Case Study

Connecticut's Residential Solar Program

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Acknowledgments

This work was supported by Yale Center for Business and the Environment.

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The authors were advised by Jeffrey Schub, Executive Director at the Coalition for Green Capital, and Stuart DeCew, Program Director at Yale Center for Business and the Environment. The draft was reviewed by Connecticut Green Bank staff including Bryan Garcia, President and CEO; Brian Farnen, General Counsel and Chief Legal Officer; Dale Hedman, Managing Director of Statutory and Infrastructure Programs; Matt Macunas, Legislative Liaison and Marketing Manager; Selya Price, Senior Manager of Statutory and Infrastructure Programs; and Mike Yu, Assistant Director. The report was edited by Kat Friedrich, News Editor at Clean Energy Finance Forum at Yale Center for Business and the Environment. The graphic design was created by Henk van Assen, Senior Critic at Yale University School of Art, together with Kelly Bryan and Igor Korenfeld, Designers at HvADESIGN. The authors thank these individuals for their valuable insights, support and assistance.

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July 24, 2017

Executive Summary

As the Connecticut Green Bank works to design high-impact programs for the solar market, it has supported the design and adoption of legislation that expanded the Residential Solar Investment Program (RSIP)[1] by creating the Solar Home Renewable Energy Credit (SHREC). The SHREC provides a stable funding structure for an expanded RSIP.

The design of the RSIP was more effective than it was set out to do. It accomplished its goals eight years ahead of schedule and far below the anticipated budget. And therefore, one of Governor Malloy's gubernatorial campaign promises in 2015 was to increase the RSIP tenfold.

Meanwhile, the reliance on renewable-energy credits (RECs) to satisfy the state's renewable portfolio standard (RPS) was being predominantly met with out-of-state resources from Maine, New Hampshire, and Vermont, yielding little economic development benefits to Connecticut.

Decision makers saw the state's approach needed to be retooled to incentivize in-state market development. Solar-market demand was accelerating faster than incentives could fulfill it—falling incentives dropped more rapidly than decreasing installed costs.

The need to maintain the momentum of the solar market's growth led to a proposal for fine-tuning the incentive programs the state offered.

This led to the creation of a bill, HB 6838 (Public Act 15-194), proposing a flexible outline for expansion of RSIP through creation of the SHREC.

This bill passed with support from a range of stakeholders including the leadership of the Governor of Connecticut and, in general, bipartisan support from the Connecticut General Assembly.

The legislation did not change how the state interfaces with customers and contractors, but it did transform how the state handles REC transactions for residential solar PV projects and recovers the costs to the Connecticut Green Bank for RSIP incentives and administration and potential securitization. It set up a Master Purchase Agreement (MPA) model that wraps the RECs into a multiyear contract at a fixed REC price with the electric distribution companies who must satisfy the RPS.

The state has had to adjust the timeline for program implementation based on developments that occurred since the legislation was proposed, passed and revised.[2]

1 The RSIP provides an upfront incentive for homeowner-owned projects and performance-based incentives for third-party-owned projects.

2 PA 15-194: https://www.cga.ct.gov/2015/act/pa/pdf/2015PA-00194-R00HB-06838-PA.pdf and PA 16-212: https://www.cga.ct.gov/2016/act/pa/pdf/2016PA-00212-R00SB-00366-PA.pdf

Problem

Although the RSIP proved to be very effective, it was a victim of its own success.

The program achieved the state's statutory goal of producing 30 MW of new, in-state residential solar PV under budget and eight years ahead of schedule.

By the end of 2014, the RSIP had allowed the Connecticut Green Bank to meet and nearly double the 30 MW installation target using only 65% of the allocated resources.

However, the rapid success in growing Connecticut's residential solar market created an environment where the demand for solar power outpaced the incentives available through RSIP.

The funding source for RSIP, a portion of the surcharge on electric customers allocated to the Connecticut Green Bank, was simply not enough to continue catalyzing residential solar growth at the high rates observed between 2012 and 2014.

Another complication resulting from the rise and popularity of the RSIP was the influx to the Connecticut Green Bank of a large volume of RECs from pre-SHREC RSIP projects.[3]

The conditions of participation in the RSIP require that owners of residential solar systems, whether they are the property owners or third-party owners/operators leasing the systems to the property owners, would cede ownership of the RECs to the Connecticut Green Bank. While the RECs provided the Connecticut Green Bank with access to a new value stream, it also created new management complications and cash-flow uncertainty.

By 2013, the Connecticut Green Bank had approved about 2000 systems for the RSIP program.

As each system generated an average of 8 RECs per year, the Connecticut Green Bank now had an incoming annual stream of 16,000 RECs. This number was growing. As of the end of June 2017, according to Selya Price, Senior Manager of Statutory and Infrastructure Programs at the Connecticut Green Bank, 145 MW were approved and completed and about 170 MW were just approved.[4]

The Connecticut Green Bank issued a request for qualifications (RFQ) for brokers to market and sell the RSIP RECs in open-market auctions.

The qualified brokers would then provide Connecticut Green Bank with price quotes when requested—which the organization could decide to act upon when it was advantageous to do so.

3 RSIP projects approved for an incentive starting January 1, 2015 are eligible for the SHREC. Projects approved before that provide non-SHREC RECs.

4 Draft Guidelines and Procedures for CEFIA Management of Class I REC Asset Portfolio Memo, CEFIA. Note that CEFIA is the Clean Energy Finance and Investment Authority, the former name of the Connecticut Green Bank.

While brokers would provide the Connecticut Green Bank with REC future prices 3–5 years out, this was far less than the REC-generating lifetime of a system.

Therefore, the Connecticut Green Bank was required to consult frequently with its brokers to find new forward contract buyers or else incur out-year risk in selling into the spot market. In either case, management of new RECs brought about a new source of risk and its associated transaction costs.

Furthermore, Connecticut had been experiencing an increasing reliance on out-of-state generation for compliance with the RPS.

Rather than purchase RECs from Connecticut Class I generators, the utilities and competitive suppliers of electricity were either importing RECs across Connecticut's borders or simply complying via the Alternative Compliance Payment (ACP), a $55 charge statutorily fixed at a higher $/MWh price than the other in-state RECs.

By 2014, about 15% of renewable-electricity compliance was coming from in-state generation.[5]

Thus, while Connecticut ratepayers were paying for RPS compliance through their utility bills, they were creating demand for renewable-energy generation and its attendant economic benefits in other states. This was mostly for biomass in Vermont and New Hampshire and wind in Maine.

In 2015, the Connecticut legislature, the Connecticut Green Bank, and the state's Department of Energy and Environmental Protection (DEEP) decided to shift the RPS's tax-revenue and job-creation benefits back to the state of Connecticut—in part, through the SHREC policy.

MARKET

Eversource Energy (Eversource)[6] and Avangrid[7] are the state's two investor-owned utilities. Nearly all electricity generation in the state comes from independent producers and municipal utilities.

The state of Connecticut has one of the highest average residential electricity prices in the United States—20.12 cents per kWh as of April 2017.[8] Approximately 54% of the state's net electricity generation is sourced from the Millstone nuclear power station. 41% is from natural gas-fired power plants. In addition, 1% is from hydroelectricity and 2.4% is from non-hydro renewables.[9]

Also, 20% of the state's greenhouse gas emissions come from the electricity sector.

5 Docket No. 15-09-18

6 Used to be Connecticut Light & Power

7 Used to be United Illuminating

8 U.S. Energy Information Administration 2017 average price of electricity to ultimate consumers (https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a)

9 U.S. Energy Information Administration March 2017 data (https://www.eia.gov/state/?sid=CT#tabs-4)

To reduce these emissions, the state's RPS sets the goal of obtaining 23% of the state's electricity from renewable-energy resources by 2020. It also targets sourcing another 4% from energy-efficient technologies that include combined heat and power.

RECs are one tool the state uses to accomplish its sustainable-energy goals.

The Connecticut Green Bank's memo, "Solar Home Renewable Energy Credits (SHRECs): Growing Connecticut's Solar Market," describes RECs as follows:

> **Utilities comply with RPS by purchasing renewable-energy certificates (RECs). A REC is a tradable certificate that represents all the positive environmental attributes of electricity generated from a residential solar-electric system, separate from the actual electricity itself.**
>
> **Each time a clean-energy system generates 1,000 kWh of electricity, a REC is metered that can be sold or traded as a transferable commodity.**
>
> **When a buyer makes an environmental claim based on a REC, the REC is considered used. The buyer then can no longer sell the REC and it is permanently retired.**

Connecticut recognizes three classes of RECs, distinguishable by the type of generator used to produce them. When utilities buy too few RECs, they instead must pay an ACP. For example, in 2014, per Docket No. 15-09-18, there was an ACP of over $7 million paid through the RPS.

The state implemented several utility incentive programs to promote solar photovoltaic (PV) systems, including a requirement by statute to provide net metering to customers that generate electricity using "Class I" [10] renewable-energy resources.[11]

This program allows owners of solar PV systems to feed the excess generated electricity back into the grid, thus creating a charge in the final consumer's bill for only the net electricity used.

Through the Connecticut Green Bank, the state also offers incentives for the development of renewables for residential customers.

Starting in 2004, Connecticut implemented a rebate program for residential installation of solar PV systems up to 5 kW.

In 2011, with the passage of Public Act 11-80, the structure of the incentives evolved to create the RSIP, which would spur the deployment of no less than 30 MW of new residential PV installations by the end of 2022.

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10 This is legally defined as "electricity derived from solar power; wind power; a fuel cell; geothermal; landfill methane gas, anaerobic digestion or other biogas derived from biological sources; thermal electric direct energy conversion from a certified Class I renewable energy source; ocean thermal power; wave or tidal power; low emission advanced renewable energy conversion technologies; a run of-the-river hydropower facility that began operation after July 1, 2003, and has a generating capacity of not more than 30 megawatts, provided the facility is not based on a new dam or a dam identified as a candidate for removal; or a biomass facility that uses sustainable biomass fuel, as defined in Conn. Gen. Stat. §16-1(a)(39), (cultivated and harvested in a sustainable manner)."

11 CGS § 16-243H.

The RSIP rebate program was developed by the Connecticut Green Bank [12] with the goal of supporting development of the 30 megawatts of residential solar PV while creating jobs and supporting local economic development.

The Connecticut Green Bank established and implemented a declining incentive program through a combination of rebates and performance-based payments with an umbrella of private third-party capital-financing support for both homeowners and contractors. A goal of the Connecticut Green Bank was to reduce the market reliance on subsidies by attracting and deploying more private capital investment in financing programs, the RSIP would be a transition to the sustained orderly development of a local residential solar PV industry in Connecticut.

Connecticut launched a suite of financing programs to support this incentive-decline strategy. These included the CT Solar Lease ($45 million), the CT Solar Loan (from $6 million to $100 million), and the Smart E-Loan.[13]

Specifically, RSIP provides homeowners an expected performance based buydown incentive as a $-per-watt upfront cost reduction to contractors on behalf of homeowners who purchase solar systems. Alternatively, it can also provide a performance-based incentive for third-party owners of systems leased to homeowners or for solar PV energy supplied to homeowners under power-purchase agreements with few or no upfront costs. These costs consist of quarterly payments for 6 years based on actual system performance and are adjusted, per statute, to be economically comparable to the upfront incentive.

As part of the contract with home owners or installers, the Connecticut Green Bank receives the Class I RECs from the distributed-generation system.

The purpose is to sell the RECs and create capital to channel back to the organization for future investment.

As of the end of June of 2017, the state has approved and completed nearly 145 MW of projects.

12 Section 106 of Public Act 11-80.

13 The CT Solar Lease is a public-private partnership with US Bank, Key Bank, and Webster Bank. The CT Solar Loan is a public-private partnership with Sungage Financial. The Smart E-Loan is a public-private partnership with local community banks and credit unions across Connecticut.

Solution

In 2015, the Connecticut Green Bank proposed an alteration to the existing RSIP program in order to maintain the success of the program and allow the state and its economy to capture a larger portion of its benefits.

The program would have a new REC funding source called SHREC—Solar Home Renewable Energy Credit. It would allow the Connecticut Green Bank to monetize a 15-year stream of RECs from residential solar PV systems through the sale of the actual RECs under a 15-year fixed-price contract with the utilities called a Master Purchase Agreement (MPA).

The MPA was approved by PURA through Docket No. 16-05-07 in January of 2017.

PURA is Connecticut's regulatory commission mandated with overseeing regulated utilities to ensure safe and reliable service at reasonable rates. Its oversight includes approval of utility procurement. Therefore, it must review and approve the MPA before the SHREC program can be implemented. This includes making decisions about the SHREC REC aggregation process for the thousands of systems included in each.

This would allow the Connecticut Green Bank to continue to monetize the value of all RECs produced by the residential PV installations, yet eliminate the existing price risk and transaction costs of REC management.

The aggregation of nearly 55 MW of SHRECs generated from thousands of residential solar PV systems was approved by PURA in May 2017 through Docket Nos. 16-08-45 (7.58 MW), 17-03-37 (20.60 MW), 17-03-38 (6.90 MW), 17-03-39 (4.30 MW), 17-03-40 (6.43 MW), and 17-03-41 (8.73 MW).[14]

Sales of the RECs to the utilities would generate a fixed, reliable source of funding for the RSIP program. Further, by establishing a fixed stream of CT residential RECs for the utilities, the SHREC program would ensure that a portion of RPS expenditures were channeled toward in-state generation.

In sum, the Connecticut Green Bank's objectives are to create a policy to achieve residential-solar-PV-market scale and system affordability in line with Connecticut's overall policy agenda.

One important difference between the current RSIP with SHRECs and the pre-SHREC RSIP is that with the SHREC, the Connecticut Green Bank would not accumulate funds from resale of SHRECs to reinvest in other programs. These funds would be used via securitization and other methods to fund the RSIP installation incentives, administrative costs, and securitization costs.

14 It should also be noted that non-SHREC REC aggregations (i.e., solar PV systems approved prior to January 1, 2015) for residential solar PV systems were approved by PURA through Docket Nos. 16-06-06 (30.0 MW), 16-06-07 (14.45 MW) and 16-08-44 (2.73 MW).

LEGISLATION

HB 6838 contains several important provisions. While the bill does not make clear exactly how the Connecticut Green Bank should manage the RSIP/SHREC program, it does codify expectations for the bank's economic research and describes the intended market effects of creating the incentive schedule.

According to the bill, the Connecticut Green Bank should undertake "willingness to pay studies and verified solar photovoltaic system characteristics such as operational efficiency, size, location, shading and orientation when determining the type and amount of incentive."

The bill also lists the various cost and revenue components the Connecticut Green Bank should consider when setting the incentive to a level "sufficient to meet reasonable payback expectations of the residential consumer and provide such consumer with a competitive electricity price."

HB 6838 makes clear that the RSIP will be designed to both spur residential solar-market development while encouraging competition through a declining schedule of incentives. Simultaneously, it attempts to avoid encouraging one ownership structure over another (i.e., the lease model versus the purchase model) by requiring that the incentive structure "provide comparable economic incentives for the purchase or lease" of a home solar system.

In addition to defining the Connecticut Green Bank's agenda for market creation and management, the statute related to HB 6838 clarifies the various actors' roles and responsibilities in maintaining the program.

Importantly, the bill text notes that the Connecticut Green Bank will retain full flexibility regarding modifying the RSIP/SHREC incentive structure to account for market shifts due to federal or state law changes or changing economic conditions that would significantly alter a typical solar home's return on investment.

It also creates a timeline for implementation of the program, which has been difficult to meet for various reasons discussed below.

Perhaps most importantly, HB 6838 lays out the structure for the SHREC.

STRUCTURE

In the RSIP, solar homeowners exchange their RECs for the RSIP incentive — as has been done since 2012.

In fact, from a customer or contractor perspective, the RSIP has not changed aside from the new capacity target of 300 MW. The major programmatic change relates to how the Connecticut Green Bank sells the RECs it receives from the solar homeowners and third-party owners.

Rather than contract into the forward or spot markets through a broker, the Connecticut Green Bank will now, as of January 1, 2015, sell any RECs received through the RSIP program (SHRECs) directly to the utilities.

The revenue from the sale will go directly into funding the RSIP. The process for this portion of the SHREC structure is governed by a 15-year MPA.

The MPA essentially allows the Connecticut Green Bank to lock in a 15-year REC buyer for each year's worth of residential solar projects that receive the RSIP.

The MPA is the crux of the program, as is explained further below.

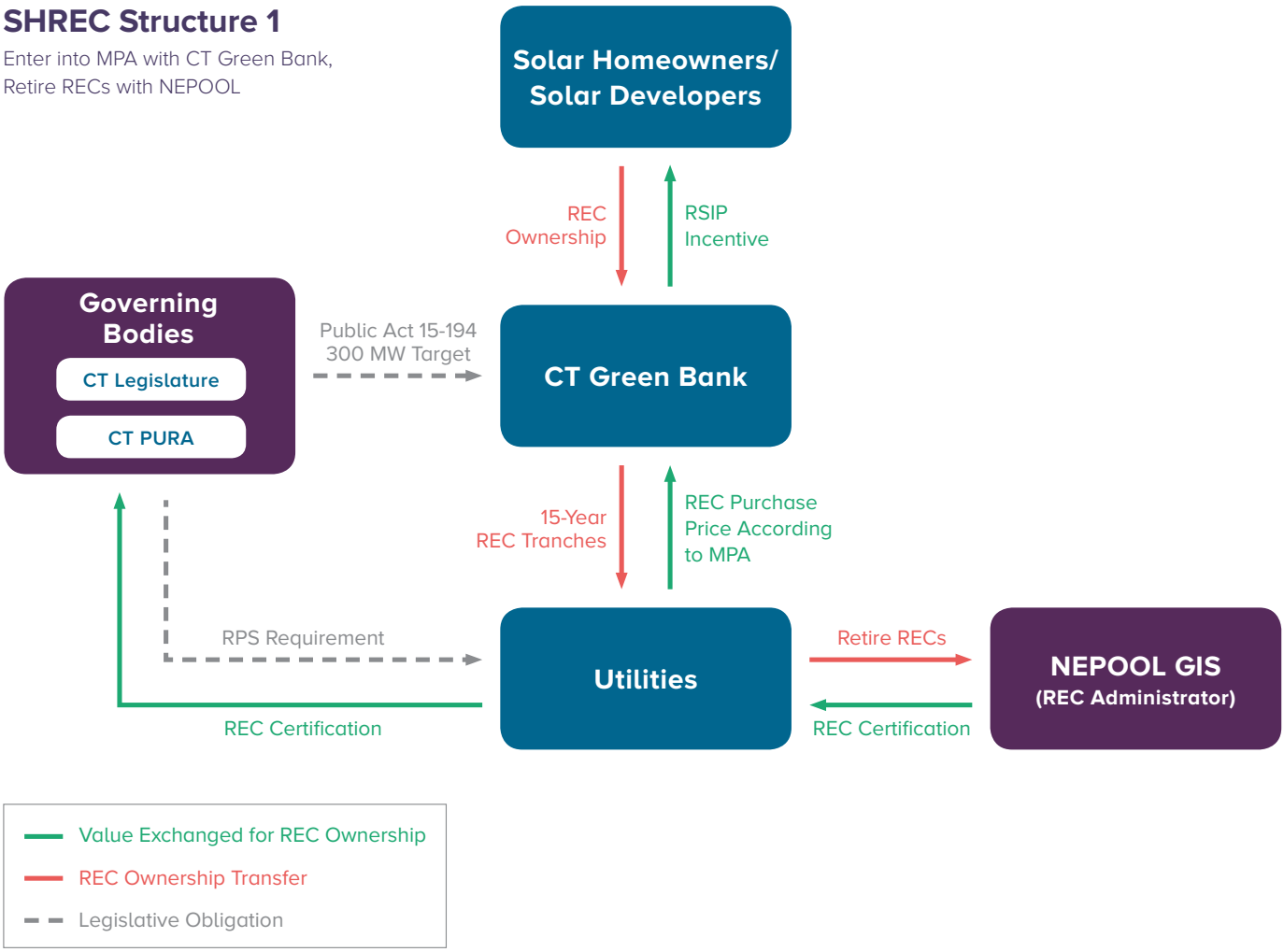
The buyer, a non-municipal utility, then has two options after receiving the RECs.

As depicted below, the utility may retire the purchased SHRECs with the New England Power Pool Generation Information System, the agency tasked with issuing and tracking certificates for electricity generation in New England ISO.

They can then use the certificates obtained to satisfy their RPS requirements with the Public Utilities Regulatory Agency (PURA).

SHREC Structure 1

Enter into MPA with CT Green Bank,
Retire RECs with NEPOOL



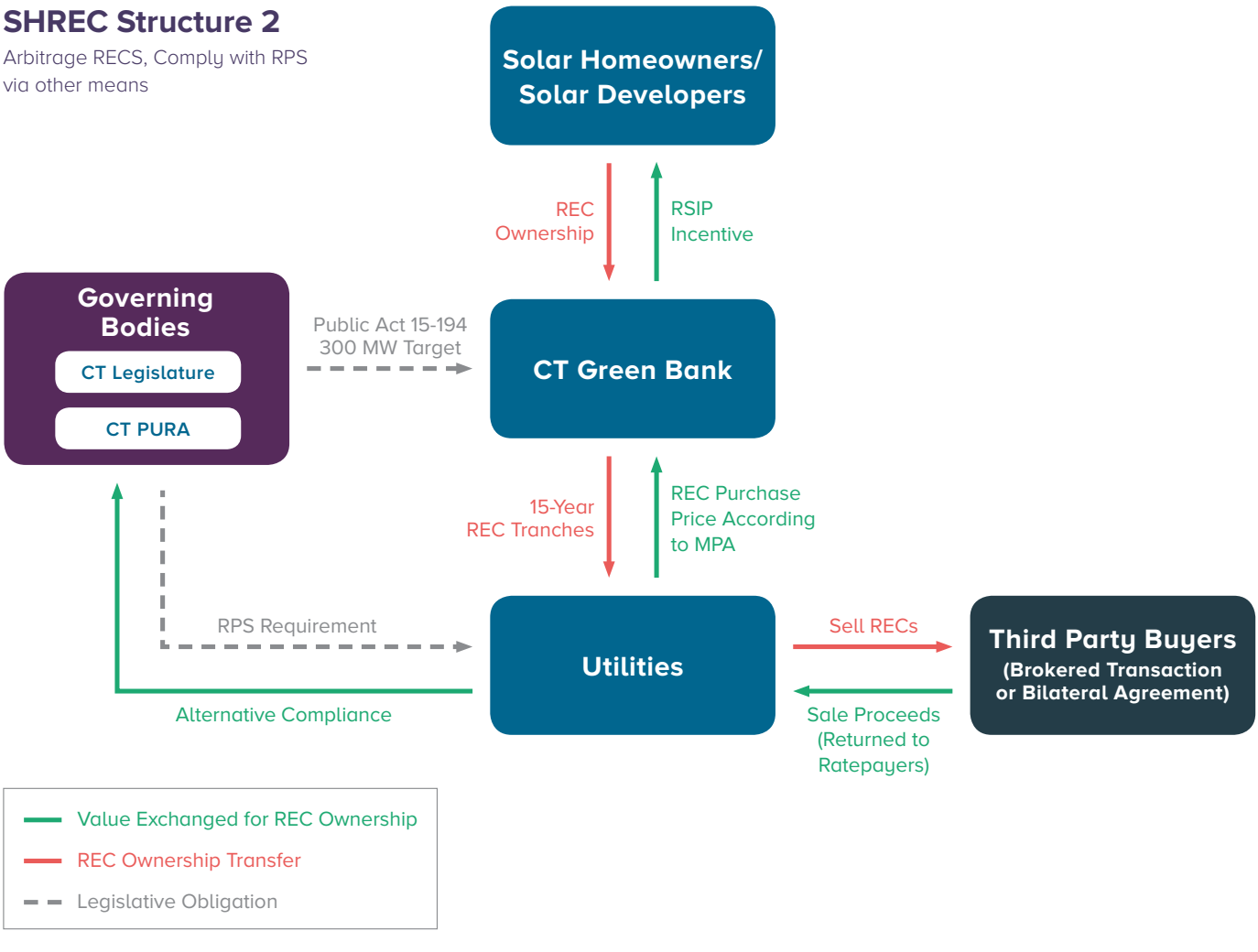
Alternatively, the utilities can elect to sell their RECs into the open market, where they may be able to negotiate a higher price than the MPA price for SHRECs. For example, in Massachusetts, the ACP is greater than $65.

In this case, the utilities would still have to comply with their RPS via some alternative means—by paying the ACP or retiring LRECs (Low-Emission Renewable-Energy Credits) or ZRECs (Zero-Emission Renewable-Energy Credits), for example.

Any income realized via SHREC arbitrage would then have to be returned to ratepayers via reconciliation during the utility ratemaking proceedings with PURA. This flexibility allows the utilities to monitor the REC markets and decide how to use the SHRECs in the best interest of their ratepayers.

SHREC Structure 2

Arbitrage RECS, Comply with RPS via other means



AGREEMENT

The MPA is a negotiated agreement between the Connecticut Green Bank and the state's two investor-owned utilities, Avangrid and Eversource. The critical components of the agreement are below.

Tranche Term Definition

The MPA is intended to govern an annual transaction between the Connecticut Green Bank and the utilities in which the utilities will purchase a new tranche at varying SHREC prices each year.

The MPA defines a given year's tranche as all SHRECs generated by SHREC projects that were not included in a prior tranche over the entire duration of the tranche term. The MPA sets each tranche term for 15 years at a fixed price.

The 2017 tranche, for example, which is the first tranche, would include all SHRECs created from residential solar projects in 2015 and 2016 and all of the RECs produced thereafter by these residential solar projects for 15 years.

The total number of tranches will be equal to the number of years between the effective date of the MPA and the Final Tranche Delivery Term, as described below.

Tranche Purchase Price

Price and terms of payment will be finalized with the executed MPA, which is expected to be ready in the summer and fall of 2017.

The first tranche SHREC price will be $50–$5 below the ACP of the Class I RPS.

Key Seller Obligations

Prior to selling SHRECs to the utilities via the MPA, the Connecticut Green Bank must ensure that certain preconditions are met.

These conditions include

1. A full regulatory approval of the MPA (Docket No. 16-05-07)
2. Preparedness of the SHREC aggregation process (Docket Nos. 16-08-45, 17-03-37, 17-03-38, 17-03-39, 17-03-40, and 17-03-41)
3. Execution of a Tranche Confirmation Agreement between buyer and seller detailing the quantity and price of SHRECs to be purchased
4. Verification of certain qualitative aspects of the SHREC projects

The Connecticut Green Bank is also required to maintain this aspect of quality control over the lifetime of the agreement and notify the buyer when individual SHREC projects go out of service and will no longer be producing RECs.

Under the MPA, the Connecticut Green Bank must deliver the SHRECs to the utility as provided by their percentage allotment—unless they are assigned as described below.

Key Buyer Obligations

The utilities are obligated to purchase their entire allotment of each tranche of SHRECs through the length of each tranche term.

Final Tranche Delivery Term and MPA Termination

Once the 300 MW residential solar target has been met, the utilities are no longer bound by the terms of the MPA.

While they are still required to purchase SHRECs generated for the entirety of each tranche's 15-year term, they will not be required to continue purchasing new tranches once the target has been met.

Specifically, the target date is set based on one of the following two criteria: 300 MW of CT residential solar PV development or December 31, 2022.

Policy Risk Reduction

Recognizing that the value for the utilities in entering into such a contract centers around easing the management burden of meeting their RPS, certain portions of the MPA allow for the utilities to retain some value in the event of a policy change eliminating the intended use of the SHRECs.

If, for example, the SHREC or the regulatory framework governing it (like the classification of solar home RECs as Class I RECs) is amended, the MPA provides that the utilities may then qualify the SHREC projects in another state program for REC certificates in order to meet the Connecticut RPS.

Buyer Percentage Entitlement

Importantly, utilities are entitled to an out-year "Buyer's Percentage Entitlement" portion of the RECs generated from SHREC projects beyond the 15-year term at *no charge*.

For Eversource, "Buyer's Percentage Entitlement" is 80% of the SHRECs created by NEPOOL GIS within each tranche. For Avangrid, it is 20%.

The delivery of such out-year SHRECs constitutes another obligation of the Connecticut Green Bank. The RECs will be sold or retained by the utilities in the best way for the ratepayers.

Assignment and Securitization

The MPA prohibits unilateral assignment of the contract by the buyer without the consent of the seller except in the case of a corporate consolidation event where the buyer's interests are transferred to another entity.

On the seller side, however, the MPA provides for the collateral assignment without consent of the buyer as it relates to financing the future revenue stream of the SHRECs.

This was done with the intent of allowing Connecticut Green Bank to securitize SHRECs in order to sell to third party investors.

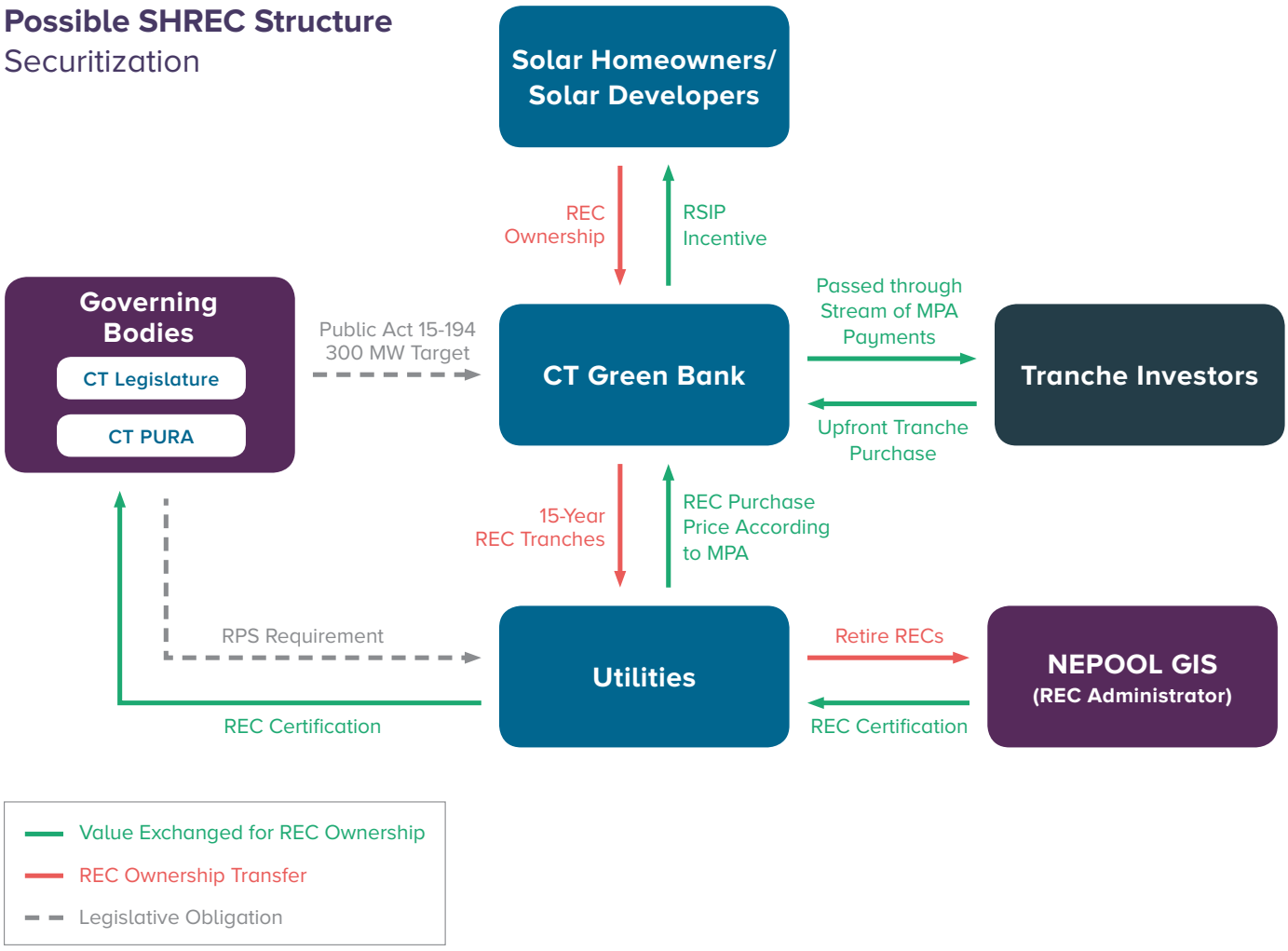
Connecticut Green Bank would receive an upfront payment in exchange for the rights to all RECs generated from a tranche of SHREC projects.

According to a study conducted by consulting group Sustainability Energy Advantage, SHRECs are expected to save ratepayers between $68 and $186 million (in 2015 dollars) compared to a scenario in which utilities simply comply with their Class I RPS obligations using the ACP.

Meanwhile, in supporting the residential solar market in Connecticut, SHRECs are expected to contribute to the creation of over 6,300 private sector jobs and $530 million of economic development.[15]

15 Connecticut Center for Economic Analysis, "Connecticut Green Bank's Residential Solar Investment Program: Economic Impact Analysis of Existing Commitments and Future Scenarios"

Possible SHREC Structure
Securitization



RESULTS

The legislation passed without any outright opposition—nearly unanimously in the Senate and with 11 "no" votes out of 151 total votes in the House of Representatives.

There was a supportive coalition behind the legislation consisting of environmental organizations, solar developers, and related industry associations.

Additionally, the University of Connecticut Economic Center weighed in with a study on the economic-development benefits of the SHRECs.

Recommendations

Reevaluating the structure and size of state solar-power incentives is periodically necessary. However, if decision makers can anticipate market growth in response to policy changes like the RSIP, they can design programs in advance to continue matching funding supply with incentive demand and reduce the need for market redesigns.

The SHREC structure appears to be a solution that will maintain and support the rapid market growth that the solar industry is experiencing in Connecticut. It will also help to bring the economic benefits of this growth within state lines to a greater extent than the previous structure required. Other states may encounter the issue of benefit export as the solar market grows, so decision makers should keep Connecticut's example in mind.

Consensus-building is a key component of creating new financing programs and their associated legislation. The Connecticut Green Bank worked successfully to help build consensus around the SHREC structure. A key element to bringing Governor Malloy's support to the conversation was demonstrating a secure revenue stream to pay for the program. The prospects of economic development and job creation resulted in support from the legislature. So did the potential reduction in RPS policy costs arising from the SHREC program.

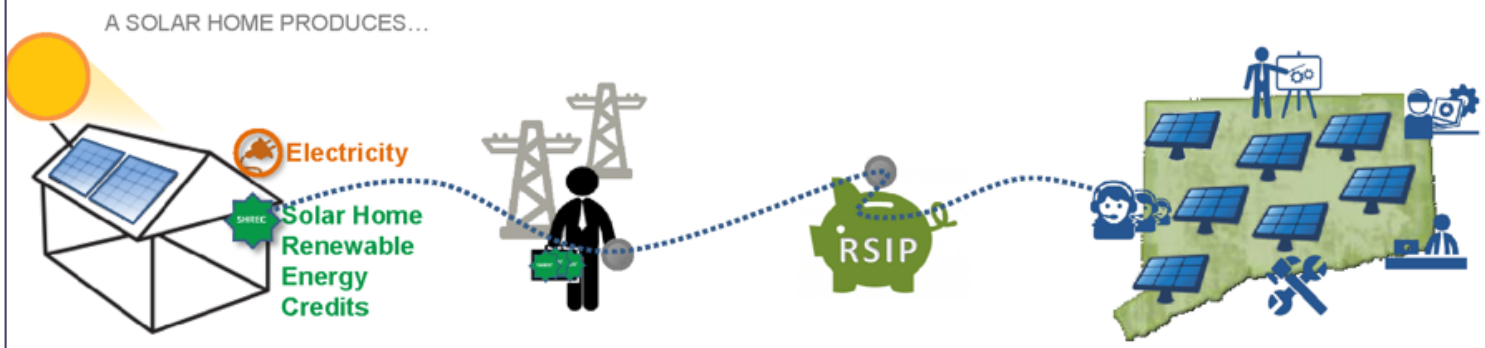
Other states developing similar programs should also pay attention to stakeholder priorities, including discussing jobs creation through market development. The SHREC funding structure for RSIP came in at the intersection of economic development and more renewable power for the state.

The financial advantages of these solutions should be emphasized. For example, the deployment of renewable energy in Connecticut would allow utilities to pick up RECs at a reduced price over time. The only issue has been making sure that utilities receive cost recovery from ratepayers.

Appendix

SHREC
Environmental Finance

CONNECTICUT GREEN BANK



When panels produce electricity for a home, they will also produce Solar Home Renewable Energy Credits (SHRECs). The green bank collects all the SHRECs produced.

Utilities would enter in to 15-year contracts with the green bank to purchase the stream of SHRECs produce from residential solar systems for RPS policy compliance.

The green bank would then use the revenues from the 15-year fixed price contracts to continue attracting private investment into the residential solar market through the RSIP program.

A SHREC policy for over 300 MW will attract over $1 billion of private investment in residential solar in CT, contribute $532 million to the state economy, create 6,000 job-years, and save ratepayers estimated $68 million in energy costs from Class I RPS policy.

1 Connecticut Center for Economic Analysis at the University of Connecticut (February, 10, 2015)

2 Sustainable Energy Advantage (February 10, 2015) – Energy cost savings based on IRP assumptions of RPS compliance costs.