financing Model feasible for customers at current electric rates.

[125] www.cl-p.com/Home/SaveEnergy/GoingGreen/Renewable_Energy_Credits/ and for UI: UI LREC/ZREC link and UI Small ZREC link
[126] www.cl-p.com/Home/SaveEnergy/GoingGreen/Renewable_Energy_Credits/ and for UI: UI LREC/ZREC link and UI Small ZREC link
[127] Ibid

CEFIA's Residential Solar Investment Program (RSIP) provides two incentive models to help customers who want to purchase or lease solar PV systems.

The RSIP is currently on Step 3 of incentives, which were designed to decline gradually – see Table 20.

1. *Expected Performance-Based Buydown (EPBB) Incentive*: The EPBB incentive is a rebate available to consumers who purchase a solar PV system. The EPBB provides a level of incentives for the first 5 kW and a lower level of incentives for the second 5 kW, specified in the table below. A 5% bonus is given to projects that use major system components principally manufactured in Connecticut and an additional bonus if these components are manufactured in distressed Connecticut municipalities.
2. *Performance-Based Incentive (PBI):* CEFIA's PBI is designed to allow homeowners to benefit from solar PV systems for little to no upfront cost. Under this model, an eligible third-party PV system owner owns the system and enters into a contract with the homeowner, typically a solar lease or a power purchase agreement. The PBI is paid to the System Owner based on actual performance over the course of six years and is used (through the contract) to reduce the homeowner's monthly cost. The PBI model also provides an additional bonus for projects that use major system components principally manufactured in Connecticut.

Table 20: Residential Solar Investment Program (RSIP) – Declining Incentives

Step	EPBB Incentive - first 5kW ($/W)	EPBB Incentive - second 5 kW ($/W)	PBI Incentive ($/kWh)
1	$2.45	$1.25	$0.300
2	$2.275	$1.075	$0.300
3	**$1.75**	**$0.55**	**$0.225**

As of the end of June 2013, the end of CEFIA's 2013 fiscal year, RSIP installations contributed approximately 9.3 MW and 1325 projects out of the cumulative total residential solar PV capacity of 23.3 MW (3430 projects) installed with support of CEFIA/CCEF administered ratepayer funds since 2004.

Figure 10 in Section 5.1, Installed Solar PV Capacity in Connecticut, illustrates ramping up of residential solar PV installations in 2012 along with decreasing costs and decreasing reliance on ratepayer funds. The ratepayer contribution to the cost of a residential solar PV system in Connecticut has dropped from approximately half of the cost historically to about one-third of the cost starting in 2011, and is expected to drop further.

14.11 Revenues from RSIP RECs

CEFIA owns the RECs associated with solar PV systems installed through the RSIP and plans to sell those RECs via auction in Q4 2014. Through the sale of a long-term strip of RECs at current prices in the CT Class I market, CEFIA should realize a net present value of over $2,000 per 7kW of residential solar PV installed. Revenues from these sales will then be reinvested back into CEFIA's residential clean energy deployment programs and products, further leveraging ratepayer funds and ensuring that Connecticut homeowners get the full benefit of their participation in the state's clean energy market.

15.0 Solarize Connecticut℠

15.1 Background

Solarize Connecticut (Solarize CT[128]) is a pilot program designed to encourage adoption of residential solar PV through a group purchasing structure that lowers costs through volume, economy of scale, peer and other effects. The Solarize CT program attracts customers by deploying a coordinated education, marketing and outreach effort, combined with a tiered pricing structure that provides increased savings to homeowners as more people in one community go solar. The more residents who sign up to install solar, the more the price decreases for everyone who participates.

The Solarize CT pilot is based on a proven residential aggregation model designed to bring down the cost of solar PV when residents sign up for a pre-selected installer's offering. Because the installer, the technology and the exact price of PV are provided upfront, and because the installed prices are very competitive and are being offered in program rounds with deadlines, residents are encouraged to make the decision to go solar.

Solarize CT is a partnership between CEFIA and the non-profit organization SmartPower with support from the John Merck Fund and Putnam Foundation. These partners launched a pilot Phase I program in the summer of 2012 with four CT towns selected through a competitive process - **Durham, Fairfield, Portland** and **Westport**.

In just five months, Solarize Connecticut drove twice as much solar adoption in the four pilot communities as those towns saw in the prior eight years. **Figure 31 illustrates the acceleration of solar PV adoption in the four Solarize Phase I communities.[129]** For example, there have been 121[130] solar PV contracts in the town of Durham during and since the Solarize pilot, bringing Durham's total number of installed solar PV installations to 144. The installation rates in Durham, Fairfield, Westport and Portland since the Solarize pilot began are 69x, 25x, 24x and 44x the rate in the previous five years, respectively.

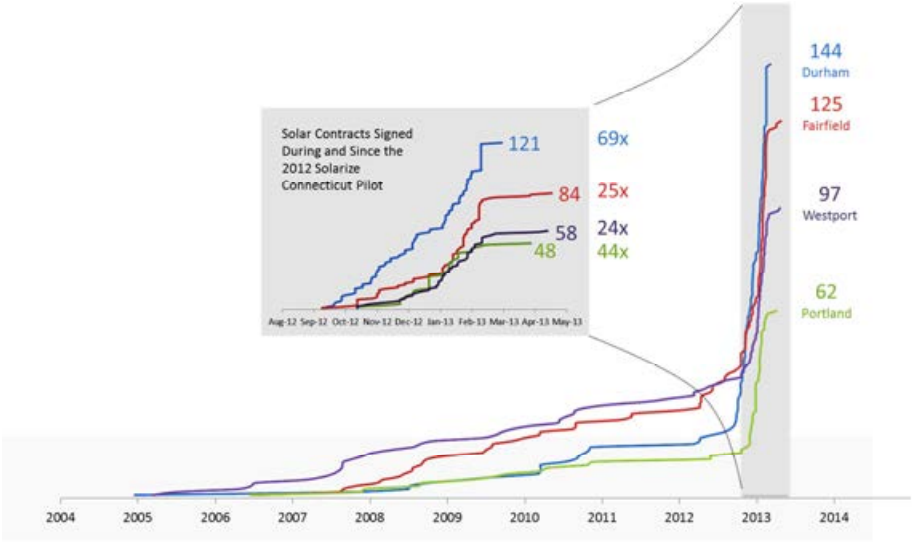


Figure 31: Dramatic Increases in Solar Contracts Signed During and Since the 2012 Solarize Connecticut Pilot in the Communities of Durham, Fairfield, Portland and Westport

[128] http://solarizect.com

[129] Graphic created by Kenneth Gillingham , Assistant Professor of Environmental & Energy Economics, Yale University, School of Forestry & Environmental Studies (2013)

[130] This number reflects data collected for Phase I at the conclusion of the campaign and does not reflect possible, subsequent attrition.

All four towns reached the lowest price level available by successfully encouraging enough town residents to participate. As more homeowners signed up to install solar through purchase or lease agreements, the price for everyone dropped – including those who installed systems earlier in the program before the maximum savings kicked in. All four communities ended up with average installed costs at or below $3.80/W, in comparison to pre-Solarize prices of close to $5/W. Figure 32 illustrates the decrease in installed costs resulting from Solarize.

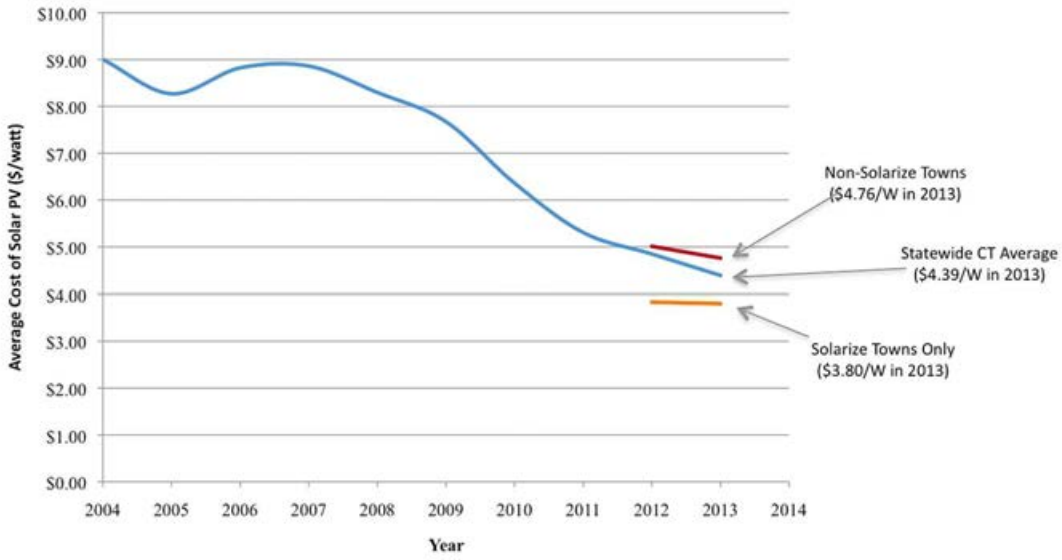


Figure 32: Decrease in Residential Solar PV Installed Cost as a Result of Solarize

15.2 Phase I Program Impacts

Results of Solarize Connecticut Phase 1 exceeded expectations. Highlights of program impacts are as follows[131]:

- Over 2.2 MW of new solar PV capacity deployed across the four communities, close to triple what was installed in those towns during the preceding eight years.
- Nearly 300 projects were completed, representing at least a doubling in the number of homeowners "going solar" in all towns, with Durham *quintupling* its solar ownership and reaching 5.7% residential solar PV market penetration, the first town in the state to reach over 5%.
- Dramatically reduced costs for solar PV, with all towns hitting the lowest tier (Tier 5) pricing and cumulative savings of over $2.2 million on the aggregate of the solar PV installations.
- Compelling drops in customer acquisition costs, at < $90/kW from a direct program spend perspective and $135/kW "all-in" – significantly less than both the industry average of $670/kW (per NREL analysis) and local installers' estimates at $250-$500/kW.

Pre-Solarize, the average installed cost for solar PV in Connecticut was close to $5.00/W, with three of the installers chosen to serve Solarize communities in fact having average installed costs above that level. Each installer selected not only bid into the program with pricing well below the industry average, but – in partnership with their host communities – they all achieved the lowest pricing tier possible under the program. Even including "adders" (or extra costs due to steep roofs, higher-priced modules, etc.), which increased prices up to 6% above the base price quoted, all four communities ended up with average installed costs at or below

[131] The numbers for capacity deployed and number of projects completed reflect data collected for Phase I at the conclusion of the campaign and do not reflect possible, subsequent attrition.

$3.80/W – representing savings of at least 20% from pre-Solarize levels, and surpassing the program goal of driving installed costs down to $4.25/W through the Solarize pilot.

15.3 Customer Acquisition

Based on initial results, we have found that community-based social marketing under a deadline-driven campaign model – together with a tiered discount approach and sufficient public support to make the process of going solar as simple as possible – can drastically reduce the costs of acquiring a solar customer (and thus contribute to lower soft costs overall). Overall, the program produced 1,500 leads and a 20% conversion rate (consistent among all installers), including generating a final customer base of whom 20% had not considered solar prior to program.[132]

Quantitatively, CEFIA committed $100,000 to support Solarize in these initial four towns, matched by grants made to SmartPower, from the John Merck Fund and the Putnam Foundation. Dividing that $200,000 total by the number of customers acquired, and then again by the average size of a Solarize installation, gives us the average customer acquisition cost per kilowatt of solar PV deployed (see Table 21). At $90/kW on a direct cost basis, Solarize has delivered a customer acquisition cost figure that is a discount of 86% from the national average of $670/kW, as reported by NREL. Even adding in estimated installers' direct marketing costs across the four towns, plus the value of CEFIA staff time, Solarize still demonstrates tremendous customer acquisition savings at $135/kW. Again, the results we achieved strongly outpaced CEFIA's goal of $190/kW for this metric.

Table 21: Solarize CT Customer Acquisition Costs

Description	Cost	Acquisition Cost / kW
CEFIA direct contribution	$100,000	$89.72
Foundations' matching grants	$100,000	
Est. installer expenditures	$30,000	$13.46
Est. value of CEFIA staff time	$72,000	$32.30
Total	$302,000	$135.48

15.4 Solarize Phase II

Building on the success of the four initial communities, the second phase of the program was conducted from March to July 2013 and included **Bridgeport, Canton, Coventry and Mansfield/Windham** (two in partnership). Two "distressed communities" are participating in Phase II (Bridgeport and Windham). The towns partnered with two experienced Solarize installers and two installers that were new to the program. CEFIA's new financing products – including the CT Solar Loan, the Smart-E Loan, and the CT Solar Lease – became available as of July 2013, before the contract signing deadline for Phase II which was extended through July 31, 2013 to give more homeowners time to benefit from these new financing products.

CEFIA's new financing options make it possible to install solar with little or no money down. The financing products are anticipated to bolster the success of the Solarize Program.

- CEFIA's new Smart-E Loan and CT Solar Loan programs provide long-term, affordable financing options designed to allow homeowners to undertake almost any measure that reduces a home's fuel or electricity usage or that increases on-site energy production from clean energy sources.
- CT Solar Lease (a CEFIA product following and expanding on CCEF's successful solar lease version one) was launched in July 2013 and will allow more customers access to solar PV. The lease provides

[132] According to 218 responses to a post-campaign survey emailed to about 900 households in three Solarize towns

financing with a credit score requirement of 640, lower than other financing products, flexibility in payment options and allows customers to be cash flow positive from day one.

15.5 Solarize Phase III

CEFIA launched Phase 3 of Solarize Connecticut in September and October 2013, with the following 11 towns competitively selected: the Ashford-Chaplin-Hampton-Pomfret town coalition, the Easton-Redding-Trumbull Town Coalition, Greenwich, Manchester, Newtown, and West Hartford.

15.6 Solarize Choice and Solarize Express

Two new Solarize programs that will be launched in fall 2013 are Solarize Express, a 10-week Solarize program rather than a 20-week Solarize program, and Solarize Choice which allows communities to select more than one installer with those installers offering a flat discounted base price (i.e., a not to exceed price) for solar.

Communities participating in Solarize Express include Glastonbury, Hamden, a Roxbury-Washington town partnership and Stafford.

Communities participating in Solarize Choice include Cheshire, Enfield, a Columbia-Lebanon town partnership, Stamford and West Haven.

15.7 Connecticut Solar Challenge

Solarize is inspiring market innovation – private sector actors want to move ahead on Solarize without CEFIA. One installer, Aegis Solar, has already arranged a similar model, the "Connecticut Solar Challenge,"[133] with several communities (Bethany, Chester, Clinton and Madison), and multiple other installers have inquired about running a Solarize initiative. CEFIA is discussing with these installers how best to support them on both administrative and substantive matters, outside of the structure of the formal Solarize Program and associated resources.

[133] ctsolarchallenge.com

Appendix I
Permitting Recommendations Specific to each of the Twelve Sun Rise New England – Open for Business Partner Communities

Bridgeport

Population: 146,824
Households: 52,261
Region: Greater Bridgeport

bridgeportct.gov/

Clean Energy Commitments

- ✔ Rooftop Solar Challenge
- ✔ CPACE
- ✔ Solarize Phase Two
- ✔ CT Clean Energy Communities

Best Practices

- ✹ Permit fee waiver for Class 1 Renewables
- ✹ Applications can be submitted by email
- ✹ Solarize webpage

Solar PV Installations 2004—April 2013

7 residential projects (39 kW)

Household penetration 0.01%

5 nonresidential projects (382 kW)

Connecticut's Sun Rise New England team, led by the Clean Energy Finance and Investment Authority (CEFIA), thanks Bridgeport for participating in Connecticut's Rooftop Solar Challenge project, focusing on improving processes and reducing non-hardware costs associated with permitting, planning and zoning, interconnection, and increasing access to financing for rooftop solar photovoltaic (PV) systems.

In addition to our specific recommendations, please also consider the general suggestions offered in the *Rooftop Solar PV Permitting Recommendations for Jurisdictions*, included in the forthcoming CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹.

Rooftop Solar PV Permitting Recommendations for Bridgeport

Make Information Available

- **Online Permitting:** Make sure all information pertaining to Bridgeport's solar PV permitting processes are clearly posted on your relevant department website and updated regularly. Use online permitting software (please see "Adopt Online Permitting" in the next section called "Streamline Permit Application Submission").
- **Create a Clean Energy Webpage** on your jurisdiction's website. Provide links to resources such as the Sun Rise New England and EnergizeCT websites. EnergizeCT is a state initiative to provide energy-related information and resources.[134] Constituents would also want to know about local clean energy projects and activities, policies and incentives, your clean energy task force (if applicable), and successes and

[134] energizect.com/SunriseNE and more generally, energizect.com

participation in programs such as the Rooftop Solar Challenge, Solarize, the Clean Energy Communities Program, the CT Solar Challenge, and C-PACE.[135] See West Hartford, Greenwich, Cornwall, Coventry, Hampton and Middletown clean energy websites for examples, though each jurisdiction should review their sites for updates and additions.[136]

- **Remember to Promote** your clean energy webpage, timely programs and solar PV adoption with radio and newspaper announcements, newsletters and environmentally friendly signage.

Streamline Permit Application Submission

- **Adopt the Standard Solar PV Permit Application:** The Sun Rise New England team has put together a CT standardized solar PV permit application package which will be offered in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ on the Sun Rise New England website.[137]
- **Simplify the Application Process:** Make one department responsible for the rooftop solar PV permitting process and reduce the number of steps, signatures and unnecessary requirements asked of installers.
- **Adopt Online Permitting:** Adopt an online permitting system[138] to enable applicants to obtain and submit solar PV permit application materials online. Otherwise, allow installers to obtain and submit permit application materials through your website or by email. This change saves installers time-intensive and costly trips to jurisdiction offices.

Permit Fees

- **Waive or Reduce Fees:** Bridgeport is providing clean energy leadership in Connecticut by waiving permit fees for Class I renewable energy systems as enabled in Public Act 11-80.[139]

Streamline Review and Inspection Requirements

- **Train Staff:** Require jurisdiction staff involved in solar PV permitting to participate in relevant solar PV training, at minimum by accessing a free online training course comparable to the "Photovoltaic Online Training for Code Officials" offered on the National Training & Education Resource (NTER) website.[140]
- **Remove Excessive Reviews**: Jurisdiction staff should identify and remove reviews that are not critical to safe and efficient operation of a proposed rooftop solar PV system. In particular, unnecessary and costly engineering reviews should be eliminated by specifying criteria and a methodology for determining when these reviews are needed.

---

[135] Rooftop Solar Challenge, eere.energy.gov/solarchallenge; SunShot Initiative, eere.energy.gov/solar/sunshot; Solarize, solarizect.com; Clean Energy Communities Program, energizect.com/communities/programs/clean-energy-communities or ctenergydashboard.com/CEC/CECHome.aspx; CT Solar Challenge, ctsolarchallenge.com; C-PACE, c-pace.com.

[136] Cornwall: cornwallctenergy.org; Coventry: www.coventryct.org/index.aspx?NID=175; Greenwich: www.greenwichct.org/Government/Commissions/Conservation_Commission/Cean_Energy_Community; Hampton: www.hamptonct.org/committee.htm?id=fhsb77u5; Middletown: www.cityofmiddletown.com/content/81/750/1840/default.aspx; West Hartford: west-hartford.com/government/CleanEnergy.htm and www.westhartford.org/living_here/green/west_hartford_clean_energy_task_force.php

[137] energizect.com/SunriseNE

[138] For examples, see: Simply Civic, simplycivic.com; City View, msgovern.com/software/cityview; View Permit, viewpermit.com.

[139] Section 29-263: cga.ct.gov/2012/sup/chap541.htm - Sec29-263.htm, "(c) Any municipality may, by ordinance adopted by its legislative body, exempt Class I renewable energy source projects from payment of building permit fees imposed by the municipality."

[140] Photovoltaic Online Training For Code Officials: nterlearning.org/web/guest/course-details?cid=402

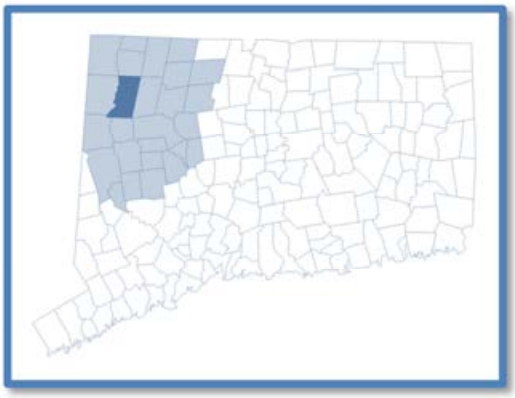
- **Simplify the Inspection Process:** The CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ offers resources and suggestions for improving inspection processes such as: (1) When an inspection is required, conduct a single, comprehensive inspection instead of requiring multiple appointments. (2) Schedule specific appointment times for inspections instead of windows of time. This saves everyone, and ultimately town residents and business owners, time, money and frustration.
- **Shorten Permit Approval Times:** By Connecticut law, a permitting decision must be made within 30 days.[141] However, a shorter timeframe encourages installers to do business in your jurisdiction and speeds up the time between a customer's intent to generate clean energy and their ability to do so. Consider the best practice of issuing permits in as short a time frame as possible, for example on the "same day" or "over-the-counter" for standard small-scale rooftop solar PV systems that clearly meet your jurisdiction's permit approval criteria.

Formalize Best Practices

- **Adopt Solar Friendly Ordinances** using the model elements offered in "Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions" found in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹. Adopting the elements of the Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions removes unnecessary barriers to solar energy installation and formalizes your jurisdiction's commitment to making rooftop solar PV permitting easier and less costly for everyone.

Photo: Lighthouse, Seaside Park at sundown, Andrew Korn, flickr.com/photos/andkorn/1593016190/sizes/l/

[141] ct.gov/dcs/cwp/view.asp?a=4218&q=305412. The 30 day permit decision time is from the State Building Code, namely the 2005 Connecticut Supplement which includes the 2009 Amendment (effective August 1, 2009) to the 2005 State Building Code. The language of the code amendment also encourages building officials to issue a permit as soon as practicable once the official is satisfied that the proposed work meets all requirements.



Cornwall

Population: 1,429
Number of residential households: 643
Region: Capitol
cornwallct.org

Clean Energy Commitments

✔Rooftop Solar Challenge
CPACE
Solarize
✔CT Clean Energy Communities

Best Practices

- Applications can be submitted by mail
- Scheduled inspection times
- Quick decisions on solar PV permit
- Approved permits can be mailed to installers

Solar PV Installations 2004—April 2013

[CEFIA program data; does not include ZREC data]

12 residential projects (93 kW)
Household penetration 0.187%
1 nonresidential project (9 kW)

Connecticut's Sun Rise New England team, led by the Clean Energy Finance and Investment Authority (CEFIA), thanks Cornwall for participating in Connecticut's Rooftop Solar Challenge project, focusing on improving processes and reducing non-hardware costs associated with permitting, planning and zoning, interconnection, and increasing access to financing for rooftop solar photovoltaic (PV) systems.

In addition to our specific recommendations, please also consider the general suggestions offered in the *Rooftop Solar PV Permitting Recommendations for Jurisdictions,* included in the forthcoming CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹.

Rooftop Solar PV Permitting Recommendations for Cornwall

Make Information Available

- **Online Permitting:** Make sure all information pertaining to Cornwall's solar PV permitting processes are clearly posted on your relevant department website and updated regularly. Use online permitting software (please see "Adopt Online Permitting" in the next section called "Streamline Permit Application Submission").
- **Clean Energy Webpage:** Cornwall has an energy task force website: cornwallctenergy.org. Perhaps this website can be linked to from the official town website. Also, consider reviewing your webpage to identify any potential updates, improvements and additions such as making sure you have a link to

EnergizeCT, a state initiative to provide energy-related information and resources.[142] See West Hartford, Greenwich, Coventry, Hampton and Middletown clean energy websites for examples of other towns' sites, though each jurisdiction should review their sites for updates and additions.[143]

- **Remember to Promote** your clean energy webpage, timely programs and solar PV adoption with radio and newspaper announcements, newsletters and environmentally friendly signage.

Streamline Permit Application Submission

- **Adopt the Standard Solar PV Permit Application:** The Sun Rise New England team has put together a CT standardized solar PV permit application package which will be offered in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ on the Sun Rise New England website.[144]
- **Simplify the Application Process:** Make one department responsible for the rooftop solar PV permitting process and reduce the number of steps, signatures and unnecessary requirements asked of installers.
- **Adopt Online Permitting:** Adopt an online permitting system[145] to enable applicants to obtain and submit solar PV permit application materials online. Otherwise, allow installers to obtain and submit permit application materials through your website or by email. This change saves installers time-intensive and costly trips to jurisdiction offices.

Waive or Reduce Permit Fees

- **Waive or Reduce Fees:** Towns may encourage solar installations by waiving solar PV permit fees.[146] If not a full waiver, consider a low or flat fee based on cost recovery instead of the value-based fee structure Cornwall currently utilizes. Value-based fee structures usually do not accurately reflect the cost of solar PV permit review and inspection. Research in Connecticut indicates that it should cost no more than $200, usually less, for a town to permit a small-scale, rooftop solar PV installation. Streamlining processes can help reduce costs to jurisdictions. For example, Bridgeport and Manchester waive permit fees for class I renewable energy systems, and Durham has a flat fee for solar PV permits.
- **Allow for Payment Electronically or by Mail:** Allow installers to pay permit fees online, electronically, or by U.S. mail to save driving time and cost.

Streamline Review and Inspection Requirements

- **Train Staff:** Require jurisdiction staff involved in solar PV permitting to participate in relevant solar PV training, at minimum by accessing a free online training course comparable to the "Photovoltaic Online Training for Code Officials" offered on the National Training & Education Resource (NTER) website.[147]

---

[142] www.energizect.com/SunriseNE and more generally, www.energizect.com

[143] Cornwall: cornwallctenergy.org; Coventry: www.coventryct.org/index.aspx?NID=175; Greenwich: www.greenwichct.org/Government/Commissions/Conservation_Commission/Cean_Energy_Community; Hampton: www.hamptonct.org/committee.htm?id=fhsb77u5; Middletown: www.cityofmiddletown.com/content/81/750/1840/default.aspx; West Hartford: west-hartford.com/government/CleanEnergy.htm and www.westhartford.org/living_here/green/west_hartford_clean_energy_task_force.php

[144] energizect.com/SunriseNE

[145] For examples, see: Simply Civic, simplycivic.com; City View, msgovern.com/software/cityview; View Permit, viewpermit.com.

[146] cga.ct.gov/2012/sup/chap541.htm - Sec29-263.htm, "(c) Any municipality may, by ordinance adopted by its legislative body, exempt Class I renewable energy source projects from payment of building permit fees imposed by the municipality."

[147] Photovoltaic Online Training For Code Officials: nterlearning.org/web/guest/course-details?cid=402

Remove Excessive Reviews: Jurisdiction staff should identify and remove reviews that are not critical to safe and efficient operation of a proposed rooftop solar PV system. In particular, unnecessary and costly engineering reviews should be eliminated by specifying criteria and a methodology for determining when these reviews are needed.

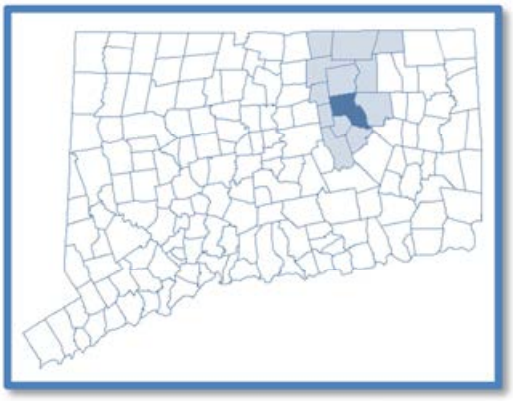
- **Simplify the Inspection Process:** The CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ offers resources and suggestions for improving inspection processes, though Cornwall already practices two of our recommendations by providing specific appointment times and a single comprehensive inspection instead of multiple inspections. These two practices save everyone, and ultimately town residents and business owners, time, money and frustration.
- **Shorten Permit Approval Times:** By Connecticut law, a permitting decision must be made within 30 days.[148] However, a shorter timeframe encourages installers to do business in your jurisdiction and speeds up the time between a customer's intent to generate clean energy and their ability to do so. Consider the best practice of issuing permits in as short a time frame as possible, for example on the "same day" or "over-the-counter" for standard small-scale rooftop solar PV systems that clearly meet your jurisdiction's permit approval criteria.

Formalize Best Practices

- **Adopt Solar Friendly Ordinances** using the model elements offered in "Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions" found in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹. Adopting the elements of the Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions removes unnecessary barriers to solar energy installation and formalizes your jurisdiction's commitment to making rooftop solar PV permitting easier and less costly for everyone.

Cornwall Covered Bridge Photo, Ray Brown ct.gov/photo/scripts/subjectbridge.asp

[148] ct.gov/dcs/cwp/view.asp?a=4218&q=305412. The 30 day permit decision time is from the State Building Code, namely the 2005 Connecticut Supplement which includes the 2009 Amendment (effective August 1, 2009) to the 2005 State Building Code. The language of the code amendment also encourages building officials to issue a permit as soon as practicable once the official is satisfied that the proposed work meets all requirements.



Coventry

Population: 12,572
Number of households: 4738
Region: Windham
coventryct.org

Clean Energy Commitments

- ✔Rooftop Solar Challenge
- ✔CPACE
- ✔ Solarize Phase Two
- ✔CT Clean Energy Communities

Best Practices

- Clean energy web information
- Online permitting system
- Online application submission and payments
- Single comprehensive inspection

Solar PV Installations 2004—April 2013

[CEFIA program data; does not include ZREC data]

28 residential projects (191 kW)

Household penetration 0.59%

1 nonresidential project (76 KW)

Connecticut's Sun Rise New England team, led by the Clean Energy Finance and Investment Authority (CEFIA), thanks Coventry for participating in Connecticut's Rooftop Solar Challenge project, focusing on improving processes and reducing non-hardware costs associated with permitting, planning and zoning, interconnection, and increasing access to financing for rooftop solar photovoltaic (PV) systems.

In addition to our specific recommendations, please also consider the general suggestions offered in the *Rooftop Solar PV Permitting Recommendations for Jurisdictions,* included in the forthcoming CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹.

Rooftop Solar PV Permitting Recommendations for Coventry

Make Information Available

- **Online Permitting:** Make sure all information pertaining to Coventry's solar PV permitting processes are clearly posted on your relevant department website and updated regularly. Coventry responded to our outreach indicating the use of the View Permit online permitting system. Installers visiting Coventry's home page or building department page should be able to access a link to the online system. See Manchester's home page or building department webpage for a good example.[149]

[149] building.townofmanchester.org/building

- **Clean Energy Webpage:** Coventry has an energy committee webpage.[150] Consider reviewing your webpage to identify any potential updates, improvements and additions such as making sure you have a link to EnergizeCT, a state initiative to provide energy-related information and resources.[151] See West Hartford, Greenwich, Cornwall, Hampton and Middletown clean energy websites for examples of other towns' sites, though each jurisdiction should review their sites for updates and additions.[152]
- **Remember to Promote** your clean energy webpage, timely programs and solar PV adoption with radio and newspaper announcements, newsletters and environmentally friendly signage.

Streamline Permit Application Submission

- **Adopt the Standard Solar PV Permit Application:** The Sun Rise New England team has put together a CT standardized solar PV permit application package which will be offered in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ on the Sun Rise New England website.[153]
- **Adopt Online Permitting:** Coventry could consider adopting use of the CT standardized solar PV permit application package through the ViewPermit online permitting system.

Waive or Reduce Permit Fees

- **Waive or Reduce Fees:** Towns may encourage solar installations by waiving solar PV permit fees.[154] If not a full waiver, consider a low or flat fee based on cost recovery instead of a value-based fee structure that may not accurately reflect the cost of solar PV permit review and inspection. Research in Connecticut indicates that it should cost no more than $200, usually less, for a town to permit a small-scale, rooftop solar PV installation. Streamlining processes can help reduce costs to jurisdictions. For example, Bridgeport and Manchester waive permit fees for class I renewable energy systems, and Durham has a flat fee for solar PV permits.
- **Allow for Payment Electronically or by Mail:** Allow installers to pay permit fees online, electronically, or by U.S. mail to save driving time and cost.

Streamline Review and Inspection Requirements

- **Remove Excessive Reviews**: Jurisdiction staff should identify and remove reviews that are not critical to safe and efficient operation of a proposed rooftop solar PV system. In particular, unnecessary and costly engineering reviews should be eliminated by specifying criteria and a methodology for determining when these reviews are needed.

  Simplify the Inspection Process: The CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ offers resources and suggestions for improving inspection processes, though Coventry already practices one of our recommendations by providing a single instead of multiple inspections. An example of an improvement

[150] www.coventryct.org/index.aspx?NID=175
[151] www.energizect.com/SunriseNE and more generally, www.energizect.com
[152] Cornwall: cornwallctenergy.org; Coventry: www.coventryct.org/index.aspx?NID=175;
Greenwich: www.greenwichct.org/Government/Commissions/Conservation_Commission/Cean_Energy_Community;
Hampton: www.hamptonct.org/committee.htm?id=fhsb77u5;
Middletown: www.cityofmiddletown.com/content/81/750/1840/default.aspx;
West Hartford: west-hartford.com/government/CleanEnergy.htm and
www.westhartford.org/living_here/green/west_hartford_clean_energy_task_force.php
[153] energizect.com/SunriseNE
[154] cga.ct.gov/2012/sup/chap541.htm - Sec29-263.htm, "(c) Any municipality may, by ordinance adopted by its legislative body, exempt Class I renewable energy source projects from payment of building permit fees imposed by the municipality."

that can be made is to schedule a specific appointment time rather than a window of time for the inspection.

- **Shorten Permit Approval Times:** By Connecticut law, a permitting decision must be made within 30 days.[155] However, a shorter timeframe encourages installers to do business in your jurisdiction and speeds up the time between a customer's intent to generate clean energy and their ability to do so. Consider the best practice of issuing permits in as short a time frame as possible, for example on the "same day" or "over-the-counter" for standard small-scale rooftop solar PV systems that clearly meet your jurisdiction's permit approval criteria.

Formalize Best Practices

- **Adopt Solar Friendly Ordinances** using the model elements offered in "Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions" found in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹. Adopting the elements of the Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions removes unnecessary barriers to solar energy installation and formalizes your jurisdiction's commitment to making rooftop solar PV permitting easier and less costly for everyone.

Photo: Visitors Center, coventryct.org/index.asp?Type=B_LOC&SEC={8F02BF33-332E-484B-94D1-40AA20648A15}

[155] ct.gov/dcs/cwp/view.asp?a=4218&q=305412. The 30 day permit decision time is from the State Building Code, namely the 2005 Connecticut Supplement which includes the 2009 Amendment (effective August 1, 2009) to the 2005 State Building Code. The language of the code amendment also encourages building officials to issue a permit as soon as practicable once the official is satisfied that the proposed work meets all requirements.

Danbury

Population: 82,409
Households: 29,508
Region: Housatonic Valley

ci.danbury.ct.us

Connecticut's Sun Rise New England team, led by the Clean Energy Finance and Investment Authority (CEFIA), thanks Danbury for participating in Connecticut's Rooftop Solar Challenge project, focusing on improving processes and reducing non-hardware costs associated with permitting, planning and zoning, interconnection, and increasing access to financing for rooftop solar photovoltaic (PV) systems.

Clean Energy Commitments

- ✔ Rooftop Solar Challenge
- ✔ CPACE
- Solarize
- CT Clean Energy Communities

Best Practices

- Online permitting system
- Permit fee exemption for cultural non-profits and municipal projects
- Escrow account for certified electricians to allow for quick payments

Solar PV Installations 2004—April 2013

[CEFIA program data; does not include ZREC data]

34 residential projects (229 kW)

Household penetration 0.12%

5 nonresidential projects (1271 kW)

In addition to our specific recommendations, please also consider the general suggestions offered in the *Rooftop Solar PV Permitting Recommendations for Jurisdictions*, included in the forthcoming CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹.

Rooftop Solar PV Permitting Recommendations for Danbury

Make Information Available

- **Online Permitting:** Make sure all information pertaining to Danbury's solar PV permitting processes are clearly posted on your relevant department website and updated regularly. Use online permitting software (please see "Adopt Online Permitting" in the next section called "Streamline Permit Application Submission").

- **Create a Clean Energy Webpage** on your jurisdiction's website. Provide links to resources such as the Sun Rise New England and EnergizeCT websites. EnergizeCT is a state initiative to provide energy-related information and resources.[156] Constituents would also want to know about local clean energy projects and activities, policies and incentives, your clean energy task force (if applicable), and successes and participation in programs such as the Rooftop Solar Challenge, Solarize, the Clean Energy Communities Program, the CT Solar Challenge, and C-PACE.[157] See West Hartford, Greenwich, Cornwall, Coventry, Hampton and Middletown clean energy websites for examples, though each jurisdiction should review their sites for updates and additions.[158]
- **Remember to Promote** your clean energy webpage, timely programs and solar PV adoption with radio and newspaper announcements, newsletters and environmentally friendly signage.

Streamline Permit Application Submission

- **Adopt the Standard Solar PV Permit Application:** The Sun Rise New England team has put together a CT standardized solar PV permit application package which will be offered in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ on the Sun Rise New England website.[159]
- **Simplify the Application Process:** Make one department responsible for the rooftop solar PV permitting process and reduce the number of steps, signatures and unnecessary requirements asked of installers.
- **Adopt Online Permitting:** Danbury could consider adopting use of the CT standardized solar PV permit application package through an online permitting system.

Waive or Reduce Permit Fees

- **Waive or Reduce Fees:** Towns may encourage solar installations by waiving solar PV permit fees.[160] If not a full waiver, consider a low or flat fee based on cost recovery instead of the value-based fee structure Fairfield currently utilizes. Value-based fee structures usually do not accurately reflect the cost of solar PV permit review and inspection. Research in Connecticut indicates that it should cost no more than $200, usually less, for a town to permit a small-scale, rooftop solar PV installation. Streamlining processes can help reduce costs to jurisdictions. For example, Bridgeport and Manchester waive permit fees for class I renewable energy systems, and Durham has a flat fee for solar PV permits.
- **Allow for Payment Electronically or by Mail:** Allow installers to pay permit fees online, electronically, or by U.S. mail to save driving time and cost.

---

[156] energizect.com/SunriseNE and more generally, energizect.com

[157] Rooftop Solar Challenge, eere.energy.gov/solarchallenge; SunShot Initiative, eere.energy.gov/solar/sunshot; Solarize, solarizect.com; Clean Energy Communities Program, energizect.com/communities/programs/clean-energy-communities or ctenergydashboard.com/CEC/CECHome.aspx; CT Solar Challenge, ctsolarchallenge.com; C-PACE, c-pace.com.

[158] Cornwall: cornwallctenergy.org; Coventry: www.coventryct.org/index.aspx?NID=175; Greenwich: www.greenwichct.org/Government/Commissions/Conservation_Commission/Cean_Energy_Community; Hampton: www.hamptonct.org/committee.htm?id=fhsb77u5; Middletown: www.cityofmiddletown.com/content/81/750/1840/default.aspx; West Hartford: west-hartford.com/government/CleanEnergy.htm and www.westhartford.org/living_here/green/west_hartford_clean_energy_task_force.php

[159] energizect.com/SunriseNE

[160] cga.ct.gov/2012/sup/chap541.htm - Sec29-263.htm, "(c) Any municipality may, by ordinance adopted by its legislative body, exempt Class I renewable energy source projects from payment of building permit fees imposed by the municipality."

Streamline Review and Inspection Requirements

- **Train Staff:** Require jurisdiction staff involved in solar PV permitting to participate in relevant solar PV training, at minimum by accessing a free online training course comparable to the "Photovoltaic Online Training for Code Officials" offered on the National Training & Education Resource (NTER) website.[161]
- **Remove Excessive Reviews**: Jurisdiction staff should identify and remove reviews that are not critical to safe and efficient operation of a proposed rooftop solar PV system. In particular, unnecessary and costly engineering reviews should be eliminated by specifying criteria and a methodology for determining when these reviews are needed.
- **Simplify the Inspection Process:** Danbury requires multiple inspection trips, which are scheduled during open blocks of time. The CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ offers resources and suggestions for improving inspection processes such as: (1) When an inspection is required, conduct a single, comprehensive inspection instead of requiring multiple appointments. (2) Schedule specific appointment times for inspections instead of windows of time. This saves everyone, and ultimately town residents and business owners, time, money and frustration.
- **Shorten Permit Approval Times:** By Connecticut law, a permitting decision must be made within 30 days.[162] However, a shorter timeframe encourages installers to do business in your jurisdiction and speeds up the time between a customer's intent to generate clean energy and their ability to do so. Consider the best practice of issuing permits in as short a time frame as possible, for example on the "same day" or "over-the-counter" for standard small-scale rooftop solar PV systems that clearly meet your jurisdiction's permit approval criteria.

Formalize Best Practices

- **Adopt Solar Friendly Ordinances** using the model elements offered in "Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions" found in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹. Adopting the elements of the Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions removes unnecessary barriers to solar energy installation and formalizes your jurisdiction's commitment to making rooftop solar PV permitting easier and less costly for everyone.

Photo: Pond at Rogers Park, http://www.city-data.com/picfilesc/picc49809.php

[161] Photovoltaic Online Training For Code Officials: nterlearning.org/web/guest/course-details?cid=402

[162] ct.gov/dcs/cwp/view.asp?a=4218&q=305412. The 30 day permit decision time is from the State Building Code, namely the 2005 Connecticut Supplement which includes the 2009 Amendment (effective August 1, 2009) to the 2005 State Building Code. The language of the code amendment also encourages building officials to issue a permit as soon as practicable once the official is satisfied that the proposed work meets all requirements.

Fairfield

Population: 59,625
Households: 20,556
Region: Greater Bridgeport

fairfieldct.org/

Clean Energy Commitments

- ✔ Rooftop Solar Challenge
- ✔ CPACE
- ✔ Solarize Phase One
- ✔ CT Clean Energy Communities

Best Practices

- ✹ Applications can be obtained online or by mail

Solar PV Installations 2004—April 2013

125 residential projects (912 kW)

Household penetration 0.61%

5 nonresidential projects (621 kW)

1 nonresidential ZREC project (297 kW) anticipated installed by end of 2013

Connecticut's Sun Rise New England team, led by the Clean Energy Finance and Investment Authority (CEFIA), thanks Fairfield for participating in Connecticut's Rooftop Solar Challenge project, focusing on improving processes and reducing non-hardware costs associated with permitting, planning and zoning, interconnection, and increasing access to financing for rooftop solar photovoltaic (PV) systems.

In addition to our specific recommendations, please also consider the general suggestions offered in the *Rooftop Solar PV Permitting Recommendations for Jurisdictions*, included in the forthcoming CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹.

Rooftop Solar PV Permitting Recommendations for Fairfield

Make Information Available

- **Online Permitting:** Make sure all information pertaining to Fairfield's solar PV permitting processes are clearly posted on your relevant department website and updated regularly. Use online permitting software (please see "Adopt Online Permitting" in the next section called "Streamline Permit Application Submission").
- **Create a Clean Energy Webpage** on your jurisdiction's website. Provide links to resources such as the Sun Rise New England and EnergizeCT websites. EnergizeCT is a state initiative to provide energy-related information and resources.[163] Constituents would also want to know about local clean energy projects

[163] energizect.com/SunriseNE and more generally, energizect.com

and activities, policies and incentives, your clean energy task force (if applicable), and successes and participation in programs such as the Rooftop Solar Challenge, Solarize, the Clean Energy Communities Program, the CT Solar Challenge, and C-PACE.[164] See West Hartford, Greenwich, Cornwall, Coventry, Hampton and Middletown clean energy websites for examples, though each jurisdiction should review their sites for updates and additions.[165]

- **Remember to Promote** your clean energy webpage, timely programs and solar PV adoption with radio and newspaper announcements, newsletters and environmentally friendly signage.

Streamline Permit Application Submission

- **Adopt the Standard Solar PV Permit Application:** The Sun Rise New England team has put together a CT standardized solar PV permit application package which will be offered in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ on the Sun Rise New England website.[166]
- **Simplify the Application Process:** Make one department responsible for the rooftop solar PV permitting process and reduce the number of steps, signatures and unnecessary requirements asked of installers.
- **Adopt Online Permitting:** Adopt an online permitting system[167] to enable applicants to obtain and submit solar PV permit application materials online. Otherwise, allow installers to obtain and submit permit application materials through your website, by email, or by U.S. mail. This change saves installers time-intensive and costly trips to jurisdiction offices.
- **Unnecessary Copies:** Consider eliminating the requirement for multiple copies of materials such as building plans**.**

Waive or Reduce Permit Fees

- **Waive or Reduce Fees:** Towns may encourage solar installations by waiving solar PV permit fees.[168] If not a full waiver, consider a low or flat fee based on cost recovery instead of the value-based fee structure Fairfield currently utilizes. Value-based fee structures usually do not accurately reflect the cost of solar PV permit review and inspection. Research in Connecticut indicates that it should cost no more than $200, usually less, for a town to permit a small-scale, rooftop solar PV installation. Streamlining processes can help reduce costs to jurisdictions. For example, Bridgeport and Manchester waive permit fees for class I renewable energy systems, and Durham has a flat fee for solar PV permits.
- **Allow for Payment Electronically or by Mail:** Allow installers to pay permit fees online, electronically, or by U.S. mail to save driving time and cost.

---

[164] Rooftop Solar Challenge, eere.energy.gov/solarchallenge; SunShot Initiative, eere.energy.gov/solar/sunshot; Solarize, solarizect.com; Clean Energy Communities Program, energizect.com/communities/programs/clean-energy-communities or ctenergydashboard.com/CEC/CECHome.aspx; CT Solar Challenge, ctsolarchallenge.com; C-PACE, c-pace.com.

[165] Cornwall: cornwallctenergy.org; Coventry: www.coventryct.org/index.aspx?NID=175; Greenwich: www.greenwichct.org/Government/Commissions/Conservation_Commission/Cean_Energy_Community; Hampton: www.hamptonct.org/committee.htm?id=fhsb77u5; Middletown: www.cityofmiddletown.com/content/81/750/1840/default.aspx; West Hartford: west-hartford.com/government/CleanEnergy.htm and www.westhartford.org/living_here/green/west_hartford_clean_energy_task_force.php

[166] energizect.com/SunriseNE

[167] For examples, see: Simply Civic, simplycivic.com; City View, msgovern.com/software/cityview; View Permit, viewpermit.com.

[168] cga.ct.gov/2012/sup/chap541.htm - Sec29-263.htm, "(c) Any municipality may, by ordinance adopted by its legislative body, exempt Class I renewable energy source projects from payment of building permit fees imposed by the municipality."

Streamline Review and Inspection Requirements

- **Train Staff:** Require jurisdiction staff involved in solar PV permitting to participate in relevant solar PV training, at minimum by accessing a free online training course comparable to the "Photovoltaic Online Training for Code Officials" offered on the National Training & Education Resource (NTER) website.[169]
- **Remove Excessive Reviews**: Jurisdiction staff should identify and remove reviews that are not critical to safe and efficient operation of a proposed rooftop solar PV system. In particular, unnecessary and costly engineering reviews should be eliminated by specifying criteria and a methodology for determining when these reviews are needed.
- **Simplify the Inspection Process:** The CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ offers resources and suggestions for improving inspection processes such as: (1) When an inspection is required, conduct a single, comprehensive inspection instead of requiring multiple appointments. (2) Schedule specific appointment times for inspections instead of windows of time. This saves everyone, and ultimately town residents and business owners, time, money and frustration.
- **Shorten Permit Approval Times:** By Connecticut law, a permitting decision must be made within 30 days.[170] However, a shorter timeframe encourages installers to do business in your jurisdiction and speeds up the time between a customer's intent to generate clean energy and their ability to do so. Consider the best practice of issuing permits in as short a time frame as possible, for example on the "same day" or "over-the-counter" for standard small-scale rooftop solar PV systems that clearly meet your jurisdiction's permit approval criteria.

Formalize Best Practices

- **Adopt Solar Friendly Ordinances** using the model elements offered in "Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions" found in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹. Adopting the elements of the Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions removes unnecessary barriers to solar energy installation and formalizes your jurisdiction's commitment to making rooftop solar PV permitting easier and less costly for everyone.

Photo: Sasco Beach, Fairfield CT, Creative Commons, flickr.com/photos/lvpdesign/7022744263/sizes/l/

[169] Photovoltaic Online Training For Code Officials: nterlearning.org/web/guest/course-details?cid=402

[170] ct.gov/dcs/cwp/view.asp?a=4218&q=305412. The 30 day permit decision time is from the State Building Code, namely the 2005 Connecticut Supplement which includes the 2009 Amendment (effective August 1, 2009) to the 2005 State Building Code. The language of the code amendment also encourages building officials to issue a permit as soon as practicable once the official is satisfied that the proposed work meets all requirements.

Greenwich

Population: 61,983
Households: 23,382
Region: South Western

greenwichct.org/

Clean Energy Commitments

- ✔Rooftop Solar Challenge
- ✔CPACE
- ✔Solarize Phase Three
- ✔CT Clean Energy Communities

Best Practices

- Applications can be obtained online
- Final permits can be mailed to installers
- Green building ordinance for public buildings

Solar PV Installations 2004—April 2013

[CEFIA program data; does not include ZREC data]

37 residential projects (199 kW)

Household penetration 0.16%

4 nonresidential projects (218 kW)

Connecticut's Sun Rise New England team, led by the Clean Energy Finance and Investment Authority (CEFIA), thanks Greenwich for participating in Connecticut's Rooftop Solar Challenge project, focusing on improving processes and reducing non-hardware costs associated with permitting, planning and zoning, interconnection, and increasing access to financing for rooftop solar photovoltaic (PV) systems.

In addition to our specific recommendations, please also consider the general suggestions offered in the *Rooftop Solar PV Permitting Recommendations for Jurisdictions*, included in the forthcoming CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹.

Rooftop Solar PV Permitting Recommendations for Greenwich

Make Information Available

- **Online Permitting:** Make sure all information pertaining to Greenwich's solar PV permitting processes are clearly posted on your relevant department website and updated regularly. Use online permitting software (please see "Adopt Online Permitting" in the next section called "Streamline Permit Application Submission").
- **Clean Energy Webpage:** Greenwich has a clean energy webpage that can be accessed directly from the Greenwich homepage.[171] Consider reviewing your webpage to identify any potential updates, improvements and additions such as making sure you have a

[171] Greenwich: www.greenwichct.org/Government/Commissions/Conservation_Commission/Cean_Energy_Community

link to EnergizeCT, a state initiative to provide energy-related information and resources.[172] See West Hartford, Cornwall, Coventry, Hampton and Middletown clean energy websites for examples of other towns' sites, though each jurisdiction should review their sites for updates and additions.[173]

- **Remember to Promote** your clean energy webpage, timely programs and solar PV adoption with radio and newspaper announcements, newsletters and environmentally friendly signage.

Streamline Permit Application Submission

- **Adopt the Standard Solar PV Permit Application:** The Sun Rise New England team has put together a CT standardized solar PV permit application package which will be offered in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ on the Sun Rise New England website.[174]
- **Simplify the Application Process:** Make one department responsible for the rooftop solar PV permitting process and reduce the number of steps, signatures and unnecessary requirements asked of installers.
- **Adopt Online Permitting:** Adopt an online permitting system[175] to enable applicants to obtain and submit solar PV permit application materials online. Otherwise, allow installers to obtain and submit permit application materials through your website, by email, or by regular mail. This change saves installers time-intensive and costly trips to jurisdiction offices.
- **Remove Unnecessary Paperwork Requirements:** Consider removing the requirement for homeowner approvals to be notarized. Eliminate the requirement for special paper types for permit applications.

Waive or Reduce Permit Fees

- **Waive or Reduce Fees:** Towns may encourage solar installations by waiving solar PV permit fees.[176] If not a full waiver, consider a low or flat fee based on cost recovery instead of the value-based fee structure Greenwich currently utilizes. Value-based fee structures usually do not accurately reflect the cost of solar PV permit review and inspection. Research in Connecticut indicates that it should cost no more than $200, usually less, for a town to permit a small-scale, rooftop solar PV installation. Streamlining processes can help reduce costs to jurisdictions. For example, Bridgeport and Manchester waive permit fees for class I renewable energy systems, and Durham has a flat fee for solar PV permits.
- **Allow for Payment Electronically or by Mail:** Allow installers to pay permit fees online, electronically, or by U.S. mail to save driving time and cost.

[172] www.energizect.com/SunriseNE and more generally, www.energizect.com

[173] Cornwall: cornwallctenergy.org; Coventry: www.coventryct.org/index.aspx?NID=175; Greenwich: www.greenwichct.org/Government/Commissions/Conservation_Commission/Cean_Energy_Community; Hampton: www.hamptonct.org/committee.htm?id=fhsb77u5; Middletown: www.cityofmiddletown.com/content/81/750/1840/default.aspx; West Hartford: west-hartford.com/government/CleanEnergy.htm and www.westhartford.org/living_here/green/west_hartford_clean_energy_task_force.php

[174] energizect.com/SunriseNE

[175] For examples, see: Simply Civic, simplycivic.com; City View, msgovern.com/software/cityview; View Permit, viewpermit.com.

[176] cga.ct.gov/2012/sup/chap541.htm - Sec29-263.htm, "(c) Any municipality may, by ordinance adopted by its legislative body, exempt Class I renewable energy source projects from payment of building permit fees imposed by the municipality."

Streamline Review and Inspection Requirements

- **Train Staff:** Require jurisdiction staff involved in solar PV permitting to participate in relevant solar PV training, at minimum by accessing a free online training course comparable to the "Photovoltaic Online Training for Code Officials" offered on the National Training & Education Resource (NTER) website.[177]
- **Remove Excessive Reviews**: Jurisdiction staff should identify and remove reviews that are not critical to safe and efficient operation of a proposed rooftop solar PV system. In particular, unnecessary and costly engineering reviews should be eliminated by specifying criteria and a methodology for determining when these reviews are needed.
- **Simplify the Inspection Process:** The CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ offers resources and suggestions for improving inspection processes such as: (1) When an inspection is required, conduct a single, comprehensive inspection instead of requiring multiple appointments. (2) Schedule specific appointment times for inspections instead of windows of time. This saves everyone, and ultimately town residents and business owners, time, money and frustration.
- **Shorten Permit Approval Times:** By Connecticut law, a permitting decision must be made within 30 days.[178] However, a shorter timeframe encourages installers to do business in your jurisdiction and speeds up the time between a customer's intent to generate clean energy and their ability to do so. Consider the best practice of issuing permits in as short a time frame as possible, for example on the "same day" or "over-the-counter" for standard small-scale rooftop solar PV systems that clearly meet your jurisdiction's permit approval criteria.

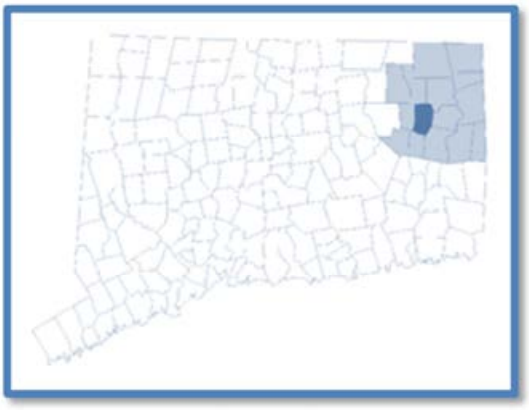
Formalize Best Practices

- **Adopt Solar Friendly Ordinances** using the model elements offered in "Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions" found in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹. Adopting the elements of the Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions removes unnecessary barriers to solar energy installation and formalizes your jurisdiction's commitment to making rooftop solar PV permitting easier and less costly for everyone.

Photo: Long Island Sound at dusk, Carl Raether, Creative Commons, flickr.com/photos/carlbock/214843728/

[177] Photovoltaic Online Training For Code Officials: nterlearning.org/web/guest/course-details?cid=402

[178] ct.gov/dcs/cwp/view.asp?a=4218&q=305412. The 30 day permit decision time is from the State Building Code, namely the 2005 Connecticut Supplement which includes the 2009 Amendment (effective August 1, 2009) to the 2005 State Building Code. The language of the code amendment also encourages building officials to issue a permit as soon as practicable once the official is satisfied that the proposed work meets all requirements.



Hampton

Population: 1,890
Households: 768
Region: Windham

Hamptonct.org

Clean Energy Commitments

- ✔ Rooftop Solar Challenge CPACE
- ✔ Solarize Phase Three
- ✔ CT Clean Energy Communities

Best Practices

- Applications can be obtained online
- Applications can be submitted by mail
- Approved permits can be mailed to installers
- Scheduled inspections
- "Green Energy" webpage

Solar PV Installations 2004—April 2013

[CEFIA program data; does not include ZREC data]

15 residential projects (87 kW)

Household penetration 1.95%

2 nonresidential projects (19 kW)

Connecticut's Sun Rise New England team, led by the Clean Energy Finance and Investment Authority (CEFIA), thanks Hampton for participating in Connecticut's Rooftop Solar Challenge project, focusing on improving processes and reducing non-hardware costs associated with permitting, planning and zoning, interconnection, and increasing access to financing for rooftop solar photovoltaic (PV) systems.

In addition to our specific recommendations, please also consider the general suggestions offered in the *Rooftop Permitting Recommendations for Jurisdictions*, included in the forthcoming CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹.

Rooftop Solar PV Permitting Recommendations for Hampton

Make Information Available

- **Online Permitting:** Make sure all information pertaining to Hampton's solar PV permitting processes are clearly posted on your relevant department website and updated regularly. Use online permitting software (please see "Adopt Online Permitting" in the next section called "Streamline Permit Application Submission").
- **Clean Energy Webpage:** Hampton has a green energy committee webpage.[179] Consider reviewing your webpage to identify any potential updates, improvements and additions such as making sure you have a

[179] www.hamptonct.org/committee.htm?id=fhsb77u5

link to EnergizeCT, a state initiative to provide energy-related information and resources.[180] For example, Hampton could replace CCEF information which is no longer up to date. See West Hartford, Greenwich, Cornwall, Coventry and Middletown clean energy websites for examples of other towns' sites, though each jurisdiction should review their sites for updates and additions.[181]

- **Remember to Promote** your clean energy webpage, timely programs and solar PV adoption with radio and newspaper announcements, newsletters and environmentally friendly signage.

Streamline Permit Application Submission

- **Adopt the Standard Solar PV Permit Application:** The Sun Rise New England team has put together a CT standardized solar PV permit application package which will be offered in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ on the Sun Rise New England website.[182]
- **Simplify the Application Process:** Make one department responsible for the rooftop solar PV permitting process and reduce the number of steps, signatures and unnecessary requirements asked of installers.
- **Adopt Online Permitting:** Adopt an online permitting system[183] to enable applicants to obtain and submit solar PV permit application materials online. Otherwise, allow installers to obtain and submit permit application materials through your website, by email, or by regular mail. This change saves installers time-intensive and costly trips to jurisdiction offices.
- **Eliminate Tax Clearance Application Requirements**

Waive or Reduce Permit Fees

- **Waive or Reduce Fees:** Towns may encourage solar installations by waiving solar PV permit fees.[184] If not a full waiver, consider a low or flat fee based on cost recovery instead of the value-based fee structure Hampton currently utilizes. Value-based fee structures usually do not accurately reflect the cost of solar PV permit review and inspection. Research in Connecticut indicates that it should cost no more than $200, usually less, for a town to permit a small-scale, rooftop solar PV installation. Streamlining processes can help reduce costs to jurisdictions. For example, Bridgeport and Manchester waive permit fees for class I renewable energy systems, and Durham has a flat fee for solar PV permits.
- **Allow for Payment Electronically or by Mail:** Allow installers to pay permit fees online, electronically, or by U.S. mail to save driving time and cost.

[180] www.energizect.com/SunriseNE and more generally, www.energizect.com

[181] Cornwall: cornwallctenergy.org; Coventry: www.coventryct.org/index.aspx?NID=175;
Greenwich: www.greenwichct.org/Government/Commissions/Conservation_Commission/Cean_Energy_Community;
Hampton: www.hamptonct.org/committee.htm?id=fhsb77u5;
Middletown: www.cityofmiddletown.com/content/81/750/1840/default.aspx;
West Hartford: west-hartford.com/government/CleanEnergy.htm and
www.westhartford.org/living_here/green/west_hartford_clean_energy_task_force.php

[182] energizect.com/SunriseNE

[183] For examples, see: Simply Civic, simplycivic.com; City View, www.msgovern.com/software/cityview; View Permit, viewpermit.com.

[184] cga.ct.gov/2012/sup/chap541.htm - Sec29-263.htm, "(c) Any municipality may, by ordinance adopted by its legislative body, exempt Class I renewable energy source projects from payment of building permit fees imposed by the municipality."

Streamline Review and Inspection Requirements

- **Train Staff:** Require jurisdiction staff involved in solar PV permitting to participate in relevant solar PV training, at minimum by accessing a free online training course comparable to the "Photovoltaic Online Training for Code Officials" offered on the National Training & Education Resource (NTER) website.[185]
- **Remove Excessive Reviews**: Jurisdiction staff should identify and remove reviews that are not critical to safe and efficient operation of a proposed rooftop solar PV system. In particular, unnecessary and costly engineering reviews should be eliminated by specifying criteria and a methodology for determining when these reviews are needed.
- **Simplify the Inspection Process:** The CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ offers resources and suggestions for improving inspection processes, though Hampton already practices two of our recommendations by providing specific appointment times and a single comprehensive inspection instead of multiple inspections. These two practices save everyone, and ultimately town residents and business owners, time, money and frustration.
- **Shorten Permit Approval Times:** By Connecticut law, a permitting decision must be made within 30 days.[186] However, a shorter timeframe encourages installers to do business in your jurisdiction and speeds up the time between a customer's intent to generate clean energy and their ability to do so. Consider the best practice of issuing permits in as short a time frame as possible, for example on the "same day" or "over-the-counter" for standard small-scale rooftop solar PV systems that clearly meet your jurisdiction's permit approval criteria.

Formalize Best Practices

- **Adopt Solar Friendly Ordinances** using the model elements offered in "Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions" found in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹. Adopting the elements of the Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions removes unnecessary barriers to solar energy installation and formalizes your jurisdiction's commitment to making rooftop solar PV permitting easier and less costly for everyone.

Photo: Goodwin Conservation Area, Don Taylor, Creative Commons, flickr.com/photos/donphoto/2076313187/sizes/l/

[185] Photovoltaic Online Training For Code Officials: nterlearning.org/web/guest/course-details?cid=402

[186] ct.gov/dcs/cwp/view.asp?a=4218&q=305412. The 30 day permit decision time is from the State Building Code, namely the 2005 Connecticut Supplement which includes the 2009 Amendment (effective August 1, 2009) to the 2005 State Building Code. The language of the code amendment also encourages building officials to issue a permit as soon as practicable once the official is satisfied that the proposed work meets all requirements.

Manchester

Population: 59,175
Households: 25,194
Region: Capitol

townofmanchester.org

Clean Energy Commitments

- ✔Rooftop Solar Challenge
- ✔CPACE
- ✔Solarize Phase Three
- CT Clean Energy Communities*

Best Practices

- Permit fee waiver for Class 1 renewables
- Online permitting system
- Applications can also be submitted by email and mail
- Single comprehensive inspections
- Software used to help assess need for engineering reviews

Solar PV Installations 2004—April 2013

27 residential projects (181 kW)

Household penetration .11%

5 nonresidential projects (416 kW)

4 nonresidential ZREC projects (1131 kW) anticipated installed by end of 2013

Connecticut's Sun Rise New England team, led by the Clean Energy Finance and Investment Authority (CEFIA), thanks Manchester for participating in Connecticut's Rooftop Solar Challenge project, focusing on improving processes and reducing non-hardware costs associated with permitting, planning and zoning, interconnection, and increasing access to financing for rooftop solar photovoltaic (PV) systems.

In addition to our specific recommendations, please also consider the general suggestions offered in the *Rooftop Solar PV Permitting Recommendations for Jurisdictions*, included in the forthcoming CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹.

Rooftop Solar PV Permitting Recommendations for Manchester

Make Information Available

- **Online Permitting:** Make sure all information pertaining to Manchester's solar PV permitting processes are clearly posted on your relevant websites and updated regularly. Manchester responded to our outreach indicating the use of the View Permit online permitting system. Installers visiting Manchester's home page or building department webpage are able to easily navigate to your online permitting system – this is a good model for other towns.
- **Create a Clean Energy Webpage** on your jurisdiction's website. Provide links to resources such as the Sun Rise New England and EnergizeCT websites. EnergizeCT is a state initiative to provide energy-related

information and resources.[187] Constituents would also want to know about local clean energy projects and activities, policies and incentives, your clean energy task force (if applicable), and successes and participation in programs such as the Rooftop Solar Challenge, Solarize, the Clean Energy Communities Program, the CT Solar Challenge, and C-PACE.[188] See West Hartford, Greenwich, Cornwall, Coventry, Hampton and Middletown clean energy websites for examples, though each jurisdiction should review their sites for updates and additions.[189]

- **Remember to Promote** your clean energy webpage, timely programs and solar PV adoption with radio and newspaper announcements, newsletters and environmentally friendly signage.

Streamline Permit Application Submission

- **Adopt the Standard Solar PV Permit Application:** The Sun Rise New England team has put together a CT standardized solar PV permit application package which will be offered in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ on the Sun Rise New England website.[190]
- **Simplify the Application Process:** Make one department responsible for the rooftop solar PV permitting process and reduce the number of steps, signatures and unnecessary requirements asked of installers.
- **Adopt Online Permitting:** Manchester could consider adopting use of the CT standardized solar PV permit application package through the ViewPermit online permitting system.

Permit Fees

- **Waive or Reduce Fees:** Manchester is providing clean energy leadership in Connecticut by waiving permit fees for Class I renewable energy systems as enabled in Public Act 11-80.[191]

Streamline Review and Inspection Requirements

- **Train Staff:** Require jurisdiction staff involved in solar PV permitting to participate in relevant solar PV training, at minimum by accessing a free online training course comparable to the "Photovoltaic Online Training for Code Officials" offered on the National Training & Education Resource (NTER) website.[192]
- **Remove Excessive Reviews**: Jurisdiction staff should identify and remove reviews that are not critical to safe and efficient operation of a proposed rooftop solar PV system. Manchester shows a commitment to

[187] energizect.com/SunriseNE and more generally, energizect.com
[188] Rooftop Solar Challenge, eere.energy.gov/solarchallenge; SunShot Initiative, eere.energy.gov/solar/sunshot; Solarize, solarizect.com; Clean Energy Communities Program, energizect.com/communities/programs/clean-energy-communities or ctenergydashboard.com/CEC/CECHome.aspx; CT Solar Challenge, ctsolarchallenge.com; C-PACE, c-pace.com.
[189] Cornwall: cornwallctenergy.org; Coventry: www.coventryct.org/index.aspx?NID=175;
Greenwich: www.greenwichct.org/Government/Commissions/Conservation_Commission/Cean_Energy_Community;
Hampton: www.hamptonct.org/committee.htm?id=fhsb77u5;
Middletown: www.cityofmiddletown.com/content/81/750/1840/default.aspx;
West Hartford: west-hartford.com/government/CleanEnergy.htm and
www.westhartford.org/living_here/green/west_hartford_clean_energy_task_force.php
[190] energizect.com/SunriseNE
[191] Section 29-263: cga.ct.gov/2012/sup/chap541.htm - Sec29-263.htm, "(c) Any municipality may, by ordinance adopted by its legislative body, exempt Class I renewable energy source projects from payment of building permit fees imposed by the municipality."
[192] Photovoltaic Online Training For Code Officials: nterlearning.org/web/guest/course-details?cid=402

encouraging solar PV installations by using software designed to help determine when engineering inspections are required and when they can be waived.

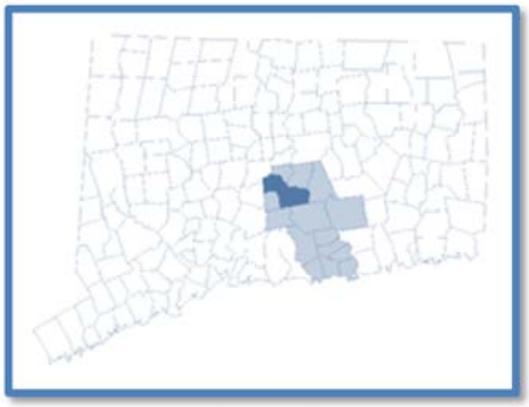
- **Simplify the Inspection Process:** The CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ offers resources and suggestions for improving inspection processes, though Manchester already practices one of our recommendations by providing a single instead of multiple inspections. An example of an improvement that can be made is to schedule a specific time rather than a window of time for the inspection.
- **Shorten Permit Approval Times:** By Connecticut law, a permitting decision must be made within 30 days.[193] However, a shorter timeframe encourages installers to do business in your jurisdiction and speeds up the time between a customer's intent to generate clean energy and their ability to do so. Consider the best practice of issuing permits in as short a time frame as possible, for example on the "same day" or "over-the-counter" for standard small-scale rooftop solar PV systems that clearly meet your jurisdiction's permit approval criteria.

Formalize Best Practices

- **Adopt Solar Friendly Ordinances** using the model elements offered in "Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions" found in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹. Adopting the elements of the Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions removes unnecessary barriers to solar energy installation and formalizes your jurisdiction's commitment to making rooftop solar PV permitting easier and less costly for everyone.

Photo: Torii Gate, Don Rogers, Creative Commons, flickr.com/photos/dsrogers/4758403810/

[193] ct.gov/dcs/cwp/view.asp?a=4218&q=305412. The 30 day permit decision time is from the State Building Code, namely the 2005 Connecticut Supplement which includes the 2009 Amendment (effective August 1, 2009) to the 2005 State Building Code. The language of the code amendment also encourages building officials to issue a permit as soon as practicable once the official is satisfied that the proposed work meets all requirements.



Middletown

Population: 48,041
Households: 20,233
Region: Midstate

cityofmiddletown.com

Clean Energy Commitments

- ✔ Rooftop Solar Challenge
- ✔ CPACE
  - Solarize
- ✔ CT Clean Energy Communities

Best Practices

- Single application
- Single department
- Single and scheduled inspections
- Approved permits can be mailed to installers

Solar PV Installations 2004—April 2013

43 residential projects (224 kW)

Household penetration 0.21%

7 nonresidential projects (565 kW)

Connecticut's Sun Rise New England team, led by the Clean Energy Finance and Investment Authority (CEFIA), thanks Middletown for participating in Connecticut's Rooftop Solar Challenge project, focusing on improving processes and reducing non-hardware costs associated with permitting, planning and zoning, interconnection, and increasing access to financing for rooftop solar photovoltaic (PV) systems.

In addition to our specific recommendations, please also consider the general suggestions offered in the *Rooftop Solar PV Permitting Recommendations for Jurisdictions*, included in the forthcoming CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE.

Rooftop Solar PV Permitting Recommendations for Middletown

Make Information Available

- **Online Permitting:** Make sure all information pertaining to Middletown's solar PV permitting processes are clearly posted on your relevant department website and updated regularly. Middletown responded to our outreach indicating the use of an online permit application submission system. (Please see "Adopt Online Permitting" in the next section called "Streamline Permit Application Submission"). Middletown provides a link from its home page to its online permit application submission system.

- **Clean Energy Webpage:** Middletown has an energy efficiency and renewable energy webpage accessible from an environmental sustainability page on the town home page.[194] Consider reviewing your webpage to identify any potential updates, improvements and additions such as making sure you have a link to EnergizeCT, a state initiative to provide energy-related information and resources.[195] See West Hartford, Greenwich, Cornwall, Coventry and Hampton clean energy websites for examples of other towns' sites, though each jurisdiction should review their sites for updates and additions.[196]
- **Remember to Promote** your clean energy webpage, timely programs and solar PV adoption with radio and newspaper announcements, newsletters and environmentally friendly signage.

Streamline Permit Application Submission

- **Adopt the Standard Solar PV Permit Application:** The Sun Rise New England team has put together a CT standardized solar PV permit application package which will be offered in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ on the Sun Rise New England website.[197]
- **Adopt Online Permitting:** Consider expanding the functionality of Middletown's current online permit application submission system by allowing for submission of attachments such as a completed CT standardized solar PV permit application package. The blank, fillable permit form could be made available for download through the permitting system or from the building department website.

Waive or Reduce Permit Fees

- **Waive or Reduce Fees:** Towns may encourage solar installations by waiving solar PV permit fees.[198] If not a full waiver, consider a low or flat fee based on cost recovery instead of the value-based fee structure Middletown currently utilizes. Value-based fee structures usually do not accurately reflect the cost of solar PV permit review and inspection. Research in Connecticut indicates that it should cost no more than $200, usually less, for a town to permit a small-scale, rooftop solar PV installation. Streamlining processes can help reduce costs to jurisdictions. For example, Bridgeport and Manchester waive permit fees for class I renewable energy systems, and Durham has a flat fee for solar PV permits.
- **Allow for Payment Electronically or by Mail:** Allow installers to pay permit fees online, electronically, or by U.S. mail to save driving time and cost.

Streamline Review and Inspection Requirements

- **Train Staff:** Require jurisdiction staff involved in solar PV permitting to participate in relevant solar PV training, at minimum by accessing a free online training course comparable to the "Photovoltaic Online Training for Code Officials" offered on the National Training & Education Resource (NTER) website.[199]

---

[194] Middletown: www.cityofmiddletown.com/content/81/750/1840/default.aspx
[195] www.energizect.com/SunriseNE and more generally, www.energizect.com
[196] Cornwall: cornwallctenergy.org; Coventry: www.coventryct.org/index.aspx?NID=175;
Greenwich: www.greenwichct.org/Government/Commissions/Conservation_Commission/Cean_Energy_Community;
Hampton: www.hamptonct.org/committee.htm?id=fhsb77u5;
Middletown: www.cityofmiddletown.com/content/81/750/1840/default.aspx;
West Hartford: west-hartford.com/government/CleanEnergy.htm and
www.westhartford.org/living_here/green/west_hartford_clean_energy_task_force.php
[197] energizect.com/SunriseNE
[198] cga.ct.gov/2012/sup/chap541.htm - Sec29-263.htm, "(c) Any municipality may, by ordinance adopted by its legislative body, exempt Class I renewable energy source projects from payment of building permit fees imposed by the municipality."
[199] Photovoltaic Online Training For Code Officials: nterlearning.org/web/guest/course-details?cid=402

- **Remove Excessive Reviews**: Jurisdiction staff should identify and remove reviews that are not critical to safe and efficient operation of a proposed rooftop solar PV system. In particular, unnecessary and costly engineering reviews should be eliminated by specifying criteria and a methodology for determining when these reviews are needed.
- **Simplify the Inspection Process:** The CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ offers resources and suggestions for improving inspection processes, though Middletown already practices one of our recommendations by providing a single instead of multiple inspections. An example of an improvement that can be made is to schedule a specific appointment time rather than a window of time for the inspection.
- **Shorten Permit Approval Times:** By Connecticut law, a permitting decision must be made within 30 days.[200] However, a shorter timeframe encourages installers to do business in your jurisdiction and speeds up the time between a customer's intent to generate clean energy and their ability to do so. Consider the best practice of issuing permits in as short a time frame as possible, for example on the "same day" or "over-the-counter" for standard small-scale rooftop solar PV systems that clearly meet your jurisdiction's permit approval criteria.

Formalize Best Practices

- **Adopt Solar Friendly Ordinances** using the model elements offered in "Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions" found in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹. Adopting the elements of the Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions removes unnecessary barriers to solar energy installation and formalizes your jurisdiction's commitment to making rooftop solar PV permitting easier and less costly for everyone.

Photo: Connecticut River, Victoria Stahl, Sun Rise New England team

[200] ct.gov/dcs/cwp/view.asp?a=4218&q=305412. The 30 day permit decision time is from the State Building Code, namely the 2005 Connecticut Supplement which includes the 2009 Amendment (effective August 1, 2009) to the 2005 State Building Code. The language of the code amendment also encourages building officials to issue a permit as soon as practicable once the official is satisfied that the proposed work meets all requirements.

Milford

Population: 52,894
Households: 21,910
Region: South Central CT
ci.milford.ct.us/

Clean Energy Commitments

- ✔ Rooftop Solar Challenge
- ✔ CPACE
- Solarize
- ✔ CT Clean Energy Communities

Best Practices

- Online permitting system
- Single comprehensive inspection
- Inspection schedules posted online

Solar PV Installations 2004—April 2013

70 residential projects (447 kW)

Household penetration 0.32%

2 nonresidential projects (370 kW)

Connecticut's Sun Rise New England team, led by the Clean Energy Finance and Investment Authority (CEFIA), thanks Milford for participating in Connecticut's Rooftop Solar Challenge project, focusing on improving processes and reducing non-hardware costs associated with permitting, planning and zoning, interconnection, and increasing access to financing for rooftop solar photovoltaic (PV) systems.

In addition to our specific recommendations, please also consider the general suggestions offered in the *Rooftop Solar PV Permitting Recommendations for Jurisdictions*, included in the forthcoming CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹.

Rooftop Solar PV Permitting Recommendations for Milford

Make Information Available

- **Online Permitting:** Make sure all information pertaining to Milford's solar PV permitting processes are clearly posted on your relevant department website and updated regularly. Milford responded to our outreach indicating the use of the View Permit online permitting system. Installers visiting Milford's home page or building department page should be able to access a link to the online system. See Manchester's home page or building department webpage for a good example.[201]

[201] building.townofmanchester.org/building

- **Create a Clean Energy Webpage** on your jurisdiction's website. Provide links to resources such as the Sun Rise New England and EnergizeCT websites. EnergizeCT is a state initiative to provide energy-related information and resources.[202] Constituents would also want to know about local clean energy projects and activities, policies and incentives, your clean energy task force (if applicable), and successes and participation in programs such as the Rooftop Solar Challenge, Solarize, the Clean Energy Communities Program, the CT Solar Challenge, and C-PACE.[203] See West Hartford, Greenwich, Cornwall, Coventry, Hampton and Middletown clean energy websites for examples, though each jurisdiction should review their sites for updates and additions.[204]
- **Remember to Promote** your clean energy webpage, timely programs and solar PV adoption with radio and newspaper announcements, newsletters and environmentally friendly signage.

Streamline Permit Application Submission

- **Adopt the Standard Solar PV Permit Application:** The Sun Rise New England team has put together a CT standardized solar PV permit application package which will be offered in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ on the Sun Rise New England website.[205]
- **Simplify the Application Process:** Make one department responsible for the rooftop solar PV permitting process and reduce the number of steps, signatures and unnecessary requirements asked of installers.
- **Adopt Online Permitting:** Milford could consider adopting use of the CT standardized solar PV permit application package through the ViewPermit online permitting system.

Waive or Reduce Permit Fees

- **Waive or Reduce Fees:** Towns may encourage solar installations by waiving solar PV permit fees.[206] If not a full waiver, consider a low or flat fee based on cost recovery instead of the value-based fee structure Milford currently utilizes. Value-based fee structures usually do not accurately reflect the cost of solar PV permit review and inspection. Research in Connecticut indicates that it should cost no more than $200, usually less, for a town to permit a small-scale, rooftop solar PV installation. Streamlining processes can help reduce costs to jurisdictions. For example, Bridgeport and Manchester waive permit fees for class I renewable energy systems, and Durham has a flat fee for solar PV permits.
- **Allow for Payment Electronically or by Mail:** Allow installers to pay permit fees online, electronically, or by U.S. mail to save driving time and cost.

---

[202] energizect.com/SunriseNE and more generally, energizect.com

[203] Rooftop Solar Challenge, eere.energy.gov/solarchallenge; SunShot Initiative, eere.energy.gov/solar/sunshot; Solarize, solarizect.com; Clean Energy Communities Program, energizect.com/communities/programs/clean-energy-communities or ctenergydashboard.com/CEC/CECHome.aspx; CT Solar Challenge, ctsolarchallenge.com; C-PACE, c-pace.com.

[204] Cornwall: cornwallctenergy.org; Coventry: www.coventryct.org/index.aspx?NID=175; Greenwich: www.greenwichct.org/Government/Commissions/Conservation_Commission/Cean_Energy_Community; Hampton: www.hamptonct.org/committee.htm?id=fhsb77u5; Middletown: www.cityofmiddletown.com/content/81/750/1840/default.aspx; West Hartford: west-hartford.com/government/CleanEnergy.htm and www.westhartford.org/living_here/green/west_hartford_clean_energy_task_force.php

[205] energizect.com/SunriseNE

[206] cga.ct.gov/2012/sup/chap541.htm - Sec29-263.htm, "(c) Any municipality may, by ordinance adopted by its legislative body, exempt Class I renewable energy source projects from payment of building permit fees imposed by the municipality."

Streamline Review and Inspection Requirements

Train Staff: Require jurisdiction staff involved in solar PV permitting to participate in relevant solar PV training, at minimum by accessing a free online training course comparable to the "Photovoltaic Online Training for Code Officials" offered on the National Training & Education Resource (NTER) website.[207]

- **Remove Excessive Reviews**: Jurisdiction staff should identify and remove reviews that are not critical to safe and efficient operation of a proposed rooftop solar PV system. In particular, unnecessary and costly engineering reviews should be eliminated by specifying criteria and a methodology for determining when these reviews are needed.
- **Simplify the Inspection Process:** The CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ offers resources and suggestions for improving inspection processes, though Milford already practices two of our recommendations by providing specific appointment times and a single comprehensive inspection instead of multiple inspections. These two practices save everyone, and ultimately town residents and business owners, time, money and frustration.
- **Shorten Permit Approval Times:** By Connecticut law, a permitting decision must be made within 30 days.[208] However, a shorter timeframe encourages installers to do business in your jurisdiction and speeds up the time between a customer's intent to generate clean energy and their ability to do so. Consider the best practice of issuing permits in as short a time frame as possible, for example on the "same day" or "over-the-counter" for standard small-scale rooftop solar PV systems that clearly meet your jurisdiction's permit approval criteria.

Formalize Best Practices

- **Adopt Solar Friendly Ordinances** using the model elements offered in "Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions" found in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹. Adopting the elements of the Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions removes unnecessary barriers to solar energy installation and formalizes your jurisdiction's commitment to making rooftop solar PV permitting easier and less costly for everyone.

Photo: Walnut Beach, Jerry Angelica, Creative Commons, flickr.com/photos/jerryangelicaphotography/6213356174/

[207] Photovoltaic Online Training For Code Officials: nterlearning.org/web/guest/course-details?cid=402

[208] ct.gov/dcs/cwp/view.asp?a=4218&q=305412. The 30 day permit decision time is from the State Building Code, namely the 2005 Connecticut Supplement which includes the 2009 Amendment (effective August 1, 2009) to the 2005 State Building Code. The language of the code amendment also encourages building officials to issue a permit as soon as practicable once the official is satisfied that the proposed work meets all requirements.

Stamford

Population: 124,908
Household: 48,288
Region: South Western

ci.stamford.ct.us/

Clean Energy Commitments

- ✔Rooftop Solar Challenge
- ✔CPACE
- ✔Solarize Choice
- CT Clean Energy Communities*

Best Practices

- Applications can be obtained online
- Approved permits can be mailed to installers
- Trained personnel for permit process
- Same day turnaround on permit decisions
- Identification criteria for systems not requiring permits

Solar PV Installations 2004—April 2013

39 residential projects (227 kW)

Household penetration 0.08%

8 nonresidential projects (1139 kW)

2 nonresidential ZREC projects (327 kW) anticipated installed by end of 2013

Connecticut's Sun Rise New England team, led by the Clean Energy Finance and Investment Authority (CEFIA), thanks Stamford for participating in Connecticut's Rooftop Solar Challenge project, focusing on improving processes and reducing non-hardware costs associated with permitting, planning and zoning, interconnection, and increasing access to financing for rooftop solar photovoltaic (PV) systems.

In addition to our specific recommendations, please also consider the general suggestions offered in the *Rooftop Solar PV Permitting Recommendations for Jurisdictions*, included in the forthcoming CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹.

Rooftop Solar PV Permitting Recommendations for Stamford

Make Information Available

- **Online Permitting:** Make sure all information pertaining to Stamford's solar PV permitting processes are clearly posted on your relevant department website and updated regularly. Use online permitting software (please see "Adopt Online Permitting" in the next section called "Streamline Permit Application Submission").
- **Create a Clean Energy Webpage** on your jurisdiction's website. Provide links to resources such as the Sun Rise New England and EnergizeCT websites. EnergizeCT is a state initiative to provide energy-related information and resources.[209] Constituents would also want to know about local clean energy projects and activities, policies and incentives, your clean energy task force

[209] energizect.com/SunriseNE and more generally, energizect.com

(if applicable), and successes and participation in programs such as the Rooftop Solar Challenge, Solarize, the Clean Energy Communities Program, the CT Solar Challenge, and C-PACE.[210] See West Hartford, Greenwich, Cornwall, Coventry, Hampton and Middletown clean energy websites for examples, though each jurisdiction should review their sites for updates and additions.[211]

- **Remember to Promote** your clean energy webpage, timely programs and solar PV adoption with radio and newspaper announcements, newsletters and environmentally friendly signage.

Streamline Permit Application Submission

- **Adopt the Standard Solar PV Permit Application:** The Sun Rise New England team has put together a CT standardized solar PV permit application package which will be offered in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ on the Sun Rise New England website.[212]
- **Simplify the Application Process:** Make one department responsible for the rooftop solar PV permitting process and reduce the number of steps, signatures and unnecessary requirements asked of installers.
- **Adopt Online Permitting:** Adopt an online permitting system[213] to enable applicants to obtain and submit solar PV permit application materials online. Otherwise, allow installers to obtain and *submit* permit application materials through your website, by email, or by regular mail. This change saves installers time-intensive and costly trips to jurisdiction offices.
- **Eliminate Multiple copies** of materials, such as building plans.

Waive or Reduce Permit Fees

- **Waive or Reduce Fees:** Towns may encourage solar installations by waiving solar PV permit fees.[214] If not a full waiver, consider a low or flat fee based on cost recovery instead of the value-based fee structure Stamford currently utilizes. Value-based fee structures usually do not accurately reflect the cost of solar PV permit review and inspection. Research in Connecticut indicates that it should cost no more than $200, usually less, for a town to permit a small-scale, rooftop solar PV installation. Streamlining processes can help reduce costs to jurisdictions. For example, Bridgeport and Manchester waive permit fees for class I renewable energy systems, and Durham has a flat fee for solar PV permits.
- **Allow for Payment Electronically or by Mail:** Allow installers to pay permit fees online, electronically, or by U.S. mail to save driving time and cost.

---

[210] Rooftop Solar Challenge, eere.energy.gov/solarchallenge; SunShot Initiative, eere.energy.gov/solar/sunshot; Solarize, solarizect.com; Clean Energy Communities Program, energizect.com/communities/programs/clean-energy-communities or ctenergydashboard.com/CEC/CECHome.aspx; CT Solar Challenge, ctsolarchallenge.com; C-PACE, c-pace.com.

[211] Cornwall: cornwallctenergy.org; Coventry: www.coventryct.org/index.aspx?NID=175; Greenwich: www.greenwichct.org/Government/Commissions/Conservation_Commission/Cean_Energy_Community; Hampton: www.hamptonct.org/committee.htm?id=fhsb77u5; Middletown: www.cityofmiddletown.com/content/81/750/1840/default.aspx; West Hartford: west-hartford.com/government/CleanEnergy.htm and www.westhartford.org/living_here/green/west_hartford_clean_energy_task_force.php

[212] energizect.com/SunriseNE

[213] For examples, see: Simply Civic, simplycivic.com; City View, msgovern.com/software/cityview; View Permit, viewpermit.com.

[214] cga.ct.gov/2012/sup/chap541.htm - Sec29-263.htm, "(c) Any municipality may, by ordinance adopted by its legislative body, exempt Class I renewable energy source projects from payment of building permit fees imposed by the municipality."

Streamline Review and Inspection Requirements

- **Remove Excessive Reviews**: Jurisdiction staff should identify and remove reviews that are not critical to safe and efficient operation of a proposed rooftop solar PV system. In particular, unnecessary and costly engineering reviews should be eliminated by specifying criteria and a methodology for determining when these reviews are needed.
- **Simplify the Inspection Process:** The CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ offers resources and suggestions for improving inspection processes such as: (1) When an inspection is required, conduct a single, comprehensive inspection instead of requiring multiple appointments. (2) Schedule specific appointment times for inspections instead of windows of time. This saves everyone, and ultimately town residents and business owners, time, money and frustration.

Formalize Best Practices

- **Adopt Solar Friendly Ordinances** using the model elements offered in "Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions" found in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹. Adopting the elements of the Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions removes unnecessary barriers to solar energy installation and formalizes your jurisdiction's commitment to making rooftop solar PV permitting easier and less costly for everyone.

Photo: building reflection 02, Monica Arellano-Ongpin, Creative Commons, flickr.com/photos/maong/2935963878/

West Hartford

Population: 63,649
Number of households: 25,513
Region: Capitol

http://www.west-hartford.com/

Clean Energy Commitments

- ✔Rooftop Solar Challenge
- ✔CPACE
- ✔Solarize Phase Three
- ✔CT Clean Energy Communities

Best Practices

- Clean energy websites
- Solar PV specific application and checklist
- Online permitting system

Solar PV Installations 2004—April 2013

45 residential projects (266 kW)

Household penetration 0.18%

6 nonresidential projects (351 kW)

2 nonresidential ZREC projects (634 kW) anticipated installed by end of 2013

Connecticut's Sun Rise New England team, led by the Clean Energy Finance and Investment Authority (CEFIA), thanks West Hartford for participating in Connecticut's Rooftop Solar Challenge project, focusing on improving processes and reducing non-hardware costs associated with permitting, planning and zoning, interconnection, and increasing access to financing for rooftop solar photovoltaic (PV) systems.

In addition to our specific recommendations, please also consider the general suggestions offered in the *Rooftop Solar PV Permitting Recommendations for Jurisdictions*, included in the forthcoming CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹.

Rooftop Solar PV Permitting Recommendations for West Hartford

Make Information Available

- **Online Permitting: Online Permitting:** Make sure all information pertaining to West Hartford's solar PV permitting processes are clearly posted on your relevant department website and updated regularly. Use online permitting software (please see "Adopt Online Permitting" in the next section called "Streamline Permit Application Submission").
- **Clean Energy Webpage**: West Hartford provides information about clean energy on its jurisdiction and clean energy task force websites.[215] Consider reviewing your webpage to identify any potential updates,

[215] West Hartford: west-hartford.com/government/CleanEnergy.htm and www.westhartford.org/living_here/green/west_hartford_clean_energy_task_force.php

improvements and additions such as making sure you have a link to EnergizeCT, a state initiative to provide energy-related information and resources.[216] See Greenwich, Cornwall, Coventry, Hampton and Middletown clean energy websites for examples of other towns' sites, though each jurisdiction should review their sites for updates and additions.[217]

- **Remember to Promote** your clean energy webpage, timely programs and solar PV adoption with radio and newspaper announcements, newsletters and environmentally friendly signage.

Streamline Permit Application Submission

- **Adopt the Standard Solar PV Permit Application:** West Hartford has provided leadership among CT jurisdictions by developing and sharing a solar PV specific permit application/checklist with the project team, contributing to development of a standardized application. The Sun Rise New England team has put together a CT standardized solar PV permit application package which will be offered in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ on the Sun Rise New England website.[218] Consider using the CT standardized solar PV permit application package through CityView.
- **Simplify the Application Process:** Make one department responsible for the rooftop solar PV permitting process and reduce the number of steps, signatures and unnecessary requirements asked of installers.
- **Adopt Online Permitting:** Allow applicants to obtain and submit solar PV permit application materials online through your CityView permitting platform. Consider using the CT standardized solar PV permit application package through CityView.

Waive or Reduce Permit Fees

- **Waive or Reduce Fees:** Towns may encourage solar installations by waiving solar PV permit fees.[219] If not a full waiver, consider a low or flat fee based on cost recovery instead of a value-based fee structure that may not accurately reflect the cost of solar PV permit review and inspection. Research in Connecticut indicates that it should cost no more than $200, usually less, for a town to permit a small-scale, rooftop solar PV installation. Streamlining processes can help reduce costs to jurisdictions. For example, Bridgeport and Manchester waive permit fees for class I renewable energy systems, and Durham has a flat fee for solar PV permits.
- **Allow for Payment Electronically or by Mail:** Allow installers to pay permit fees online, electronically, or by regular mail to save driving time and cost.

---

[216] www.energizect.com/SunriseNE and more generally, www.energizect.com

[217] Cornwall: cornwallctenergy.org; Coventry: www.coventryct.org/index.aspx?NID=175;
Greenwich: www.greenwichct.org/Government/Commissions/Conservation_Commission/Cean_Energy_Community;
Hampton: www.hamptonct.org/committee.htm?id=fhsb77u5;
Middletown: www.cityofmiddletown.com/content/81/750/1840/default.aspx;
West Hartford: west-hartford.com/government/CleanEnergy.htm and
www.westhartford.org/living_here/green/west_hartford_clean_energy_task_force.php

[218] energizect.com/SunriseNE

[219] http://www.cga.ct.gov/2012/sup/chap541.htm#Sec29-263.htm, "(c) Any municipality may, by ordinance adopted by its legislative body, exempt Class I renewable energy source projects from payment of building permit fees imposed by the municipality."

Streamline Review and Inspection Requirements

- **Train Staff:** Require jurisdiction staff involved in solar PV permitting to participate in relevant solar PV training, at minimum by accessing a free online training course comparable to the "Photovoltaic Online Training for Code Officials" offered on the National Training & Education Resource (NTER) website.[220]
- **Remove Excessive Reviews**: Jurisdiction staff should identify and remove reviews that are not critical to safe and efficient operation of a proposed rooftop solar PV system. In particular, unnecessary and costly engineering reviews should be eliminated by specifying criteria and a methodology for determining when these reviews are needed.
- **Simplify the Inspection Process:** The CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹ offers resources and suggestions for improving inspection processes, though West Hartford already practices one of our recommendations by providing a single instead of multiple inspections. An example of an improvement that can be made is to schedule a specific appointment time rather than a window of time for the inspection.
- **Shorten Permit Approval Times:** By Connecticut law, a permitting decision must be made within 30 days.[221] However, a shorter timeframe encourages installers to do business in your jurisdiction and speeds up the time between a customer's intent to generate clean energy and their ability to do so. Consider the best practice of issuing permits in as short a time frame as possible, for example on the "same day" or "over-the-counter" for standard small-scale rooftop solar PV systems that clearly meet your jurisdiction's permit approval criteria.

Formalize Best Practices

- **Adopt Solar Friendly Ordinances** using the model elements offered in "Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions" found in the CONNECTICUT ROOFTOP SOLAR PV PERMITTING GUIDE ✹. Adopting the elements of the Rooftop Solar PV Model Ordinance for Connecticut Jurisdictions removes unnecessary barriers to solar energy installation and formalizes your jurisdiction's commitment to making rooftop solar PV permitting easier and less costly for everyone.

West Hartford Tulips, from the **West Hartford and Clean Energy** site west-hartford.com/government/CleanEnergy.htm

[220] Photovoltaic Online Training For Code Officials: www.nterlearning.org/web/guest/course-details?cid=402

[221] http://www.ct.gov/dcs/cwp/view.asp?a=4218&q=305412. The 30 day permit decision time is from the State Building Code, namely the 2005 Connecticut Supplement which includes the 2009 Amendment (effective August 1, 2009) to the 2005 State Building Code. The language of the code amendment also encourages building officials to issue a permit as soon as practicable once the official is satisfied that the proposed work meets all requirements.

Appendix II
Municipal Permitting Survey[222]

Sun Rise New England – Open for Business Municipal Survey Data

1. Please provide the following:

Name of Municipality/Jurisdiction	Person(s) Completing the Survey	Contact Information for Person(s) Completing Survey	Date Survey Completed
Bridgeport	Ted Grabarz	Ted.grabarz@bridgeportct.gov (203) 576-8439	December 20, 2012
Cornwall	Paul Prindle	(860) 672-0711	July 3, 2012
Coventry	Joseph Callahan	jcallahan@coventryct.org	July 11, 2012
Danbury	Sean Hearty	(203) 797-4526	July 17, 2012
Fairfield	James Gilleran	(203) 256-3036	August 16, 2012
Greenwich	William Marr	(203) 622-7754	January 18, 2013
Hampton	Leslie Davis	860-455-9132	December 26, 2012
Manchester	Jim Roy	(860) 647-3110	July 20, 2012
Middletown	John Parker, Dean Lisitano, Robert Dobmeier, Ron Klattenberg	Bob.Dobmeier@MiddletownCT.Gov	August 3, 2012
Milford	Jocelyn Mathiasen	(203) 783-3374	August 20, 2012
Stamford	Rob Demarco	rdemarco@ci.stamford.ct.us	July 17, 2012
West Hartford	Tim Mikloiche, Mary Ann Basile	(860) 561-7536	July 10, 2012

[222] Survey data have been minimally edited for grammar and spelling.

2. Who are the primary contacts involved in processing permits and inspecting completed systems? Please list important contact persons, their titles, roles and contact information. (Indicate applicability to residential and/or commercial installation)

BGPT	Peter Paajanen (Building Official) (203) 576-7225
CORN	Roof mount - Paul Prindle (Building), Karen Nelson (Zoning) Ground Mounts - Building & Health district
COVE	Joseph Callahan (Building Official) (860) 742-4064 jcallahan@coventryct.org / permit review, approval and inspection. Brigit Tanganelli (Permit Tech) (860) 742-4064 btanganelli@coventryct.org / process application and information. schedules inspections
DANB	Sean Hearty (203) 256-3036
FAIRF	James Gilleran (Director of Building Department)
GRNCH	William Marr (Building Official), John Vallerie (Deputy Building Official) Building Inspection Division, DPW - Inspection and clerical staff (203) 622-7755
HAMP	John Berard (Building Official), Lesley Davis (Clerk) (860) 455-9132 building@hamptonct.org
MANC	Greg Smith
MLFD	Christine Angelica (Clerk - Building Inspection) (203) 783-3235, Tom Raucci (Chief Building Inspector) (203) 783-3235, Jocelyn Mathiasen (Director, Permitting and Land Use) (203) 783-3374
MTWN	Dean Lisitano (Electrical Inspector) - dean.lisitano@MiddletownCT.gov, John Parker (Head of Building Office) - john.parker@MiddletownCT.gov, Robert Dobmeier (Deputy Head of Building Office) - bob.dobmeier@cityofmiddletown.com
STAM	Rob Demarco (Chief Building Inspector), Dwight Carlson (Permits), Robert Bounder
W HRT	Tim Mikloiche (Senior Building Inspector & Electrical Inspector), Mary Ann Basile (Supervisor of Inspections)

3. To how many departments does an installer have to submit separate applications? (Choose "1" if one office coordinates for multiple departments. Do not count the interconnection application with a utility.) R=RESIDENTIAL and C=COMMERCIAL.

	1	2	≥ 3
BGPT			R/C
CORN		R/C	
COVE	R/C		
DANB	R		C
FAIRF		R/C	
GRNCH		R/C	
HAMP		R/C	
MANC	R	C	
MLFD	R	C	
MTWN	R/C		
STAM		R	C
W HRT	R	C	

3a. Which departments require separate application?

	Building	Electrical	Fire	Planning	Plumbing	Structural	Zoning	Other, Specify
BGPT	R/C	C					R/C	R/C Engineering Department
CORN	R/C	R/C						
COVE	R/C							
DANB	R/C	R/C						
FAIRF	R/C	R/C	C		R/C		R/C	
GRNCH	R/C						R/C	
HAMP	R/C							R/C Tax Collector
MANC	R/C	R/C	C					Building only required when Structural changes necessary
MLFD	R/C	R/C						
MTWN		R/C						
STAM	R/C	R/C	R/C	R/C	R/C	R/C	R/C	WPCA and Tax collector. Stamford does not issue permits unless homeowner can prove they paid these
W HRT	R/C	R/C						Only Electrical if no Roof improvements needed

3b. Which additional documentation is required?

Document	BGPT	CORN	COVE	DANB	FAIRF	GRNCH	HAMP	MANC	MTWN	MLFD	STAM	W HRT
Insurance Certificate	R/C	R/C	R/C				R/C	R/C				Building Only
Affidavit of Worker's Compensation	R/C	R/C	R/C	R/C	R/C	R/C	R/C	R/C			R/C	Building Only
Copy Of License	R/C	R/C	R/C	R/C	R/C	R/C	R/C	R/C				
Line Drawing	R/C	R/C	R/C	R/C	R/C			R/C	R/C		R/C	R/C
Roof Description	R/C	R/C	R/C	R/C	C		R/C	R/C				R/C
List of System Components	R/C	R/C	R/C	R/C				R/C				R/C
Engineer/Architect Approved Plans	R/C	R/C	C	C	R/C			C	R/C	R/C	R/C	Roof analysis (not 'official')
Building Plans			R/C	R/C	R/C			R/C				R/C
Signed Application Fee	R/C		R/C		R/C		R/C	R/C	R/C	R/C		
Application Sign-off Sheet	R/C				R/C	R/C					R/C	
Consent form from homeowner	R/C	R/C	R/C		R/C		R/C	Only if condo assoc.	R/C	R/C	R/C	
Other			Letter from electrician if electrician not signing	Mounting Detail			Tax Clearance R/C					

4. Through which departments or what types of approvals are required for a typical installation? (Check all that apply even if coordinated through one office/department.)

	Building	Electrical	Fire	Planning	Plumbing	Structural	Zoning	Other
BGPT	R/C	R/C	R/C	R/C	R/C	R/C	R/C	(see note)
CORN	R/C						R/C	
COVE	R/C	R/C	C			R		
DANB	R/C	R/C					R/C	
FAIRF	R/C	R/C			R/C			
GRNCH	R/C	R/C		C	R/C	R/C	R/C	
HAMP	R/C							R/C
MANC	R/C		C				R/C	
MLFD	R/C		C					
MTWN	R/C							
STAM	R/C	R/C	C	C		R/C	C	R/C
W HRT	R/C	R/C	C		R/C	R/C	R/C	R/C

4a. What is the total number of departments that require approval?

	1	2	3	4	5	6	7
BGPT							R/C
CORN		R/C					
COVE	R/C						
DANB			R/C				
FAIRF			R/C				
GRNCH					R	C	
HAMP		R/C					
MANC		R	C				
MLFD	R	C					
MTWN	R/C						
STAM				R			C
W HRT		R/C					

5. You selected Other. Please specify which departments permits are processed through.

BGPT	Engineering
HAMP	Tax Department
STAM	Tax Department
W HRT	Historical if designated as such by town or state

6. Describe the permitting process, listing departments and types of approvals as they are involved. Provide links to relevant websites which supplement this information. (Indicate whether requirements pertain to residential and/or commercial installations)

BGPT	For both residential and commercial permits, you will need two sets of documents, completed permit application, certificate of worker's compensation for contractors, and state licenses. For residential building permits (one and two family), the order of necessary approvals is: zoning, engineering and building departments. For commercial building permits, the order of necessary approvals is: zoning, engineering, fire and building. If the work requires only an electrical permit, then the order of necessary approvals is: zoning and building.
CORN	1st step - roof mount - goes to zoning first. If there are any original non-conformance, zoning approval first, then goes to buildings. Only two steps. 99% of installations are residential. Ground mount systems must also be approved by the Health Department. Professional Engineers are only required for specific installations - it depends on the age of the building, what records exist for the building, etc.
COVE	Submitted application reviewed for code compliance. Building permit for structural, electrical for PV components for both residential and commercial projects, ground mounted systems would require zoning, wetlands and Health Department review.
DANB	Danbury has one central "Permit Center" location. Working at the office are 3 customer reps and one manager. The initial PV application is sent to zoning for initial approval. After zoning has approved, the application and plan are sent to the electrical and building inspectors. Eligible installers are able to submit their applications online after having first signed up (involved depositing an escrow with the permitting office, which in turns gives the eligible contractors a CD that they can then use to submit the application online. Solar installers, due to their low quantity of work, do not use this online application system.
FAIRF	Applicant must submit electrical permit and in most situations, a building permit (could potentially be avoided if the house is new or has up to date roof construction). Applicant must also receive P&Z approval, which in most cases can be done very quickly - with a quick approval across the hall. If the applicant is in one of Fairfield's historical districts, they must also receive approval from the chairman of that board. Professional engineer-approved structural design diagrams are generally required (Fairfield's proximity to the ocean creates potentially dangerous wind uplift situations). Commercial installations required fire marshal approval.
GRNCH	A sign-off sheet is given to the applicant who is required to have other Town agencies review and sign the plans and sheet prior to our Dept. accepting the application. Typical agency sign-offs are, Health Dept., IWWA, Highway and Sewer Depts., DPW, Fire Marshal, Zoning, Tax Collector.
HAMP	Both the Building Department and Tax Collector require separate application for a rooftop solar PV system for both residential and commercial
MANC	Residential - Building/Zoning Dept. - Buildingdept@manchesterct.gov Commercial - Building/Zoning Dept./Fire Marshal Fire Marshal - Ltalbot@manchesterct.gov
MLFD	Department of Permitting and Land Use, Fire Department http://www.ci.milford.ct.us/Public_Documents/MilfordCT_Building/BuildingIndex
MTWN	For rooftop PV installations, there is one application for both building & commercial. If it's a historical building, then the P/Z dept. must also approve. Applications can be filled out online, but the contractor/owner must physically come into the office in order to submit payment the necessary signatures. A one-line electrical diagram and a structural diagram are also required.
STAM	Start with building department for application, which is checked by staff who will then direct applicant to where they need to go for signatures, permits and approvals. Most departments are within the Stamford Government Center building. The exception is areas with volunteer fire departments (Longridge and Turner River). Applicants would have to go to those departments directly. Usually the flow order is Tax department->Environmental Protection->zoning and then back to building
W HRT	westhartford.org. Town website-> Community Services-> Building Department Building and zoning applications-see drop down menus for forms.

7. What approvals from Professional Engineers are required as part of the permit package for a typical installation? (Check all that apply.)

	Civil	Electrical	Environmental	Fire Protection	Mechanical	Structural	Notes
BGPT		R/C			R/C	R/C	
CORN						R/C	Only needed on some occasions
COVE						C	
DANB		R/C				R/C	
FAIRF						R/C	
GRNCH		R/C				R/C	
HAMP						R/C	Only needed on some occasions
MANC		C				C	
MLFD					R/C	R/C	
MTWN		C				R/C	
STAM		R/C				R/C	
W HRT						R/C	

8. [N/A (no one chose "other"]

9. In addition to state licensing requirements, does your city/town require any additional licensing for contractors working on a solar PV installation? (Indicate applicability to residential and/or commercial installations.)

BGPT	No
CORN	Installer has to be licensed - either PV1 (can install, but requires an electrician) or PV2 (can install, but can't get permit). Electricians require an E1. (Note from Joe - this seems to be the standard procedure for all of CT.)
COVE	No
DANB	No
FAIRF	No
GRNCH	No
HAMP	No
MANC	No
MLFD	No
MTWN	No
STAM	Yes - installers must be registered and licensed with Consumer Protection for the state of CT. In structural cases (commercial) - major construction contractor's license and registration is also needed. For residential, Home Improvement Registration for contractor for single family home (up to 6 units).
W HRT	No

10. What do you estimate to be the average time it takes for an installer/customer to complete a permit application? (This refers to the original application submission) Provide answer in terms of hours (e.g., 5 business days should be entered as 40 hours.)

	R	C
BGPT	.25	.25
CORN	1	1
COVE	1-2	2-4
DANB	.5	.5
FAIRF	.25	.25
GRNCH	40	80
HAMP	<4	<4
MANC	0.5	0.5
MLFD	20	20
MTWN	< 24	< 24
STAM	2	3
W HRT	2	5

11. What do you estimate to be the average time it takes for an installer/customer to provide revisions to or additional information requested to complete a permit application? Provide answer in terms of hours (e.g., 5 business days should be entered as 40 hours.)

	R	C
BGPT	16	16
CORN	0	0
COVE	0.5	0.5
DANB	40	40
FAIRF	.25	.25
GRNCH	16	32
HAMP	<4	<4
MANC	24	24
MLFD	40	40
MTWN	16	16
STAM	10	15
W HRT	20	40

12. What are the options for obtaining an application? (Check all that apply.)

	Online	Email	In person	Mail
BGPT			R/C	
CORN	R/C		R/C	
COVE	R/C		R/C	R/C
DANB	R/C	C	R/C	
FAIRF	R/C			R/C
GRNCH	R/C		R/C	R/C
HAMP	R/C		R/C	
MANC	R/C		R/C	R/C
MLFD	R/C	R/C	R/C	R/C
MTWN	R/C		R/C	
STAM	R/C		R/C	
W HRT	R/C		R/C	

13. What are the options for submitting an application? (Check all that apply.)

	Online	Email	In person	Mail
BGPT			R/C	
CORN			R/C	R/C
COVE	R/C		R/C	R/C
DANB	R/C		R/C	C
FAIRF			R/C	
GRNCH			R/C	
HAMP			R/C	R/C
MANC	R/C		R/C	R/C
MLFD	R/C	R/C	R/C	R/C
MTWN			R/C	
STAM			R/C	
W HRT			R/C	Has City Permit – capable of online submission, but are not fully utilizing

14. What forms, design documents or other paperwork are required for applicable permit approval? (Indicate applicability to residential and/or commercial installations)

BGPT	For both residential and commercial permits, you will need two sets of documents, completed permit application, certificate of worker's compensation for contractors, and state licenses.
CORN	Insurance certificates, affidavit of workman's comp (this depends on whether an established contractor is doing the work). If it's a new contractor, a copy of the license is required. PV systems require a line drawing, descriptions of the roof type, and listing of the system components.
COVE	Copy of valid license or registration for all contractors. Certificate of workers compensation for all contractors with employees
DANB	In addition the application, engineer/architecture-approved plans are required. This used to no be the case, but Danbury found that some plans were not submitting the correct structural info for roofs.
FAIRF	Workman's comp, state license, 3 copies of building plans
GRNCH	Permit application form Workman's Compensation Affidavit Permit sign-off sheet Copy of State license Forms associated with Town Drainage Manual Above for both Residential and Commercial
HAMP	For both residential and commercial: insurance certificate, affidavit of worker's compensation, copy of license, roof description, signed application fee, consent form from homeowner, and tax clearance
MANC	The more information the faster plan review for both residential and commercial.
MLFD	Require stamped, engineered drawings showing that solar installations are installed in a way that can sustain 110 mph winds.
MTWN	Signed application fee, consent form signed by homeowner giving installer permission to apply on their behalf. Engineer-approved plans are only required for particularly large installations.
STAM	Two sets of drawings, with a professional engineer approved design. Completed application (sign-off sheet, through different departments), application for electrical permit, owner's form (for owner of property), and worker's compensation form.
W HRT	See attached documents. Additionally, you can submit mail for electrical permits, but for Building you must submit in person.

15. Do you have an online permitting system in place already?

	No	Yes
BGPT	R/C	
CORN	R/C	
COVE		R/C
DANB		R/C
FAIRF	R/C	
GRNCH	R/C	
HAMP	R/C	
MANC		R/C
MLFD		R/C
MTWN		R/C
STAM	R/C	
W HRT	R/C	

16. You selected Yes. What is the name of the software?

COVE	View Permit Automated Permit Management
DANB	HTE Permitting System (computer management system) - a secondary platform is used to allow eligible contractors to submit applications online via email.
MANC	View Permit
MTWN	PWPermit (developed in-house)
MLFD	View Permit

17. Can you accept permit application data electronically, particularly in a format that may expedite the process? If so, please specify the types of files and data formats you are able to accept (email, spreadsheet, PDF, CSV, etc.) (Indicate applicability to residential and/or commercial installations.) What types of files are you able to accept?

BGPT	No
CORN	N/A
COVE	All – also accept e-mail. Issues with PayPal online payment methods but do allow mail in check
DANB	Pdf, email, spreadsheet
FAIRF	No
GRNCH	No
HAMP	No
MANC	View Permit, PDF, email
MLFD	Applicants can attach files in all formats. However, engineered documents require a wet stamp/seal under Connecticut State Law. There is no electronic stamp format accepted in Connecticut (there is in other states), therefore we need the original stamp and seal on the documents. We can conduct the review on electronically submitted documents but to issue the permit we need a wet stamp.
MTWN	Yes – still must come to office
STAM	No
W HRT	No

18. Specify the best persons to contact (and their contact information) for further questions about electronic submission capabilities.

BGPT	N/A
CORN	N/A
COVE	Brigit Tanganelli (860)742-4064 btanganelli@coventryct.org
DANB	Sean Hearty
FAIRF	N/A
GRNCH	IT Dept. (203) 622-6448
HAMP	John Berard & Lesley Davis
MANC	Debbie Bowen (860) 647-3184
MLFD	Jocelyn Mathiasen (203) 783-3374
MTWN	John Parker & Dean Lisitano
STAM	No contact
W HRT	Mary Ann Basile

19. How is information describing the permitting process accessible? (Check all that apply.)

	Online and easily accessible	Online	Email	In person	Mail	Phone
BGPT	R/C	R/C	R/C	R/C		R/C
CORN		R/C		R/C		R/C
COVE	R/C	R/C	R/C	R/C	R/C	R/C
DANB	R/C			R/C		R/C
FAIRF				R/C		R/C
GRNCH	R/C		R/C	R/C	R/C	R/C
HAMP		R/C		R/C	R/C	
MANC		R/C	R/C	R/C	R/C	
MLFD	R/C	R/C	R/C	R/C	R/C	R/C
MTWN	R/C					
STAM		R/C		R/C		R/C
W HRT		R/C		R/C		

20. Is there an accessible designated point of contact (POC), with contact information available online, for questions about the PV permitting process?

	No designated POC	Yes, there is POC but contact info not online	Yes, POC info is online
BGPT			R/C
CORN	R/C		
COVE			R/C
DANB	R/C		
FAIRF			R/C
GRNCH	R/C		
HAMP			R/C
MANC	R/C		
MLFD			R/C
MTWN	R/C		
STAM		R/C	
W HRT	R/C		

21. Is there a policy to issue/deny PV permits within a specified number of business days from submission of application?

	No	Yes, ≤ 3 days	4-10 days	> 10 days	30 days	Notes
BGPT					R/C	
CORN					R/C	
COVE					R/C	Usually 1-2 weeks
DANB					R/C	
FAIRF					R/C	
GRNCH					R/C	
HAMP					R/C	
MANC					R/C	
MLFD					R/C	
MTWN					R/C	
STAM					R/C	
W HRT					R/C	

22. Specify the applicability of the time limit. Does the time limit apply to full process resulting in permit issuance/denial, or just response time to original application which may include notice about revisions or additional information required? (Indicate applicability to residential and/or commercial installations.)

FAIRF	Standard state guidelines - must approve within 30 days
MANC	Action on application is 30 days to either approve or deny CT State Building Code Section 105.3.1.
STAM	State building code, 30 day requirement to issue/deny permits
W HRT	State building code requires permits be issued or denied within 30 days. The time limit applies to the response time to the original application.

23. If there is a time limit, is there an opportunity to shorten the existing time limit, and why or why not? If there is no time limit, would it be feasible to set a time limit, and why or why not? (Indicate applicability to residential and/or commercial installations.)

MANC	Typically permits are approved in 1 to 2 weeks.
STAM	Stamford doesn't have its own time limit outside of the state's guidelines.
W HRT	If all required info available, including structural, will expedite.

24. What are the biggest factors impacting permit processing time? (Indicate applicability to residential and/or commercial installations.)

BGPT	Tax collection searches, historical district
CORN	There is no policy, but verbal approvals are done almost instantaneously. They are required to make a decision within 30 days (unclear if there's ever a delay anywhere near that long). If the contractors are difficult and don't submit full paperwork, etc., then the process can take longer. Quality of the application is the single most important determinant. The office is usually never too busy to take and process permits.
COVE	Incomplete applications (has not been a problem with solar); building department workload
DANB	Quality of the original plan. If drawings are complete, the building inspector can give a verbal approval within 10 minutes or so.
FAIRF	Application fullness
GRNCH	Incomplete applications - both
HAMP	Hours of building department & incompleteness of forms
MANC	Lack of information
MLFD	1) Overall volume of work in the office / 2) Available staffing / 3) Quality of materials submitted to us
MTWN	Nothing really. Clerical staff usually processes permits quickly.
STAM	Depends on departments permits are processing through. Zoning or Environment have tendency to be slower. If construction documents are in order, then things move quickly. Issues with design can slow things down.
W HRT	Lack of structural approvals

25. What are the biggest factors impacting the decision to issue/deny permits? (Indicate applicability to residential and/or commercial installations.)

BGPT	Compliance with code
CORN	Permits are never denied, but are sometimes received as incomplete and require additional follow-up.
COVE	Incomplete applications – has not been a problem with solar
DANB	Quality of the original plan. Revisions are asked for fairly often.
FAIRF	Full application
GRNCH	Permits are not denied by building department but are sometimes delayed due to lack of information or code violations that need to be corrected on plans. Zoning is the agency that usually denies applications.
HAMP	Hours of building department & incompleteness of forms
MANC	Amount of detailed information or lack of information
MLFD	Materials must show code compliance. #1 issue on solar is fastening details and 110 mph wind rating.
MTWN	Only reason permit may be denied is if the application is missing some major information.
STAM	Completeness of application and appropriate construction documents.
W HRT	Structural approvals missing

26. Does the jurisdiction track the number of days each permit takes to process?

	No	Yes
BGPT	R/C	
CORN	R/C	
COVE		R/C
DANB		R/C
FAIRF		R/C
GRNCH		R/C
HAMP	R/C	
MANC		R/C
MLFD		R/C
MTWN		R/C
STAM	R/C	
W HRT		R/C

27. What data pertaining to the permit application, if any, is recorded? Is the information recorded on paper or saved electronically? (Indicate applicability to residential and/or commercial installations.)

BGPT	Construction documents and item list on paper, then indexed in database
CORN	A hard copy of each permit is kept on file. An additional hard copy is sent to the tax assessor.
COVE	All data is entered electronically into ViewPermit and saved indefinitely. Any paper records are kept for at least two years for residential and indefinitely for commercial.
DANB	All applications and plans are stored electronically using their HTE system. However, there is not an easy way to analyze the data (each permit would have to be manually identified as being a solar PV installation. 8
FAIRF	All application info electronically input into Mitchell Humphrey management system
GRNCH	Application date/ issue date, CO date recorded electronically date for both
HAMP	Create spreadsheet of permit data
MANC	All data, both residential and commercial, is recorded on paper.
MLFD	Our software indicates date of submission, date of initial review completion, date of resubmission, date of issuance, etc. This isn't the software, but currently it is very difficult to run results that aggregate this information. We are working on this.
MTWN	Clerical staff time-stamps the application when it comes in. Permit is open for 180 days (6 months).
STAM	Is tracked by date manually when the application is submitted (dated envelopes)
W HRT	Since 2008, all stored in electronic file.

28. What is the average number of business days between application submission and decision (issuance or denial) regarding permits? Provide answer in terms of hours (e.g., 5 business days should be entered as 40 hours).

	Residential	Commercial
BGPT	24	24
CORN	8	8
COVE	40	40
DANB	16-32	16-32
FAIRF	24	24
GRNCH	40	80
HAMP	40	40
MANC	40	75
MLFD	Building (80-120), Electrical (24)	Building (80-120), Electrical (24)
MTWN	<24	<24
STAM	80	80
W HRT	80	80

29. If the permit application is incomplete upon original submission, what is the average number of business days between application submission and response to applicant including notice about need for revisions or additional information? Provide answer in terms of hours (e.g., 5 business days should be entered as 40 hours).

	Residential	Commercial
BGPT	16	16
CORN	0.5	0.5
COVE	24	24
DANB	8	8
FAIRF	<24	<24
GRNCH	16	32
HAMP	0	0
MANC	15-40	30-40
MLFD	80-120	80-120
MTWN	< 24	< 24
STAM	20	20
W HRT	80	80

29a. How many hours does it take to review an application (hours)?

	Residential	Commercial
BGPT	0.5	0.5
CORN	1	1
COVE	1	2
DANB	1-1.5	1-1.5
FAIRF	1	3
GRNCH	0.5	0.5
HAMP	0.5	0.5
MANC	1	2
MLFD	1	1
MTWN	0.5	1-3
STAM	0.5	1
W HRT	0.5	2

29b. How much time does an inspection take? Include all inspections – electric, structural, fire, mechanical etc. (Hours.)

	Residential	Commercial
BGPT	0.5	0.5
CORN	0.5	0.5
COVE	0.5	0.5
DANB	0.5	0.5
FAIRF	0.5	1
GRNCH	0.5	0.5
HAMP	0.5	0.5
MANC	0.75	2
MLFD	1	1
MTWN	0.5	1
STAM	0.5-1	1
W HRT	1	2

30. Are there mechanisms in place for accelerating PV permitting processes under certain conditions (e.g., expedited process for standard residential systems meeting certain criteria, option to pay for expedited issuance, or expediting for experienced installers with a track record of code compliance)?

	No	Yes
BGPT	R/C	
CORN	R/C	
COVE	R/C	
DANB	R/C	
FAIRF	R/C	
GRNCH	R/C	
HAMP	R/C	
MANC		R/C
MLFD	R/C	
MTWN	R/C	
STAM	R/C	
W HRT	R/C	

31. You indicate there are options for accelerating the PV permitting process. Please specify.

MANC	A $79.00 additional fee for immediate review.

32. How is information on permit fees made available? (Check all that apply.)

	Online	Email	In person	Mail	Phone	Not Available
BGPT	R/C	R/C	R/C		R/C	
CORN	R/C		R/C		R/C	
COVE	R/C	R/C	R/C	R/C	R/C	
DANB	R/C		R/C		R/C	
FAIRF			R/C		R/C	
GRNCH	R/C		R/C			
HAMP		R/C	R/C	R/C	R/C	
MANC	R/C		R/C		R/C	
MLFD	R/C	R/C	R/C	R/C	R/C	
MTWN	R/C		R/C			
STAM	R/C				R/C	
W HRT	R/C		R/C			

33. What is the average total amount charged for the applicable permit fee(s) for typical residential installations?

	≤ $250	$251-$500	> $500
BGPT	R (as of 12/2012)		
CORN		R	
COVE		R	
DANB		R	
FAIRF	R		
GRNCH			R
HAMP		R	
MANC		R	
MLFD	R		
MTWN			R
STAM			R
W HRT		R	

34. Specify an exact amount in dollars and specify the contributing components of this fee.

BGPT	As of Dec 2012, ~$50. The cost of the class-1 renewable system is not included in the permit fee calculation [NO FEE for residential rooftop PV as of Dec. 10, 2012]
CORN	$25 for first $1,000 (minimum), then $7 for each $1000 or part there-of
COVE	Varies based on construction value at $15.00 per $1000.
DANB	$22 for first $1,000, then $11 for each additional $1,000; no ceiling
FAIRF	$50.26 for 1st $1k, then $12.26 for every additional $1k, then $6 for every $k over $10M
GRNCH	$13.26 per $1,000 Res
HAMP	$10 per $1,000
MANC	$20 first $1,000 and $15 per each additional $1,000 (SINCE ZEROED FOR CLASS 1)
MLFD	$15 for the first $1,000 in value; $12 for each subsequent. $0.26/$1,000 goes to the state
MTWN	$15.26 for first $1,000 then $14.26 for each additional $1,000
STAM	$12 per 1,000
W HRT	$32.26 for first $1,000 and $17.26 for each additional $1,000

35. What is the average total amount charged for the applicable permit fee(s) for typical commercial installations?

	≤ $1000	$1001-$2000	> $2000
BGPT	C		
CORN	C		
COVE		C	
DANB	C		
FAIRF	C		
GRNCH	C		
HAMP	C		
MANC		C	
MLFD	C		
MTWN	C		
STAM			C
W HRT		C	

36. Specify an exact amount in dollars and specify the contributing components of this fee.

BGPT	A bit higher than residential at ~$150
CORN	$25 for first $1,000 (minimum), then $7 for each $1000 or part there-of
COVE	Varies based on construction value at $15.00 per $1000
DANB	$18 for each $1,000, no ceiling
FAIRF	$50.26 for 1st $1k, then $12.26 for every additional $1k, then $6 for every $k over $10M
GRNCH	$15.26 per $1,000 Commercial
HAMP	$10 per $1,000
MANC	$20 first $1,000 and $15 per each additional $1,000
MLFD	$15 for the first $1,000 in value; $12 for each subsequent. $0.26/$1,000 goes to the state
MTWN	Same as residential
STAM	$16 per 1000
W HRT	$32.26 for first $1,000 and $17.26 for each additional $1,000

37. Is/are the permit fee(s) structured as flat, cost recovery, valuation open ended, valuation capped, valuation with exclusions, or other structure?

	Flat	Cost Recovery	Valuation Open Ended	Valuation Capped	Valuation with Exclusions	Other
BGPT		R/C				
CORN			R/C			
COVE			R/C			
DANB			R/C			
FAIRF			R/C			
GRNCH			R/C			
HAMP			R/C			
MANC		R/C				
MLFD			R/C			
MTWN			R/C			
STAM			R/C			
W HRT			R/C			R/C

38. You selected Other. Specify what type of permit fee structure you use.

W HRT	Commercial requires fire marshal plan review fee

39. Please elaborate on how this fee is calculated, providing an example(s). (Indicate applicability to residential and/or commercial installations.)

BGPT	Based on value of the work. If it is a building permit then a certificate of occupancy will be required and thus the fee
CORN	Fee is based on "true" value of construction. Occasionally an affidavit of value is required
COVE	Permit fees based on construction value – materials and labor $15 per $1000 for both residential and commercial
DANB	Residential: $22 for first $1,000, then $11 for each additional $1,000; no ceiling Commercial: $18 for each $1,000, no ceiling
FAIRF	1st $1,000 is $50 + $0.26 rounded up = $51 and $12 + $0.26 for every thousand after rounded up to the nearest $
GRNCH	$15.26 per $1,000 of valuation for Commercial. $13.26 per $1,000 of valuation for Residential
HAMP	Valuation - $10 per $1,000 of value
MANC	Fee schedule
MLFD	$15 for the first $1000 in value; $12 for each subsequent. .26/$1000 goes to the state. For zoning approvals there is a flat $85 fee of which $60 goes to the state
MTWN	$15.26 for 1st thousand; $14.26 for every thousand thereafter; same for residential & commercial
STAM	$12 per 1000, residential, $16 per 1000 commercial. Certificate of approval $25 (residential), $75 (commercial)
W HRT	$32.26 for first $1,000 and $17.26 for each additional $1,000

40. Are there any conditions for which there is an exemption or discount on the permit fee? If Yes, what are the conditions and how much? (Indicate applicability to residential and/or commercial installations.)

BGPT	The only fee exemption is for city projects done by city employees [NO FEE for residential rooftop PV as of Dec. 10, 2012]
CORN	Not really, but the selectman can waive the fee for certain projects (e.g. - school projects). Paul mentioned "only the rich can afford PV"
COVE	Town property is exempt but State Education Fee is still required. State Education Fee is 0.26 per $1000
DANB	City projects and cultural projects (cultural non-profits)
FAIRF	Town projects
GRNCH	No
HAMP	Town Buildings
MANC	Town projects 0.26 per 1,000
MLFD	Municipal projects are exempt but by statute the state fees must always be paid
MTWN	City projects (must still pay state fee)
STAM	If solar system can be installed without building permit and only needs mechanical, electrical and/or Plumbing (MEP), then there is no fee
W HRT	Only town-owned properties

41. Are there any situations in which a fine may be issued for non-compliance, and if so what are the conditions and fines? (Indicate applicability to residential and/or commercial installations.)

BGPT	R: Double fee for work being done without permit. The City adheres to the State of Connecticut penalties
CORN	$200 additional charge/fine if construction begins before permit is accepted. Fine rarely occurs and never has for PV work
COVE	Work done without a permit will add $100 to the permit fee. There is also a $25 re-inspection fee for failure to cancel inspection if work is not ready for scheduled inspection
DANB	No, but a stop work order can be issued and a contractor can be required to tear out all prior changes made to a structure and re-start after the permit is granted
FAIRF	$700-$1,000 fine for work started w/ out permit
GRNCH	$200 investigation fee for work started w/o a permit - both
HAMP	No
MANC	Double fee for work started without a permit
MLFD	Technically, we can issue a fine for violation of the state building code but I cannot recall any time when this has been done. We do not issue zoning fines
MTWN	No fines. Not much in terms of non-compliance because CL&P needs Dean Lisitano's approval before system can be powered on
STAM	Only time would charge during inspection process is if they call an unneeded inspection or if they did not correct errors that were identified before final inspection. In both cases, the fine is $50.00
W HRT	Work without a permit- fine is 2 times permit fee with maximum of $100 fine

42. To what degree do you use the Solar ABCs expedited permitting process template for typical residential installations? (Please see Survey Instructions.)

	Default Template	Optional Template	Have Reviewed and Considered	Unaware/ Reject
BGPT			X	
CORN				X
COVE			X	
DANB				X
FAIRF				X
GRNCH				X
HAMP				X
MANC				X
MLFD				X
MTWN				X
STAM				X
W HRT				X

43. Comment about use of Solar ABCs expedited permitting process template (Indicate applicability to residential and/or commercial installations.)

COVE	Statewide acceptance of this template process would certainly help expedite the approval process.

44. What is the average number of business days from inspection request to actual inspection? Provide exact answer in terms of hours (e.g., 5 business days should be entered as 40 hours.)

	Residential	Commercial
BGPT	16-56	16-56
CORN	24 (max)	24 (max)
COVE	24-48	24-48
DANB	8	8
FAIRF	72-96	72-96
GRNCH	24	24
HAMP	40	40
MANC	24	24
MLFD	24	24
MTWN	40	40
STAM	40	40
W HRT	24	24

45. Is the installer provided with a specific appointment time for the final onsite inspection, or a window of time?

	Specific Appointment Time	Window of Time
BGPT		R/C
CORN	R/C	
COVE		R/C
DANB		R/C
FAIRF		R/C
GRNCH		R/C
HAMP	R/C	
MANC		R/C
MLFD		R/C
MTWN	R/C	
STAM		R/C
W HRT		R/C

46. Specify the window of time in terms of hours.

BGPT	0.5 hour
COVE	2 hour window
DANB	2 hour span, to occur the next business day after the inspection is requested/approved
FAIRF	1 hour (if contractor calls day of appointment, they can get a more specific time)
GRNCH	2 hours
MANC	2 Hours – can be more specific day of inspection
MLFD	2 hours
STAM	4 hours
W HRT	9-12 PM or 1-2 PM. However, if you book first AM or 1PM, then window is only 40 minutes or so.

47. How is information on inspection requirements made available? (Check all that apply.)

	Online	Email	In person	Mail	Phone	Not Available
BGPT	R/C	R/C	R/C		R/C	
CORN			R/C		R/C	
COVE	R/C	R/C	R/C	R/C	R/C	
DANB	R/C		R/C		R/C	
FAIRF		R/C	R/C	R/C	R/C	
GRNCH	R/C			R/C		
HAMP			R/C		R/C	
MANC		R/C		R/C		
MLFD						R/C
MTWN	R/C		R/C			
STAM	R/C				R/C	
W HRT	R/C		R/C	R/C		

48. How many separate inspection trips are required? (Check all that apply.)

	Single Comprehensive Inspection	Electrical Rough-in	Electrical Final	Roof Penetrations (pre-install)	Structural/ Building Final	Other
BGPT		R/C	R/C			
CORN			C	R/C		
COVE	R/C					
DANB			R/C	R/C		
FAIRF				R/C	R/C	
GRNCH		R/C	R/C		R/C	
HAMP	R/C					
MANC	R/C					
MLFD					R/C	
MTWN	R/C					
STAM		R/C	R/C	R/C		
W HRT	R	C	C		C	All in one trip

49. What is the average number of business days from inspection request to actual inspection? Provide exact answer in terms of hours (e.g., 5 business days should be entered as 40 hours)

	Residential	Commercial
BGPT	16-56	16-56
CORN	24 (max)	24 (max)
COVE	24-48	24-48
DANB	8	8
FAIRF	72-96	72-96
GRNCH	24	24
HAMP	40	40
MANC	24	24
MLFD	24	24
MTWN	40	40
STAM	40	40
W HRT	24	24

50. How many people do you employ and/or subcontract to for conducting inspections? (Enter numbers in blank spaces). (Note: An FTE amounts to 2000 hours per year, or 40 hours per week times 50 weeks per year.)

	FTE (R)	FTE (C)	# Subcontractors (R)	# Subcontractors (C)
BGPT	5	5	0	0
CORN	0	0	0	0
COVE	1	1	0	0
DANB	8	8	0	0
FAIRF	5	5	0	0
GRNCH	8	8	0	0
HAMP	1	1	0	0
MANC	5	5	0	0
MLFD	1	3	1	0
MTWN	2	2	0	0
STAM	5	5	0	0
W HRT	4	4	0	0

	Part-Time (R)	Part-Time (C)	Total # Subcontracted Hours Per Year (R)	Total # Subcontracted Hours Per Year (C)
BGPT	0	0	0	0
CORN	0	0	0	0
COVE			0	0
DANB				
FAIRF				
GRNCH	2	2		
HAMP	0	0	0	0
MANC	1	1		
MLFD				
MTWN				
STAM	1	1		
W HRT	1 (1000 hrs.)	1 (1000 hrs.)		

51. Comment on how you estimate residential versus commercial workforce.

BGPT	Same – based on first come, first serve
CORN	Same person does both
COVE	Same person conducting residential and commercial
DANB	8 total full-time inspectors, which cover both commercial and residential
FAIRF	no split
GRNCH	Don't understand the question
HAMP	Same
MANC	Same staff covers both when necessary
MLFD	We don't specialize but we do a lot of residential projects.
MTWN	Same staff cover both. Two total, but Middletown is in the process of hiring one additional FTE.
STAM	Everyone shares. No one works on exclusively residential or commercial projects
W HRT	Our inspectors are cross-trained and do both commercial and residential.

52. Do the utility and local jurisdiction coordinate regarding inspection requirements and on-site inspection times for the permit and interconnection inspections?

	No	Yes
BGPT		R/C
CORN	R/C	
COVE	R/C	
DANB	R/C	
FAIRF	R/C	
GRNCH	R/C	
HAMP	R/C	
MANC		R/C
MLFD		R/C
MTWN	R/C	
STAM		R/C
W HRT	R/C	

53. You selected Yes. Specify how the utility and local jurisdiction coordinate on inspection and interconnection.

FAIRF	Once permit approved, building office calls automated utility service to confirm.
MANC	Direct access to utility tech assigned to area.
MTWN	CL&P has an inspector website that they go on and Dean Lisitano makes his approval/denial. Calvin Hart (CL&P employee), also lives in Middletown, is the City's contact person. CL&P approval process may take the longest time.
STAM	Need release from municipality saying applicant has been approved before proceeding with scheduling

54. What are the benefits of and what are the difficulties of coordinating these inspections? (Indicate applicability to residential and/or commercial installations.)

BGPT	UI marches to own time table, not all there at one time
CORN	The installers coordinate directly with the utilities (building office has no direct role)
COVE	The building official calls CL&P to approve installation. The interconnection by the utility can take quite a bit of time. Not really anything that muni can do to speed up the process.
DANB	N/A
FAIRF	None
GRNCH	Inspections are scheduled by the permit applicant
HAMP	N/A
MANC	A quicker service connection; there are no difficulties.
MLFD	N/A
MTWN	Yes; CL&P has an inspector website that they go on and Dean Lisitano makes his approval/denial. Calvin Hart (CL&P employee), also lives in Middletown, is the City's contact person. CL&P approval process make take the longest time.
STAM	Don't usually have a problem. They coordinate scheduling in accordance with approval of permits.
W HRT	N/A

55. Is there any communication between the utility and local jurisdiction that is aimed at expediting interconnection? (Indicate applicability to residential and/or commercial installations.)

BGPT	Depending on nature, we'll coordinate appointments, but very little communication
CORN	No
COVE	No
DANB	N/A
FAIRF	N/A
GRNCH	Inspections are scheduled by the permit applicant
HAMP	N/A
MANC	Yes, both residential and commercial
MLFD	N/A
MTWN	No
STAM	No
W HRT	Once inspection is completed and approved, inspectors send in OK via e-mail to utility

56. How long did it take you to complete this survey? Incorporate time spent gathering data and information into your figure.

BGPT	2.25 hours
CORN	1.5 hrs.
DANB	1 hour
GRNCH	Too Long
MANC	3.5 hours
STAM	45 minutes
W HRT	2.75 hours including research

Appendix III
Installer Permitting Survey

Installer Survey Report

The CEFIA Sun Rise New England team distributed a survey to 14 solar PV installers working in the State of Connecticut. The questions below contain feedback given by installers on the current state of the permitting and inspection process for rooftop solar in Connecticut. Text answers have been edited for grammar and spelling.

Bridgeport replaced New Haven as a project participant due to timing constraints in part resulting from relocation of New Haven's original project contact person. However, this installer permitting survey had already been conducted before Bridgeport joined the project so data for New Haven is still included here. Findings from this installer survey were largely aggregated to help identify overall opportunities for permitting improvement. The project team did provide Bridgeport with an individual municipal permitting survey, so data for Bridgeport is used in Appendix II.

1. In which of the following Connecticut towns have you installed rooftop solar PV systems? (Check all that apply.)

Town	Residential	Commercial	Responses
Cornwall	3	0	3
Coventry	3	0	3
Danbury	5	2	7
Fairfield	7	3	10
Greenwich	5	2	7
Hampton	5	2	7
Manchester	4	1	5
Middletown	7	2	9
Milford	5	1	6
New Haven[223]	7	3	9
Stamford	5	3	8
West Hartford	5	0	5

[223] Bridgeport replaced New Haven as a participating municipality but it was after this installer survey had already been conducted.

2. Compared to other towns in CT, where do these towns stand in terms of the amount of time required to secure a permit (including completing the application and receiving approval)?

Town	C/R	Significantly Slower than Average	Slower than Average	Average	Faster than Average	Significantly Faster than Average	N/A
Cornwall	Res.			1			
	Com.						
Coventry	Res.			2	1		
	Com.						
Danbury	Res.		1	1			1
	Com.			1			1
Fairfield	Res.		1	1	2	1	
	Com.		1				
Greenwich	Res.	1		1			1
	Com.			2			
Hampton	Res.			2	1		
	Com.			1	1		
Manchester	Res.						
	Com.						
Middletown	Res.	1		1	1	2	
	Com.						
Milford	Res.	1	3	1			
	Com.						
New Haven	Res.	1		2	1		
	Com.	1					
Stamford	Res.	2		1			
	Com.		1	1			
West Hartford	Res.			1			
	Com.						

3. Please comment on the time required to secure a permit. Are there reasons why this town is faster or slower to process permits? Please comment on issues such as the number of visits required to permit offices, the number of different departmental approvals required, and your travel time. Please indicate the applicability of your comments to residential and/or commercial installations.

Town Name	Text Response
Cornwall	• Permitting is quick and straightforward. Everything can be done by mail.
Coventry	• Town is typical of many smaller towns. The applicant goes to the building department, fills out an application and leaves it with the secretary along with the appropriate documents and payment. The inspector then reviews the application at a later time and the permit is mailed to the contractor.
Danbury	• Danbury requires permitting to be done in-person. Getting information for required documents is inaccurate or incomplete. Hence, multiple trips were taken before we fully understood that we were misinformed. • Permits were still required despite the project being for two Danbury schools. Two trips for each commercial installation were required.
Fairfield	• Although permits are issued on the same day, the applicant needs to go around the Town Hall to collect various signatures. In addition, there are usually long lines at the building department. • This town requires multiple visits because you have to obtain signatures from multiple departments in multiple buildings. Unlike a simple electrical permit which they will sign off on right away, solar rooftop permits require multiple departments which take time, especially since it is not guaranteed that the necessary contacts are in the office. In addition, there is only a limited time to get permits which is in the morning maybe around 8:30 to 10. • The requirement of an engineer stamp letter for load and wind lift is the biggest hassle. You do not need this letter when building a second story addition or roofing but you need it to install a solar system weighing less than a layer of shingles. On the other hand I am starting to see and be called for spotty workmanship and can see the point. • There needs to be continuity in the permit process throughout the state. Some towns such as Cheshire require two weeks of review. Some towns do not require any review • Fairfield needs no appointment AND they give you the permit the same day
Greenwich	• Took about two weeks and the permit was mailed. Lack of interest and knowledge of PV slowed down process. • 2 visits with not much effort required - school under construction so we just piggy backed on the existing electrical permits • Took 3-4 weeks to obtain permit
Hampton	• Town of Hampton building inspector is only available one night a week for 2 hours. This makes obtaining a permit an inconvenience sometimes. • Due to part time building department it may take extra time

Middletown	• Middletown issues permits same day and the applicant need not gather signatures from other offices. • Online portal had a tremendous positive impact on securing the permit. However the inspection schedule was significantly and unexpectedly bad. Two weeks out. When normally you can have a system inspected same day. Definitely room for a SIP [simplified inspection process].
Milford	• Permit is issued same day but the applicant needs to collect many signatures from other offices. The Tax Collector and Zoning take significant time. • Permit process seems arbitrary. Permit hours are very limited, lines of up to one hour long will form and if you exceed the time window for permit application submittal you may have to come back again. • There is no continuity from town to town. It is challenging to obtain a permit when the installer does not know the requirements from town to town. • Some towns require approval from multiple departments, some unnecessary.
New Haven	• Permit is issued same day. • This again takes multiple trips and a long time frame to get the permits. The electrical inspector must review the materials and he is usually not in the office. So you have to come back in person to drop off the files, review the paperwork and pay the fees. You can't do it all in one trip. • In the past only electrical permit applications have been required for roof mounted systems where sealed structural engineering plans are provided. The chief electrical inspector David Kaplan is knowledgeable, friendly, and helpful.
Stamford	• Even though the permit is issued on the same day, the applicant must collect a myriad of signatures (Tax Collector, WPCA, EPB, Zoning) and it can take 3-5 hours because lines are so long. • Process is refined, and requires a plan review on all projects. Plan review must be scheduled in advance and has set hours. The plan review process could be expedited if a list of criteria, drawings types and documents required was provided by the building department. • Residential permits much more difficult to obtain than large commercial installations. Now working on small solar project for the City and permits were very difficult for their own project!

4. Compared to other towns in CT, how reasonable is the permit fee amount?

Town Name	R/C	Significantly Below Average Fee	Below Average Fee	Average	Above Average Fee	Significantly Above Average Fee	N/A
Cornwall	Res.			1			
	Com.						
Coventry	Res.			1	1		
	Com.						
Danbury	Res.			1	1		1
	Com.			1			1
Fairfield	Res.		1	2		1	
	Com.					1	
Greenwich	Res.				1		1
	Com.						1
Hampton	Res.		1	2			
	Com.		1	1			
Manchester	Res.						
	Com.						
Middletown	Res.			3			
	Com.						
Milford	Res.			3	1		
	Com.						
New Haven	Res.			1	1	2	
	Com.				1	1	
Stanford	Res.			1	2		
	Com.			1	1		
West Hartford	Res.			1			
	Com.						

5. Please comment on the permit fee amount and how fairly you believe the fee is calculated. Please indicate the applicability of your comments to residential and/or commercial installations.

Town Name	Text Response
Cornwall	• Fee reasonable compared to surrounding towns. Usually .8% of pre-rebate system cost.
Coventry	• I think all permit fees are a bit high in CT
Danbury	• City should not have permit fees for school buildings.
Greenwich	• High for the cost of the system. Especially, in light of the difficulty in getting the permit. • No fee on school project
Fairfield	• The permit fee is based on full value of solar, not taking into account what the actual customer is paying after rebates which can be 70% less. VALUE means what the person is willing to pay. It does not mean full cost of the project. • No different from when obtaining an electrical or building permit. Solar is not higher or lower than these permits.
Hampton	• I feel any fees for a solar PV permit are too much.
Middletown	• We have no visibility into how the fees are calculated and therefore cannot comment. Ultimately the fees are passed onto the customer. We would like to see them reduced to a flat rate per job and not calculated on the value of a job.
Milford	• Towns would benefit from setting fees based on kW capacity. Then it would not be a guessing game on "contract Value." The problem with contract value calculations is that the value must account for Building permit fees which means you're paying a fee on a fee. In addition, many times we sign a lease contract where the construction does not actually have a value in the contract document. • Fee is fair, calculated by total job cost
New Haven	• Very expensive compared to other towns! • Very High Permit fee even for a small residential project. The cost can exceed $500 for a small 5 KW project.
Stamford	• Fees in the CT cities are quite a bit more than in your more common town.

6. Compared to other towns in CT, please indicate your overall experience in acquiring permits in this town.

Town Name	R/C	Significantly Harder than Average	Harder than Average	Average	Easier than Average	Significantly Easier than Average	N/A
Cornwall	Res.			1			
	Com.						
Coventry	Res.			2			
	Com.						
Danbury	Res.		2				1
	Com.			1			1
Fairfield	Res.	1	1	1	1		
	Com.	1					
Greenwich	Res.	1					1
	Com.				1		
Hampton	Res.			3			
	Com.			2			
Manchester	Res.						
	Com.						
Middletown	Res.			1	1	2	
	Com.						
Milford	Res.	2	1	1			
	Com.						
New Haven	Res.		1	2	1		
	Com.		1		1		
Stamford	Res.	2		1			
	Com.		1	1			
West Hartford	Res.			1			
	Com.						

7. Please highlight any best practices that make the overall permitting process in this town more efficient and streamlined. Are there other aspects that are particularly burdensome or difficult? Please indicate the applicability of your comments to residential and/or commercial installations.

Town Name	Text Response
Coventry	• This town is nice to work with because the applicant just fills out an application and drops off paperwork. However, it can be annoying to have to drive all the way out to the town just to be there for less than five minutes. • Having to include a PE stamped structural letter in the submitted application packet is burdensome.
Danbury	• They always require a Building permit and Electrical permit. Many towns will only require an Electrical permit for roof mounted PV systems when a Sealed Engineering letter/plans are provided for the structural component of the project. The building permit process in most towns is typically much more drawn out and costly.
Fairfield	• Harder given the process of gathering signatures from multiple offices takes time and the long lines at the building department can be time-consuming. • For rooftop solar, there should be a one page application just like electricians use for an electrical permit. There should be one department you have to go to, not multiple departments and multiple trips. You should also have an online application that you can upload all the files and pay by credit card. • Educate the inspectors. Most are not comfortable because there is no continuity between towns in the inspection process. • Applicable to residential: quick, one-stop process.
Greenwich	• More knowledgeable staff with regards to solar PV.
Hampton	• One night a week is difficult and slows down the project
Milford	• The scavenger hunt for signatures is annoying; the town requires engineering which adds significant cost to the project; inspections are difficult to schedule. • More continuity from town to town on requirements. Educate the inspectors • Planning and zoning - burdensome when installing on the roof. Streamline when town has specific guidelines for solar installations
Middletown	• Permit issued same day; no long lines; no scavenger hunt for signatures. • Online permitting definitely adds efficiency. • Positive factor includes standard requirements that are posted on the town's web site so that an installer is well prepared and can secure the permit in one visit. • Merchant account capabilities are definitely a problem for towns. Checks and cash are such outdated methods of payment. We utilize Square, not sure why the town cannot adopt the same technology. • Many of our experiences seem to indicate that the towns are out of touch with standard ITIL practices and rather than continuously improve their services, they remain the same and do not adapt to the needs of their customers. This can be very discouraging for new startups as it presents a logistical challenge that is avoidable.

Stamford	• Very long permitting process. After the job is complete, inspections are very difficult to schedule. Once the inspection has passed, the contractor has to go back to City Hall to close-out the permit. This entails going back to all departments for signatures - like securing the permit, this process takes a few hours. They also require a final as-built letter from the engineer, which along with the required engineer's report to pull the permit, adds even more cost that has to be passed on to the homeowner. • Electrical inspectors are very knowledgeable and "up to snuff" on PV systems

8. Please estimate the total number of man-hours required to secure a rooftop solar PV permit in CT (excluding travel time).

Fast Permit Process		Average Permit Process		Slow Permit Process	
Res.	**Com.**	**Res.**	**Com.**	**Res.**	**Com.**
2	2	30 minutes		8	12
10 minutes	-	6	8	hours, days	-
2	2	3	-	16	30
2	-	1	2.5	8	-
0.25	1	10-20 min	10-20 min	3	4
2	3	4	-	5-6	7
0.5	-	3-4	5	>2	-
-	-	2	-	-	-
-	-	7	6	-	-

9. Regarding the amount of time required to secure permits, please comment on best and worse practices you have observed both in and outside CT. When applicable please include the towns/states that employ these practices.

Text Response
• See notes about Stamford. In addition, Stamford requires two forms of the building permit application to be notarized and two forms be signed by the homeowner - very inconvenient! • Greenwich requires a form be signed by the homeowner and notarized - this can be difficult to coordinate with the homeowner. • Lebanon allows contractors to mail permit applications and then the town will mail the permit to the contractor when approved - this is the easiest and most time-saving of all. • Newtown is similar to Stamford in that the applicant needs to get many signatures. They also require that the applicant pick up the permit after it is approved - they will not mail it. After the job is complete, the contractor has to go back to the building department in person to close-out the permit. • Norwalk permits are issued by appointment only, and the applicant needs to gather many signatures beforehand. This can be difficult to coordinate if the applicant does not want to make two trips to City Hall.

- Southbury requires applicants to apply for a zoning permit first. After that has been approved (can take a few weeks), the applicant must come back to Southbury to apply for the electrical permit in person. They also require a notarized form.
- Waterford is the same as Southbury.
- Making two separate trips to a town hall is very inconvenient and a waste of time.
- There are many towns similar to Coventry that the applicant fills out the permit applications and leaves it with the documents and once the inspector approves them, the permits are mailed. This is the easiest, except it can be annoying to have to travel long ways just to be there for less than five minutes.
- These towns should be like Lebanon and accept mailed-in permit applications.

- Best practice: Submit the application package, pay the clerk and within a few days you have the permit.
- Best practice: Fill out the form online, pay online and the permit is issued within a week.
- The worst practice is requiring in-person applications during a short morning period and requiring multiple trips to acquire multiple signatures from different departments.
- Trumbull is a worst case example.
- Durham and East Haddam are the best examples.

- The best experiences to date have been with Bristol, Middletown and E. Windsor.
- The most challenging practice we have observed was a W. Hartford permit.
- Regarding fees: Fees are based on the value of the contract, therefore we cannot present the average or highest fee for obvious reasons.

- This would account for time spend in building dep't/town hall. This does not include permit application rejections for discrepancies or subjective matter.

- Some towns require a health department permit (Woodstock for a ground mount system). This slows down the process since the average time takes a week to obtain this permit.

- The inspectors need to be educated and more comfortable with solar PV. Some take up to two weeks to review a simple residential plan. This is mainly due to under staffed departments

- No consistency

- We mail all our permit packets to the towns

- Stumbling blocks more often come from the lack of understanding of PV systems or oddball interpretation of rules. For example, Falls Village requires a P&Z sign-off roof-mounted PV (costs $75) to determine that the system does not cause the home to exceed height regulations. Doesn't matter how many times you tell them a properly designed system sits below the ridgelines.

10. Regarding permit fees, please provide the following information to the best of your knowledge.

Average permitting fee in CT		Highest fee and town(s) with highest fee(s)		Lowest fee and towns(s) with lowest fee(s)	
Residential	Commercial	Residential	Commercial	Residential	Commercial
$300	$600	$650	$1,500	$150	$200
$400	$800	$600 New Haven	$1,200 New Haven	$200 Durham	$300 Durham
unknown	unknown	unknown	unknown	Unknown	Unknown
Depends on cost of project		$27/$1,000, New Haven	Bridgeport	$6/$1,000 Kent	$12/$1,000 Trumbull
$13.50/$1,000	$14/$1,000	$25/$1,000		Litchfield	
$15/$1,000				$8.50/$1,000	
$15/$1,000					

11. Regarding permit fees, please comment on best and worst practices that you have observed both in and outside of CT. Have you observed whether different fee structures are more/less effective (e.g. flat fees, cost recovery, valuation open ended or capped, etc). Where possible, please include the towns/states that employ these practices and indicate applicability of your comments to residential and/or commercial installations.

Text Response
• Flat fees seem to work the best for residential-MA & FL towns seem to have more of a flat fee structure. A flat fee would be great for commercial projects. Currently fees are uncertain adding difficulty to planning the project and creating a budget.
• In my experience, every town has permit costs that are a certain amount of money per thousand dollars. This rate varies between towns. A small PV system in New Haven can cost the same as a large PV system in another town that is not as expensive. Since the contractor does not know the rates when closing a sale, the permit fees are usually under-estimated.
• A town with a limited fee is Durham. They are very good with permit processing and reduced fees. • The worst towns are New Haven, Trumbull and some small towns in Fairfield County.
• There are no primary standards, again making it very difficult to navigate and accurately prepare customer proposals.
• Fixed fee based on System Capacity would be an effective way to build permit fees into project costs and eliminate the guessing game.
• All towns I have obtained permits in have been based on the cost of the job. The Town of Shelton CT requires a roof analysis by a PE
• It is dictated by the Municipality and I have no comment on their budget
• No. All towns calculate the permit fee the same way. Regulating these fee schedules would be the most advantageous
• Having basic knowledge of PV system requirements greatly speeds up the process. Even if additional departments need to weigh-in or approve. Knowing who to contact, what the process requires and how much it costs on the phone prior to the appointment or waiting in line, greatly speeds up the process. Building department personnel that are unfamiliar with PV slow things down.

12. Have you used online permitting systems for solar PV permits (or other types of permits) in CT or elsewhere? If so, please indicate the town/state and comment on how they have helped or hindered the permitting process. If possible, please also provide the name of the online system.

Text Response
• We have not done online applications as we need to hand in documentation.
• I believe the online permitting system is for regular building permits only, not for solar.
• Yes, North Haven has an online application but they did not process it properly and still required the electrician to come into the office, which negated the point of having the online application. But the process of filling out everything online and uploading documents and paying online was a step in the right direction.
• Yes, Middletown. A very good experience
• Litchfield and Harwinton I believe. Online process is nice because Permits and Signoffs are all emailed out. Cuts down on lag time between inspection and signoff's

13. Please provide an overview of the best and worst practices for rooftop solar PV permitting both in CT and elsewhere. What methods or systems help/hinder the most in securing permits?

Text Response
• Requiring structural engineering for residential homes is too much money and time. This is required by West Hartford.
• For rooftop PV systems, allowing an electrical permit application only when structural engineering plans/letter is provided is simplest way to obtain proper technical information and also have the properly qualified Structural engineer sign off and assume liability.
• Best practices: Have all your paperwork ready (electrical diagrams, site plans, system specs) • Town of Shelton required a PE stamp for a roof analysis. This caused a major delay and added expense to the homeowner. In my opinion this was not needed. Any building inspector knows that a solar system will not compromise the structure with a 2x10 rafter 16 in on center with a 45 degree pitch.
• Help = Educating the inspectors Hinder = not educating the inspectors.
• Help: Speaking with building inspector beforehand to go over required documentation. If town has experience with PV= good. If doesn't have experience with PV= bad/slow Hinder: Planning and Zoning approval for roof-mounted systems prolongs permitting process Planning and zoning fees increase cost of permitting.
• No consistency between towns and projects.

14. From your perspective, what aspects of the solar PV business in Connecticut (either residential and/or commercial) could be improved? While this project is focused on reducing non-hardware costs (and in particular, permitting), we welcome additional information that may inform other initiatives.

Text Response
• Uniform permit application, documentation required and fee structure
• Solar standard form just like an electrical permit form used in CT. There needs to be a streamlined program that all towns understand and use for ROOFTOP solar. This is not complicated. Electricians have simplified their permit process and they get permits on the spot using a simple yellow form.
• Speaking from experience as a grass roots organization, we are pleased with how CT's PV practice has evolved in just the last three years. That said, there is always room for improvement. Therefore, streamlining the rebate process is one opportunity. • Increased CEFIA PV marketing would certainly help educate the general population and drive our joint PV objectives. • Providing more lead time on RFP's would be helpful and improved ZREC program • Awareness/education towards our CT commercial community would help take the explanation out of our presentation decks so that we can focus on the design and installation side of the project.
• Sunset the PV license it is electrical work
• Do not require sealed engineering for residential systems: Installers assume responsibility
• Focus on market wide programs and efforts, not town or installer specific. There is a very strong market in CT that CEFIA was instrumental in getting ramped-up. All programs/efforts should leverage this by providing access to all approved installers. It is probably impossible to create a more efficient process than a strong market to best protect ratepayers and incentivize competition. The economic road is strewn with the wrecks of market manipulation.
• A better ZREC program - need more frequent auctions to have a stable industry
• A standardized permitting process, mandated by the state is the only way towns will change. As frustrating as the permitting process can be, the expense is relatively insignificant and typically accounts for less than 1% of the total project cost.
• Open Secret that the fees based on construction value are high relative to the burden placed on inspectors.

15. Please provide a rough estimate of how many people you employ and subcontract to for your solar PV installation work in Connecticut. If unsure of your residential versus commercial workforce, please estimate.

Full-Time Employees		Part-Time Employees		Sub-Contractors	
Residential	Commercial	Residential	Commercial	Residential	Commercial
4	2	5	2	6	8
10		2		1	
4	4	0	0	6	6
2	2	0	Mix	4	10
18	Mix	2		2	Mix
1		1	0	2	
4		5		1	2
3	5		2	3	
2				1	3
	5				

Appendix IV
Municipal Planning and Zoning Survey

Table 22: Solar Rights and Access Data for Participating Jurisdictions

Solar Rights and Access	Is there a state or local law that protects property owner rights to install solar systems on their property?		If there is a state or local law that protects property owner rights to install solar systems on their property, does it protect from both local ordinances and restrictive covenants?		What type of enforcement mechanism is used to support solar rights?		Is there a state or local law that provides for solar easements to protect access to sunlight (solar access)?	Is there a state or local process for a PV system to be registered in order to protect solar access?
Bridgeport	N (R)	N (C)	N (C)	N (R)	N/A (R)	N/A (C)	N	N
Cornwall	Y (R)	Y (C)	N (R)	N (C)	N/A (R)	N/A (C)	N	N
Coventry	Y (R)	N (C)	N (R)	N (C)	N/A (R)	N/A (C)	N	N
Danbury	N (R)	N (C)	N (R)	N (C)	N/A (R)	N/A (C)	N	N
Fairfield	Y (R)		N (R)	N (C)	N/A (R)	N/A (C)	N	N
Greenwich	N (R)	N (C)	N (R)	N (C)	N/A (R)	N/A (C)	N	N
Hampton	Y(R) like any other structure	N (C)	N (R)	N (C)	N/A (R)	N/A (C)	N	N
Manchester	Y (R)	Y (C)	N (R)	N (C)	N/A (R)	N/A (C)	N	N
Middletown	Y (R) treated like any roof accessory	Y (C) treated like any roof accessory	N (R)	N (C)	N/A (R)	N/A (C)	N	N
Milford	Y (R)	Y (C)	N (R)	N (C)	N/A (R)	N/A (C)	N	N
New Haven	N (R)	N (C)	N (R)	N (C)	N/A (R)	N/A (C)	N	N
Stamford	N (R)	N (C)	N (R)	N (C)	N/A (R)	N/A (C)	N	N
West Hartford	N (R)	N (C)	N (R)	N (C)	N/A (R)	N/A (C)	N	N

Table 23: Zoning Data for Participating Jurisdictions

Zoning	Approximately what percent of structures in your jurisdiction are zoned to allow rooftop solar facilities automatically "as a matter of right" or "by right"? (Show residential and commercial/ non-residential separately)			Approximately what percent of structures in your jurisdiction are zoned to allow rooftop solar facilities only after a public hearing and the issuance of a special or conditional use permit? (Show residential and commercial/ non-residential separately)			Has your jurisdiction conducted a review of local ordinances to identify barriers to solar installations and make recommendations for updating ordinances to address those barriers? Do you have any solar-friendly regulations or practices?	
Bridgeport	None (C)	None (R)		None (R)	None (C)	Hearing is only required if a variance is required because of a height violation. This has not occurred and is unlikely to occur with current height limits.	Y	Ordinance exempts the value of solar PV panels and electrical wiring from permitting fees. Permit fee exemption is for all class I renewables. Labor is not exempt.
Cornwall	All Structures (R)	All Structures (C)	Zoning permit only required for stand-alone structure, not for rooftop solar PV system.	None (R)	None (C)		Y	
Coventry	All Structures (R)	None (C)		None (R)	> 50% (C)		N	No ordinances yet, but section 4.04.05 from the Zoning Regulations provides flexibility to height restrictions on accessory uses, such as solar panels.
Danbury	All Structures (R)	All Structures (C)	Approval for rooftop solar PV installations is granted through building permit application. If the application is complete and installation meets height restrictions, approval is granted within one day. For R and C, height may not exceed 10ft above rooftop of the building.	None (R)	None (C)		N	
Fairfield	All Structures (R)	All Structures (C)	For C, height may not exceed 5 ft above building	None (R)	None (C)		N	Subdivision regulations mirrors state in that it suggests that renewables, solar access and passive solar should be considered.
Greenwich	None (R)	None (C)	Commercial solar installations must come before the Architectural Review Committee (ARC) which sometimes makes suggestions for improvement to the system plans.	None (R)	None (C)	Exceptionally large systems (no specific size cutoff) would require special administrative review in addition to ARC approval.	Y	(1) Mechanical structures are limited to 25% of roof area. If a solar system stays within this limit, height restrictions waived. Otherwise, height restrictions apply. (2) Ground mounted systems may be likely to violate setback rules. (3) Municipality has no authority to prevent deed restrictions by real estate developers or neighborhood associations.
Hampton	All Structures (R)	Most Structures (C)	Some C, have to have commission review	None (R)	< 50% (C)	The hearing is for a site plan review. More visible system, more likely review needed. Reasons largely to protect town aesthetic.	N	Most zoning and permitting problems for solar in rural areas are ground-mount related.
Manchester	All Structures (R)	All structures (C)	Rooftop PV is permitted as an accessory use. Commercial panels must not be visible.	None (R)	None (C)		N	Rooftop PV is permitted as an accessory use. Ordinance waiving permit fees for all class I renewables.
Middletown	All Structures (R)	All Structures (C)	For R or C, in village district may have design committee review for aesthetic reasons	None (R)	None (C)		N	Online permitting system for building permits.
Milford	All Structures (R)	All Structures (C)	Zoning approval granted automatically when building permit issued for residential or commercial.	None (R)	None (C)		N	
New Haven	All Structures (R)	All Structures (C)	Approval for rooftop solar PV installation is granted through building permit application. Solar PV installation is treated as an accessory.	None (R)	None (C)		N	
Stamford	None (R)	None (C)	Solar not listed as accessory use	None (R)	None (C)		N	Exception for solar in code: Solar can exceed building height limits by 25%.
West Hartford	All Structures (R)	All Structures (C)	Solar PV installation is not dealt by with by planning and zoning department. It is handled through building permit process.	None (R)	None (C)		N	

Table 24: New Construction Standards; Other Solar and Clean Energy Commitments

New Construction; Other Solar and Clean Energy Commitments	Are there state or local standards for new construction that reduce barriers to solar deployment?			Plans and commitment to supporting solar energy and other clean energy deployment.
Bridgeport	No (R)	No (C)		Comprehensive Plan includes a Sustainability Plan and a specific Energy Plan, including support for municipally-owned solar arrays.
Cornwall	Yes (R)	No (C)	Cornwall does enforce the state statute encouraging consideration for passive solar in its subdivision regulations, but no subdivision development since 1990s. Space between lots makes solar access concerns minimal.	Energy Task Force works to support renewables.
Coventry	None			Town Plan of Conservation and Development encourages alternative energy sources. Clean energy task force.
Danbury	No (R)	No (C)		
Fairfield	Yes (R)	No (C)	Subdivision regulations mirrors state in that it suggests that renewables, solar access and passive solar should be considered.	
Greenwich	Yes (R)	No (C)	Subdivision regulations require thate homes are aligned to make use of passive solar	Greenwich Plan of Conservation and Development encourages use of solar energy. Solar starting to be seen as economic investment rather than just as a value statement.
Hampton	Yes (R)	No (C)	Subdivision regulations not being enforced anywhere in CT.	
Manchester	Yes (R)	No (C)	Subdivision regulations support consideration of energy conservation, renewables and passive solar techniques, mirroring state statute.	Looking at Capital Region Sustainable Communities plan recommendations for renewables. Intends to share with neighboring town planning commissions and discuss further.
Middletown	Yes (R)	No (C)		Clean energy task force
Milford	Yes (R)	No (C)	Subdivision regulation suggests use of passive solar techniques.	
New Haven			There are no municipal subdivision regulations.	City plan encourages use of clean energy.
Stamford	Yes (R)	No (C)	For new construction, it is required that "energy conservation" is considered in Stamford's subdivision regulations, which include passive solar.	Stamford is undergoing a comprehensive master plan update, which will include ways to foster more sustainable energy development.
West Hartford	None			Clean energy task force

Appendix V
Installer Planning and Zoning Survey

1. Are there towns in CT which require a planning and zoning (P&Z) permit or P&Z approval to install rooftop solar PV?

- Trumbull, Reading, Fairfield, Newtown - anything west of Highway 95.
- Most towns do if you have a ground mount near setbacks or near wetlands for residential. For commercial, you never know what a town could come up with.
- For a 6 kW ground mount system, the Town of Willington wanted a professional site plan to scale. If it was over 10' tall it would require P&Z review.
- No, but some towns do have a review for commercial sites that are on main streets.
- None that we've found yet.
- Yes, Towns need more education to feel comfortable letting some things go. We in the electrical industry are used to this kind of process. Other out of state companies are not accustomed to this protocol.
- Yes, it's on a case by case basis.

2. Are you aware of any P&Z restrictions/hurdles to rooftop solar PV installation in CT towns (e.g., height restrictions, aesthetic requirements, homeowner's association restrictions, restrictions in historic districts)?

- Not yet, condo associations have been slow to adopt solar.
- Historic districts and aesthetic requirements for residential, and aesthetic requirements for commercial sites.
- Some homeowners associations and historic districts have restrictions, but this is usually a minor problem and most approve installations upon review.
- None so far.
- No.
- Yes, all exist in one town or another. Most are not onerous except for the separate applications or application order (for example Falls Village). Chief grievances are treating PV installs flat against the roof as potential height variations; there should be an exception if less than 5" are added or if the PV does not extend above the ridge line. Another is treating ground mounts as structures and requiring them to meet setbacks; the ground mounts should be viewed in this case as fences (if under 8' or so) so they can be backed neatly up to the property line. If plantings to hide the system are required, fine.

3. Are there improvements you would recommend to P&Z ordinances in CT towns to remove hurdles to rooftop solar PV installation?

- No, but we would like a better inspection process. Hanging wires are not good. We don't want solar to get a bad name from a few reckless installers.
- Does DOT need municipal approval to install a culvert? CEFIA projects are state level DEEP projects. Municipalities can tag along for community awareness, but should not hold the strings.
- None so far.
- If a company has best practices there should not be any problems. For those who try and skirt the system these things need to be in place.
- Same as stated in previous question.

4. Are you aware of any green, sustainable or solar-friendly P&Z ordinances in CT?

- Fee limit in Durham to $200.
- No
- Some towns have eliminated permitting fees.
- No.
- No.
- No.

5. Are you aware of any green, sustainable or solar-friendly P&Z ordinances in other states?

- Fee elimination in East Haddam. Both East Haddam and Durham fee changes were passed with help from solar installers.
- No.
- California
- No.
- No.

6. Other comments/suggestions?

- Make it all online at least so it is all done without using paper.
- Someone at CL&P recently told my electrician that line side tap is not permitted on 100 amp service? Let's ensure this is not true or doesn't become a rule. Can we get a centralized single pre-approval on electrical diagrams? Not all parts have only one way to be installed. I was taught one way, municipal inspectors think it should be another way despite code, and Richard Dziadul wants to see things another way. At least Richard will consider alternatives with code based arguments. Richard is helpful and informative at the end of process, but these issues should be clear before we start. Let's not waste SunShot funds trying to get a bunch of municipalities on the same track. CEFIA is now a branch of DEEP, so CEFIA projects are state level projects. DOT doesn't need town permission to install a culvert. Municipalities follow state building codes. Let's build a centralized state level solar permit process.
- We license holders in Connecticut work hard to earn our licenses and continue to with CEU courses mandated by our state. By introducing a limited PV license, an E-1 unlimited license loses value. By introducing the limited license for PV we in Connecticut are opening up other industries to do the same. For example, swimming pool companies will want a limited license for wiring swimming pools, landscape companies will want a limited license to wire landscape lighting and so on. How could we deny other industries and allow PV, and before we know it E-1 and E-2 licenses have no value.

Appendix VI
Planning & Zoning – Example Solar Access Ordinances

Permitting and Recordation Ordinance

Permitting and recordation ordinances protect a home owner's investment in a solar collector by creating a "first-in-time, first-in-right" system that preserves the solar collector's access to sunlight. If the owner of solar collector successfully obtains and records a solar access permit, future construction will not be allowed to obstruct solar access. Such an ordinance should include the following elements:

- **Record solar agreements:** The ordinance should provide a recordation procedure that provides for documentation of solar easements, agreements, and permits in the local land records.
- **Establish Guidelines for Permits:** The ordinance should issue solar access permits based on a "first-in-time, first-in-right" concept, and should not place any restrictions on vegetation or structures that predate the collector. The ordinance should provide for a permit to be revoked if it is not put to beneficial use—i.e., the owner removes its solar panel or the panel falls into disrepair. The ordinance should provide for a maximum time period of non-use before the permit is terminated. The ordinance should provide an exception for de minimis obstructions of a solar collector that arise after recordation, and should define what level of obstruction qualifies as de minimis.
- **Establish Procedure for Obtaining Solar-Access Permits:** The ordinance should create a clear procedure for obtaining a solar-access permit, which includes, at a minimum, notification of potentially affected property owners, ability for affected property owners to request a hearing on the issuance of the permit, and opportunity for appeal. The ordinance should provide for criteria for when the permit will or will not be granted. For example, the ordinance may provide that the permit will not be granted if a neighboring land owner can provide evidence of pre-existing plans to build a structure that will obstruct the solar panel. This procedure may also include a mechanism for cost-allocation or recovery to affected property owners.
- **Outline Access Reconciliation Procedures**: The ordinance should provide a remedy for interference with a permitted solar collector. For example, if a neighboring property owner's tree obstructs a pre-existing solar panel, the neighboring property owner should be responsible for the costs of trimming the restricted vegetation. Permits should not be granted to neighboring property owners for structures that will obstruct a pre-existing permitted solar collector.

Solar Envelope Ordinance

Solar envelopes provide a more comprehensive form of solar rights protection, and place more restrictions on neighboring properties than the "permit and recordation" ordinance model. For this reason, the "permit and recordation" model may be preferable for some towns. Solar envelope ordinances work by creating solar overlay zones that impose solar fences around a property on the property line. Shadows from structures on neighboring properties may not exceed a shadow that would be cast by the hypothetical solar fence on a certain day and time of the year. For example, Boulder, Colorado's solar envelope ordinance creates two different solar overlay zones, which create either a 12 foot or 25 foot solar fence that neighboring properties must comply with (i.e., the shadow from any building or structure on a neighboring property, may not exceed the shadow cast by a 12 foot or 25 foot fence on the property line, between 9am-3pm on the winter solstice). Boulder combines the solar envelope model with the permit and recordation model by creating a third zone where no fence is imposed because such fences might unduly burden development. In these no-fence overlay zones, solar access permits are available. It is thus possible to combine the solar envelope model and the permit and recordation

model, depending on the needs and pattern of development of the municipality. If a town chooses to adopt a solar envelope ordinance, we recommend that it should include the following elements:

- **Define Applicable Structures:** The ordinance should exempt pre-existing structures from complying with the ordinance and should create an exemption for de minimis breaches of the solar fence, and should define what level of obstruction qualifies as de minimis.
- **Develop Calculation Method for Solar Envelope:** The ordinance should clearly define the scope and method of calculating a solar envelope. A variety of solar envelope models exist other than the solar fence model adopted by Boulder. Ashland, Oregon, for instance, uses a formula to ensure that buildings on properties on the south facing side of a property are a certain setback distance from their northern property line.
- **Specify Duration of Envelope:** The ordinance should specify the time frame for which the solar envelope is in effect. Many existing solar ordinances enforce the envelope to protect solar access from 9am to 3pm on the Winter Solstice—the day on which the longest shadows occur.
- **Determine Appropriate Envelope Overlay Zones:** The ordinance should only use solar envelope overlay zones where such zones are feasible in light of the development pattern of the underlying zones involved. Some neighborhoods may be well positioned to adopt such an envelope, while heavily developed neighborhoods or neighborhoods with a high-development potential may be ill-suited to the solar envelope model. Close evaluation of the development characteristics of a municipality's neighborhoods is required to determine whether this model is feasible.

Appendix VII
Sample Solar Site Design Worksheet for a Proposed Subdivision

Please provide information in the fillable form below to describe how the developer of the proposed subdivision has considered solar access in the design of the subdivision site and homes.

Street and Lot Layout

☐ Home lots are arranged on streets that run within 20 degrees of east/west to maximize solar exposure

If yes, describe details below. If no, describe reason(s) not implemented (include attachments if needed)

House Orientation

☐ Homes are designed in a manner that the longer axis of the house is aligned within 20 degrees of east/west in order to maximize solar exposure

If yes, describe details below. If no, describe reason(s) not implemented (include attachments if needed)

☐ Homes are designed so that south-facing roof surfaces (and more generally, sections of the roof ideal for placement of solar energy systems) receive unobstructed sun between 9 am and 3 pm

If yes, describe details below. If no, describe reason(s) not implemented (include attachments if needed)

☐ Homes are designed so that primary living spaces include a southern exposure

If yes, describe details below. If no, describe reason(s) not implemented (include attachments if needed)

☐ Homes are designed so that at least 50% of window area contributes to passive heating during the heating season and are shaded in the cooling season (attach calculations)

If yes, describe details below. If no, describe reason(s) not implemented (include attachments if needed)

Vegetation

☐ Plantings support solar access

If yes, describe details below. If no, describe reason(s) not implemented (include attachments if needed)

Protection of solar access within the development

☐ Subdivision regulations protect solar access

If yes, describe details below. If no, describe reason(s) not implemented (include attachments if needed)

Appendix VIII
Installer Interconnection Survey

1. What is your experience with rooftop solar PV interconnection in CT in terms of process, timing, requirements, cost?

- It is very costly and very time consuming. Even the utility requires a printed and mailed copy of paperwork and a check. Interconnection should be free in CT.
- Generally painless. Used to the process. 1-2 week turn around. Average $350 for under 10kW. New Haven was painful and took 1-2 weeks turn around.
- The municipal permitting process is a large part of our soft cost. Unfamiliar building inspectors require unnecessary engineering. Many take a subjective position on a job that should be fact and code based. In construction the inspectors are met with while other parts of the project are in progress. For us meeting with inspectors is another trip back to a project that has been finished and we could be working across the state. Many inspectors don't have evening hours, so access to the house can be a challenge to schedule with the homeowner.
- Residential and commercial PV systems - about 100 systems in CT.
- The process is time consuming and expensive, much more so with systems over 10kW. An average residential job is around $1,000 with interconnection costs. Average commercial job is substantially more.
- Category 2 takes too long and too expensive.
- I have no issues with the process. I would like to see more representatives to keep up with the load. I suggest having the clearance desk reps assigned to certain areas.
- Well run program, modest cost ($100 for 10 kW and under), inspections waived after a few passes.

2. What are the costs associated with interconnecting rooftop solar PV in CT? How could these costs be reduced?

- Getting permits and doing the utility application is extensive and time consuming. A registration policy will eliminate this similar to Vermont.
- Electrical permit, building permit, interconnection. Unsure.
- Let's build a centralized state level total permitting process so we only have one inspector. Send the municipality a token $100 to verify that the house is constructed to modern code. This information should be on file so they don't even have to go to site. Use the SunShot $ to build this process. Our fees will maintain it.
- $100 if 10kW or less, $500 for 10kW+, witness test fee usually $500. I think these are reasonable.
- Application fees usually amount in the $200-$500 range. Biggest expense is time associated with witness tests and scheduling.
- CL&P & UI category 1 $100 (negligible), category 2 $500 for interconnect and $550 for witness test (both too much).
- Costs are passed to the rate payer. The cost should be absorbed before the installer or the rate

payer sees them. Taken by the utility on a case by case basis out of the fund making less paper work for the installer. This does not lower the cost but makes it more efficient for the installer.

- Some are advocates of removing the utility disconnect requirement (as inverters are 1741 listed). I'd leave that decision to safety studies.

3. In what ways can the rooftop solar PV interconnection process be improved in CT?

- Eliminate it at the state level and the utility can just register them without any paperwork or fees. Pass a law like Vermont's law.
- Consistency.
- Interconnection works well. But please remove the unfamiliar building inspectors from the required steps.
- It is pretty good compared to some other states and their utilities. The downside is after the town inspection. Some inspectors are not computer savvy and never fill in the proper information so we can move to interconnection and net meter the installation.
- Need faster and simpler process. Updating existing metering systems would also be helpful.
- Requirement for homeowner signature can delay process – establish electronic signature process or eliminate need for homeowner signature.
- Costs are passed to the rate payer. The cost should be absorbed before the installer or the rate payer sees them. Taken by the utility on a case by case basis out of the fund making less paper work for the installer. This does not lower the cost but makes it more efficient for the installer.

4. What is your experience with coordination between municipal permitting and utility interconnection, including coordination on inspection requirements, on-site inspection times, and approval notifications?

- Coordinating with towns for the final inspection is time consuming and they usually do not know enough about electrical parts for solar to do a good survey anyway. Having a CEFIA trained inspector is enough to keep quality high and eliminate all local and utility permits.
- 7 years used to working with towns. Hardly any problems.
- Some inspectors approve online the same day, others take a week. This is a bad set-up. Having unfamiliar inspectors with so much power. Please change the format. New installers should have a pre net meter inspection by CEFIA, post inspection for those of us that have earned it, or let us request a pre inspection or project review if a project is out of norm.
- This is the weakest link, not from utilities but inspectors doing the proper online submittal in a timely fashion. CL&P is pretty good and timely. Usually temporary interconnect within a week and net meter usually 1-2 weeks after inspector filing.
- After the local inspection we call the town and ask them to release the job to the utility company. There are some instances where the town does not know how to do this or realize it needs to be released to the utility company. CL&P has a way to keep track of the job and where it is in the release process. You need the utility job number and the town the customer lives in and you can access the online feature from their website.
- Scheduling witness tests can be difficult as three parties are involved (utility company, customer, and contractor). The utility company does not seem to have set available hours (Monday-Friday

9am-5pm, etc.) as the local municipality does. The utility company picks a date and time and asks if you can make that time and then contact the customer to confirm they can as well.

- CL&P witness test are always scheduled at least 10 days after the job has been released. UI witness tests are after scheduled after 5 business days of the job being released. The weather impacts the witness test and rescheduling can be difficult as well as costly in some cases.
- The amount of time the witness test takes is 15-30 minutes for the entire process which is great. CL&P usually sends the approval to us within 2 business days of installing the net meter via email. UI sends the approval to us several days after the witness test and via snail mail for the customer (the customer already has the ok to power on the system after the witness test though).
- All takes too long. Some towns advise utilities of inspection approval directly, others require contractor to handle; inconsistent. CEFIA inspections take too long – perhaps due to third party contractors for inspections.
- More educational courses for inspectors, they would understand how easy the process could be, and inspectors would be more comfortable with installers. On the flip side there are so many companies jumping in the game because of how easy the state has made it for licensing for example for HIC, laborers, even painting companies hiring out of state unregistered workers spoils the industry and inspectors need to be harsh with everyone. I think the more control of registered workers and licensing needs to be in place before inspectors and interconnection would be easier.
- No coordination, separate tracks, doubtful coordination (desirable) would be possible in this area.

5. What best practices for rooftop solar PV interconnection would you recommend from CT or other states?

- See Vermont's process.
- Consistency
- The more electronic the process can become the quicker the process will become. Credit card processing for payments would also speed up process.
- Like Massachusetts. Only electrical contractors should install PV, no laborers, no HIC contractors, no out of state unregistered workers.