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CLEAN ENERGY
FINANCE AND INVESTMENT AUTHORITY

February 8, 2012

Dear Clean Energy Finance and Investment Authority Board of Directors:

We are looking forward to the next Board of Directors meeting on Tuesday, February 14th from 3:00 to 4:00 p.m. at our offices located at 865 Brook Street Rocky Hill, CT.

Please note that we have not provided all of the background materials in this mailing. These materials cannot be available until Friday afternoon on February 10, 2012 because we have two very important meetings this week – the results of which will provide additional mailing information for the Board:

1. Deployment Committee Meeting – review and recommend approval to the Board of Directors of the Residential Solar Investment Program that will take place on February 9, 2012 from 8:30 to 10:30 a.m.

2. Comprehensive Planning Meeting – facilitated discussion of the final pieces of the Comprehensive Plan including objectives, financing strategies, structure, and principles that will take place on February 9, 2012 from 10:30 a.m. to 3:30 p.m.

As you can see, we are in full implementation mode at CEFIA, including having recently met with several CEO's of local community banks on financing programs.

It was stressed at the last Board meeting a desire to get financing programs in place. As a result, we are looking to adopt a standard for commercially reasonable lending practices that will enable us to get our financing programs moving. As background, you will find a useful memo written by Latham & Watkins which provides an overview of our statute and the potential finance opportunities it presents.

I will not be present at the Board meeting in-person, but I will be attending by phone. I am on vacation in Spain and Egypt from February 11th through the 29th. As a result, I am asking Brian Farnen to coordinate the meeting with Commissioner Smith.

If you have any questions, comments or concerns, please feel free to contact me at any time.

We look forward to the meeting next week.

Sincerely,

Bryan Garcia
President and CEO

CLEAN ENERGY
FINANCE AND INVESTMENT AUTHORITY

REVISED AGENDA

Board of Directors of the
Clean Energy Finance and Investment Authority
865 Brook Street
Rocky Hill, CT 06067

Tuesday, February 14, 2012 – Special Meeting
3:00-4:00 p.m.

Staff Invited: Jocelyn Anastasiou, George Bellas, Christin Cifaldi, Brian Farnen, Keith Frame, David Goldberg, Dale Hedman, Dave Ljungquist, and Bob Wall

1. Call to order
2. Public Comments – 10 minutes
3. Approval of meeting minutes for January 20, 2012* – 5 minutes
4. Update from the General Counsel – 5 minutes
5. Residential Solar Investment Program update and recommendations by the Deployment Committee* – 20 minutes
6. Discussion of the Comprehensive Plan – 10 minutes
7. Adoption of a broad standard of commercially reasonable lending practices* – 5 minutes
8. Discussion of two new pilot programs under Section 103 of Public Act 11-80 – 5 minutes
9. Adjourn

* Denotes item requiring Board action

Call-in information: 1-877-885-3221 access code: 8446562

Next Meeting: Friday, March 16, 2012 from 9:00-11:00 a.m.
Clean Energy Finance and Investment Authority, 865 Brook Street, Rocky Hill, CT

CLEAN ENERGY
FINANCE AND INVESTMENT AUTHORITY

REVISED RESOLUTIONS

Board of Directors of the
Clean Energy Finance and Investment Authority
865 Brook Street
Rocky Hill, CT 06067

Tuesday, February 14, 2012 – Special Meeting
3:00-4:00 p.m.

Staff Invited: Jocelyn Anastasiou, George Bellas, Christin Cifaldi, Brian Farnen, Keith Frame, David Goldberg, Dale Hedman, Dave Ljungquist, and Bob Wall

1. Call to order

2. Public Comments – 10 minutes

3. Approval of meeting minutes for January 20, 2012* – 5 minutes

   Motion to approve the minutes of the Board of Directors January 20, 2012 Regular Meeting. Second. Discussion. Vote.

4. Update from the General Counsel – 5 minutes

5. Residential Solar Investment Program update and recommendations by the Deployment Committee* – 20 minutes

   WHEREAS, Section 106 of Public Act 11-80 "An Act Concerning the Establishment of the Department of Energy and Environmental Protection and Planning for Connecticut's Energy Future" (the Act) requires CEFIA to design and implement a Residential Solar Photovoltaic Investment Program (Program Plan) that results in a minimum of thirty (30) megawatts of new residential PV installation in Connecticut before December 31, 2022.

   WHEREAS, pursuant to Section 106 of the Act, CEFIA has prepared this Program Plan to identify barriers to the development of a permanent Connecticut-based solar workforce and support comprehensive training and accreditation and certification programs.

   WHEREAS, pursuant to Section 106 of the Act, CEFIA has prepared this Program Plan to offer direct financial incentives, in the form of performance-based incentives or expected performance-based buydowns, for the purchase or lease of qualifying residential solar photovoltaic systems.

WHEREAS, CEFIA has prepared a declining incentive block schedule ("Schedule") that: (1) provides for a series of solar capacity blocks the combined total of which shall be a minimum of thirty megawatts and projected incentive levels for each such block; (2) provides incentives that are sufficient to meet reasonable payback expectations of the residential consumer; (3) provides incentives that decline over time and will foster the sustained, orderly development of a state-based solar industry; (4) automatically adjusts to the next block; and (5) provides comparable economic incentives for the purchase or lease of qualifying residential solar photovoltaic systems.

NOW, therefore be it:

RESOLVED, that the Board hereby approves of the Program Plan and Schedule as presented by the CEFIA staff and as subsequently modified by the Deployment Committee.

RESOLVED, that Section 2.3.2 - Financing of the Program Plan is hereby deleted and will be reviewed by the Deployment Committee at a later date for approval.

RESOLVED, that the Board approves a total allocation of $8,850,000 (inclusive and not in addition to any previous funding) to be used for (1) incentives supporting steps one and two of the Program Plan and (2) program operations.

RESOLVED, the CEFIA staff will (1) continuously monitor activities pursuant to the Program Plan and (2) provide quarterly updates to the Deployment Committee.

RESOLVED, at the point that $5,000,000 has been committed to projects under the Program, the Deployment Committee will decide whether and how to modify the Program Plan after steps one and two to ensure the sustained and orderly deployment of the residential solar market in Connecticut.

RESOLVED, that this Board action is consistent with Section 106 of the Act.

RESOLVED, that the proper CEFIA officers are authorized and empowered to do all other acts and execute and deliver all other documents as they shall deem necessary and desirable to effect this Resolution.

6. Discussion of the Comprehensive Plan – 10 minutes

7. Adoption of a broad standard of commercially reasonable lending practices* – 5 minutes

WHEREAS, Section 99 of Public Act 11-80 "An Act Concerning the Establishment of the Department of Energy and Environmental Protection and Planning for Connecticut's Energy Future" (the Act) requires CEFIA to develop standards to govern the administration of CEFIA through rules, policies and procedures that specify borrower eligibility, and terms of support before making any loan, loan guarantee, or such other form of financing support or risk management for clean energy projects.

WHEREAS, CEFIA plans on partnering with financial institutions (i.e. banks, insurers and third party administrators) for financing support and risk management for all clean energy projects.

NOW, therefore be it:

RESOLVED, that the Board approves that CEFIA adopt, as minimum standards, the commercially reasonable lending and risk management standards established by the financial institutions that CEFIA partners with in the development and management of financing and risk management for clean energy projects.

8. Discussion of two new pilot programs under Section 103 of Public Act 11-80 – 5 minutes

9. Adjourn

* Denotes item requiring Board action

Next Meeting: Friday, March 16, 2012 from 9:00-11:00 a.m.
Clean Energy Finance and Investment Authority, 865 Brook Street, Rocky Hill, CT

CLEAN ENERGY FINANCE AND INVESTMENT AUTHORITY
Board of Directors
Draft Minutes – Regular Meeting
Friday, January 20, 2012

A regular meeting of the Board of Directors of the **Clean Energy Finance and Investment Authority ("CEFIA")** was held on January 20, 2012, at the office of CEFIA, 865 Brook Street, Rocky Hill, CT.

1. Call to Order: Catherine Smith, Chairperson of CEFIA, called the meeting to order at 9:08 a.m. Board members participating: Mun Choi; Mark Cirilli; Daniel Esty, Vice Chairperson of CEFIA; Norma Glover; Donald Kirshbaum,; Reed Hundt (by phone), Catherine Smith,.

Member Absent: John Olsen; Matthew Ranelli; and Patricia Wrice

Staff Attending: Brian Farnen, Jocelyn Anastasiou; Keith Frame, Bryan Garcia, David Goldberg, Dale Hedman, Dave Ljungquist, Shelly Mondo, and Cheryl Samuels.

Others Attending: Peggy Diaz and Jonathan Schrag (by phone) of the Department of Energy and Environmental Protection; Jessica Bailey, the Rockefeller Brothers Fund (by phone); Eric Brown, CBIA (byphone):Dot Kelly, Darien; and Mike Trahan, Solar Connecticut.

2. Public Comments:

Mr. Trahan gave a brief description of Solar Connecticut and its members. He noted that Solar Connecticut has provided comments to CEFIA on the Residential PV Program. Mr. Trahan commended CEFIA, its leadership and staff for conducting an open process, sharing information with the public and accepting ideas from stakeholders. He thanked CEFIA for considering changes to its programs based on information received from the public and further stated that the industry is pleased that workforce development is incorporated into the program plan.

Dot Kelly, a member of the Connecticut Resource Recovery Board, thanked CEFIA for its leadership and encouragement of alternative energy sources.

3. Approval of Minutes of Meeting of December 16, 2011:

Ms. Smith asked the Board to consider the minutes from the December 16, 2011 Board meeting.

There was consensus to make the following change to the draft minutes:

- Under "Others Attending," change Ms. Diaz's affiliation to the Department of Energy and Environmental Protection.

Upon a motion made by Mr. Choi, seconded by Mr. Esty, the Board members voted unanimously in favor of adopting the minutes from the December 16, 2011 meeting as amended.

4. Update from the President:

Mr. Garcia reported on the Chief of Staff search, noting that CEFIA received approximately 60 applications for the position. He mentioned that final interviews will be conducted this afternoon with two finalists. Mr. Garcia briefly spoke about the experience and qualifications of the two finalists and mentioned that the finalists have been asked to prepare a memorandum in response to a scenario provided and to have a conversation with the search committee on the recommendations made in the memo.

Mr. Garcia provided an update on the American Recovery Reinvestment Act ("ARRA") State Energy Program ("SEP"). He mentioned that the U.S. Department of Energy ("DOE") visited several ARRA funded-projects and were pleased with the progress at the sites. The Connecticut Clean Energy Fund ("CCEF") was allocated ARRA funding of $4,000,000 for solar thermal, $5,000,000 for geothermal, $3,000,000 for Solar PV, and $8,000,000 for fuel cells; and staff has been working since November 2011 to repurpose $8,250,000 of the $20,000,000 ARRA funding into a technology agnostic residential clean energy finance program. Mr. Garcia explained the rationale using the funding for a residential financing program rather than commercial program, noting that residential projects are excluded from many of the administrative encumbrances and requirements imposed by federal funds. He mentioned that CEFIA is receiving a lot of support and technical assistance on the structure of the program from DOE. Mr. Garcia stated that staff will be meeting with banks in the coming weeks and month about the program. A suggestion was made to meet with the banks before finalizing the structure of the program to which Mr. Garcia agreed. Mr. Garcia mentioned that staff has met with Howard Pitkin, Banking Commissioner, who is assisting with providing contacts at various banks. A suggestion was made to take steps to have the Banking Commissioner serve as a member of the CEFIA Board. The Board agreed with this suggestion.

Mr. Garcia explained some leverage ratios for programs in other states across the country. He mentioned that best practices are being reviewed in an effort to identify a better program design for Connecticut. A suggestion was made by Mr. Esty to look at lessons learned as well. Mr. Garcia discussed the importance of balancing the funds of the program with appropriate marketing of the program. Mr. Garcia and Ms. Bailey summarized some the discussions held with external groups and DOE thus far on the various financing programs. A memorandum will be prepared identifying the key points, including best and worst practices, understanding marketing issues, and the types of projects that have been successful and work. Ms. Bailey noted the importance of the Governor acting as the chief communicator. Mr. Kirshbaum noted that the Connecticut Development Authority ("CDA") has a similar loan guarantee program and expressed interest in hearing some suggestions to make the CDA program more successful.

The Board members expressed the urgency to get the residential clean energy finance program up and running and the importance of making sure that the program is easily accessible to everyone. Some guidance was provided for structuring the program (i.e. having a contact name, having the technical expertise, making the program simple to understand and easily accessible, contacting other agencies who have experience with operating programs at this scale, extracting best practices as well as lessons learned from failures, and having the appropriate marketing tools in place). A suggestion was made for CEFIA to use its own capital for a loan program to get the money out and to eventually sell the loans.

Some concern was expressed that CEFIA may not be able to reach its goals strictly with the residential program. It was noted that a different program will be necessary for the commercial projects, and the commercial program would require more tailoring while the residential program could be more routine.

Mr. Garcia reported on legislative issues. He mentioned that staff is working on making technical legislative changes to: 1) clarify the quasi-public agency status of CEFIA, 2) changing the investment fund management board appointment to a business community member to the Board; 3) adding the Banking Commissioner as a member of the Board and 4) changing CEFIA's name to the Clean Energy Authority. Additionally, CEFIA would like to propose changes to its statute and is working with the Treasurer's office to include the words "pension funds" to the list of sources of funds. Mr. Garcia mentioned that CEFIA would also like to change some of the bonding provisions giving CEFIA some of the powers and authorities that other agencies have (i.e. having a special capital reserve fund ("SCRF")) which could be more advantageous for CEFIA in the bonding market. A discussion ensued with Mr. Kirshbaum on the authorization process for the CEFIA bond issues, and it was noted by Mr. Esty that the structure of the bond package should be consistent with the State's energy and economic development policies. Ms. Smith stated that the uses of funds from the bond issues will be under the purview of the CEFIA Board. There being no objection, CEFIA will move forward with the proposed legislative agenda.

Mr. Esty mentioned that one of the priorities for the legislative session will be commercial Property Assessed Clean Energy ("PACE"). He noted that approximately thirty states have a workable program and have gotten beyond some of the obstacles with the Federal Housing Administration related to residential PACE programs. Mr. Esty indicated that meetings will be held with banks and Community Development Financial Institutions regarding commercial PACE, and underwriting standards and guidelines will be developed. Mr. Esty noted the importance of getting everyone comfortable with the proposal.

A general discussion ensued on CEFIA's relationship with DEEP and questions arose regarding policies and program issues. Mr. Esty explained that CEFIA and DEEP staff meet on a regular basis, and he is comfortable with the current arrangement. There was general consensus that DEEP should remain focused on policy issues, and CEFIA

should focus on programmatic issues. CEFIA Board members were encouraged to contact Mr. Esty with any policy questions or issues.

5. Residential Solar Investment Program Update and Recommendations:

Mr. Garcia explained that in accordance with Section 106 of Public Act 11-80 "An Act Concerning the Establishment of the Department of Energy and Environmental Protection and Planning for Connecticut's Energy Future, CEFIA is required to design and implement a residential solar photovoltaic investment program that results in a minimum of 30 megawatts of new residential PV installation in Connecticut before December 31, 2022, not utilizing more than 1/3 of the total surcharge collected annually through the CCEF (approximately $9,000,000 to $10,000,000 annually). Mr. Garcia stated that he has challenged staff with designing and structuring a program that exceeds the goals of the statute and produces 50 megawatts of residential PV with half of the proposed funding in accordance with the December 31, 2022 deadline.

Mr. Garcia stated that staff wants to structure a residential solar photovoltaic investment program to ensure that all households have access to the solar PV market, that installers are capable and qualified to install PV, and that the systems can be financed with low interest loans that include cost-effective energy efficiency measures. The program also supports the solar workforce by making provisions for comprehensive training, accreditation and certification programs. Questions arose as to whether solar installers will be required to do energy efficiency audits. It was noted that the solar installers will be required to do energy audits as they have always done, but that the more comprehensive energy efficiency measures like insulation would not be initially required. Mr. Garcia explained the proposed block incentive step-down program, noting how the incentives adjust with the installed capacity. Mr. Garcia stated that staff proposes to test the market, keep costs down and minimize subsidization. He explained the benefits of energy efficiency and noted that energy efficiency can lower the PV subsidies. The Board had a lengthy discussion on the incentives, the estimated payback time both with and without energy efficiency, the upfront costs of the systems, and the role of low cost capital. Some concern was expressed that the manner in which the information about the program is provided is not easily understood. Additional concerns were expressed that the upfront costs for the systems are too high and that the estimated payback period may be too long. The Board discussed possible ways to reduce upfront costs to homeowners. A suggestion was made to aggregate panels to lower panel prices. However, some concern was expressed with excluding contractors if one supplier is chosen to provide all the panels, and that this approach was inconsistent with the requirements under the statute.

A discussion ensued on how to proceed given some of the concerns raised. It was noted that there is approximately $3,250,000 of available funding that was approved for fiscal year 2012 and could be used to start moving forward with a pilot program while the details of the program are being finalized. The Board discussed some of pros and cons with moving forward without finalizing the program details. The Board invited Mr. Trahan to comment on the issue from a stakeholder perspective. Mr. Trahan indicated

that the industry in Connecticut is not robust at this time because of the uncertainties in the market. He noted the need to develop a solid program and not a program that may change in several months. Mr. Trahan stated that he believes CEFIA will be able to install the targeted number of residential systems with 10-year pay backs since the system lives are 20 years. There was general consensus to have the CEFIA Deployment Committee review the issues raised and make recommendations to the Board to consider at the February meeting.

The Board discussed the development and approval of programs. There was general consensus that programs should be reviewed well in advance and in more detail at a committee level with a recommendation being made by the respective committee to the Board. Mr. Garcia noted that the committees may have to meet more frequently than quarterly if charged with reviewing and approving programs.

6. <u>Financing Program Priorities and Recommendations</u>:

The Board considered the resolution authorizing the engagement of Lamont Financial Services Corporation to provide financial advisory services to assist CEFIA with the development and implementation of new and innovative financing programs.

Upon a motion made by Mr. Kirshbaum, seconded by Mr. Cirilli, the Board members voted unanimously in favor of adopting the following resolution authorizing the engagement of Lamont Financial Services Corporation to provide financial advisory services to CEFIA:

WHEREAS, a major goal of CEFIA is to attract and deploy capital to finance Connecticut's clean energy goals;

WHEREAS, CEFIA must develop financing programs that attract private capital investment in Connecticut to enable a dramatic scale-up in clean energy deployment;

WHEREAS, Lamont Financial Services Corporation provides financial advisory services on public finance including support for the Connecticut Office of Policy and Management, Connecticut Office of the State Treasurer, Connecticut Health and Educational Facilities Authority, and the Connecticut Development Authority.

NOW, THEREFORE, BE IT:

RESOLVED, that the President of CEFIA shall engage the services of Lamont Financial Services Corporation to provide financial advisory services to assist with the development and implementation of new and innovative financing programs.

RESOLVED, that per CEFIA's Operating Procedures, the Chair and President of CEFIA are authorized to expend up to $150,000 over twelve (12) months for services such as these.

RESOLVED that this Board action is consistent with Connecticut General Statutes Section 16-245n and with the CEFIA Comprehensive Plan.

7. Approval of Committees 2012 Meeting Calendars:

Upon a motion made by Ms. Glover, seconded by Mr. Kirshbaum, the Board members voted unanimously in favor of approving the regular committee meeting schedules for the following committees 2012:

- **Budget and Operations Committee;**
- **Audit, Compliance and Governance Committee; and**
- **Deployment Committee.**

8. Other Business: There was no other business to discuss.

9. Executive Session:

Upon a motion made by Mr. Esty, seconded by Ms. Glover, the Board members voted unanimously in favor of going into executive session at 11:03 a.m. to discuss personnel matters (Mr. Garcia and Mr. Farnen were invited to attend the executive session).

The executive session ended at 11:15 a.m., and the special meeting was immediately reconvened.

10. Adjournment: Upon a motion made by Mr. Esty, seconded by Mr. Choi, the Board members voted unanimously in favor of adjourning the January 20, 2012, meeting at 11:16 a.m.

Respectfully submitted,

Catherine Smith, Chairperson

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CLEAN ENERGY
FINANCE AND INVESTMENT AUTHORITY

Residential Solar Photovoltaic Investment Program

Revised Program Plan

Table of Contents

Section 1 - Program Summary

1.1. Executive Summary and Funding Request

Per Section 106 of Public Act 11-80 (the Act), the Clean Energy Finance and Investment Authority (CEFIA) is required to design and implement a residential solar photovoltaic investment program (the Program). The Act requires that the Program result in a minimum of thirty (30) megawatts (MW) of new residential solar photovoltaic (PV) installations in Connecticut on or before December 31, 2022. Based on the Act, the Program is to be funded by no more than one-third of the total surcharge collected annually from the Clean Energy Fund (CEF).

Key components of the Program include:

- **Incentives** – direct financial incentives that decrease over time in the form of expected performance-based buy-down incentives (EPBB) and performance-based incentives (PBI) for the purchase and/or lease of qualifying residential PV systems.

- **Financing** – residential clean energy (i.e. energy efficiency and renewable energy) financing from repurposed American Recovery and Reinvestment Act (ARRA) State Energy Program (SEP) funds and new power purchase agreement programs.

- **Marketing** – community-based social-marketing campaigns and technical support offerings through solar ambassadors and coaches to acquire residential customers through innovative techniques and community-based customer acquisition strategies to lower upfront costs.

- **Legal** – integration of local, state, and federal policies and regulations to support consumers, contractors, and program administrators.

- **Workforce Development** – identification of the barriers to the development of a permanent Connecticut-based solar workforce and support for comprehensive training, accreditation and certification programs including marketing, financing, and energy efficiency.

- **Technology** – inclusion of metering and monitoring equipment, software, and online tools that are developed to provide households, contractors, program administrators and stakeholders readily accessible information.

- **Evaluation, Measurement and Verification (EM&V)** – determination of the causal effects and impacts of the Program on achieving the intentions of the Act.

The proposed program seeks to achieve the goal of at least 30 MW by the end of 2022 at an incentive level of half of the maximum level of incentives allowable by the Act (i.e. $50 million) allthewhile delivering a reasonable payback for residential customers.

To support the Program, the following funds are being requested ~~for FY 2012-2014~~ (see Table 1):

Table 1. Funding Request for the Residential Solar PV Investment Program

	~~Total~~Budget	% Budget
Incentives[1]	$7,500,000	~~6~~85%
~~Financing[23]~~	~~$3,500,000~~	~~%~~
~~Marketing~~Program Operations	$1,350,000	15%
~~Legal~~	~~$,000~~	~~1%~~
~~Workforce Development[4]~~	~~$,000~~	~~%~~
~~Technology~~	~~$,000~~	~~2%~~
~~EM&V[5]~~	~~$,000~~	~~2%~~
~~Miscellaneous~~	~~$,000~~	~~1%~~
Total	**$8,850,000**	**100%**

Of the $~~23,675,000~~8,850,000 requested for the Program, $10,475,000 was approved by the Clean Energy Fund Board of Directors as part of the FY 2011 and FY 2012 comprehensive plan.

1.2. Policy and Project Goals

CEFIA's goal for the policy is to design a declining incentive structure that exceeds the 30 MW goal, at half of the allowable costs under the statute, by the end of the year 2022, and delivering a reasonable payback for residential customers.

Here are the key short-term targets over the next year:

- **Payback Period** – demonstrate a payback period of no more than 9.0 years for solar PV only;

[1] $5,500,000 of the incentives budget allocation from the Connecticut Clean Energy Fund's FY 2011 and FY 2012 Comprehensive Plan.

[2] ~~ARRA SEP grant repurposing of $8,250,000 from grants towards financing is currently in process. Funds will be used as credit enhancements to attract private capital into a residential clean energy finance program.~~

[3] ~~$3,500,000 of revolving loan fund budget allocation from the Connecticut Clean Energy Fund's FY 2011 and FY 2012 Comprehensive Plan.~~

[4] ~~$1,475,000 of the workforce development fund budget allocation from the Connecticut Clean Energy Fund's FY 2011 and FY 2012 Comprehensive Plan.~~

[5] ~~$200,000 of the EM&V budget allocation from the Connecticut Clean Energy Fund's FY 2011 and FY 2012 Comprehensive Plan.~~

- **Subsidy** – reach Step 3 in the schedule of incentives for both the EPBB and the PBI, with a review of the proposed incentive level for Step 3 in the middle of Step 2;

- **Cost Reductions** – demonstrate up to a 20 percent reduction in the installed costs of a system with a target of $4.00/$W_{STC}$;

- **Financing** – launch a low-interest residential clean energy financing program;

- **Energy Efficiency** – demonstrate the economic case for the inclusion of energy efficiency into a solar PV project; and

- **Workforce Development** – provide support for programs that help installers market solar PV, financing, and energy efficiency.

Here are the key long-term targets over the next decade:

- Achieve at least 50 MW of new residential solar PV systems, nearly 70 percent more than the statutory goal;

- Provide less than half in incentives, as opposed to $100 million allowable by the statute;

- Reach between a 5 to 7 year payback period for residential solar PV systems (see Table 2);

- Develop a new model for residential solar PV financing that would not require the need for a subsidy, or would at least cover the cost of a subsidy over the useful life of a project; and

- Establish a permanent long-term capital base for CEFIA (i.e. return of capital)

Table 2. Estimate of the Subsidy ($/kW$_{PTC}$) Required to Achieve 10, 7, and 5 Year Payback Period vs. Range of Installed Cost ($/kW$_{STC}$)

	Range of Installed Cost ($/kW$_{STC}$)						
Payback Period	**$5.00**	**$4.38**	**$3.94**	**$3.51**	**$3.08**	**$2.81**	**$2.63**
10-Years	$2.66	$1.96	$1.47	$0.99	$0.50	$0.20	$0.00
7-Years	$3.49	$2.79	$2.30	$1.81	$1.33	$1.03	$0.82
5-Years	$4.05	$3.35	$2.86	$2.37	$1.89	$1.59	$1.38
	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
CEFIA	$2.45	$2.10	$1.75	$1.40	$1.05	$0.75	$0.55

To achieve these goals over time, CEFIA will focus on three (3) key economic drivers for a project:

1. **Subsidy** – providing EPBB and PBI incentives that decline over time;

2. **Cost Reductions** – lower the hardware and non-hardware related costs for solar PV systems through customer aggregation and other strategies; and

3. **Low-Interest Financing** – provide a low-interest product to finance the system with the possibility of repayment occurring on the bill and subsidies being repaid over time.

Although energy efficiency is an important tool to improving the economic performance of a solar PV system, it was not included in the payback analysis. Cost-effective energy efficiency measures like an energy audit, duct sealing, air sealing, and insulation, that have quick payback periods (e.g. 3 to 5 years in most cases) were not included in the payback analysis.

The following table demonstrates the short-term pathway to reducing the payback period for residential customers in Connecticut from the initial launch state to a future one-year state (see Table 3).[6]

- **No Subsidy** – the no subsidy state reflects the economics of a solar PV system at an installed cost of $5.00/$W_{STC}$, no subsidy for the solar PV system, and a discount rate of 4.0 percent. It should be noted that without a subsidy, residential solar PV currently is uneconomic for mostly all residential customers.

- **Launch State** – the launch state reflects the economics of a solar PV system at an installed cost of $5.00/$W_{STC}$, Step 1 subsidy of $2.45/$W_{PTC}$ for the solar PV system, and a discount rate of 4.0 percent.

- **Future State** – the future state demonstrates a 20 percent reduction in the installed cost (e.g. $4.00/$W_{STC}$), Step 2 subsidy for the solar PV system (e.g. $2.10/$W_{PTC}$), and a discount rate of 4.0 percent. It should be noted that Massachusetts was able to achieve an installed cost of $4.00/$W_{STC}$ through a community-based customer aggregation strategy called Solarize.

Table 3. Pathway to Sustained Orderly Development of the Residential Solar PV Industry in Connecticut

	No Subsidy State	**Launch State** (Step 1)	**Future State** (Step 2)
Installed Cost ($/kW$_{STC}$)	($5,000)	($5,000)	($4,000)
System Size (kW$_{STC}$)	5.0	5.0	5.0

[6] Assumes 14% capacity factor and 0.5% degradation rate on the solar PV system, 2% inflation rate on electricity price starting at $0.1826/kWh, and a 15-year financing term. Note the useful life of the solar PV system is 20 to 25 years.

System Cost ($)	($25,000)	($25,000)	($20,000)
Ratepayer Subsidies	$0	$10,903	$9,345
Installed Cost Post Ratepayer Subsidies	($25,000)	($14,097)	($10,665)
Federal Tax Credits	$7,500	$4,229	$3,197
Installed Cost Post Subsidies and Tax Credits	($17,500)	($9,868)	($7,459)
Debt Interest	($6,110)	($3,445)	($2,604)
Avoided Annual Energy Costs	$1,244	$1,244	$1,244
Payback	19.0	10.7	8.0
IRR	(3.4%)	5.3%	10.4%
NPV	($3,373)	$1,018	$3,983

If CEFIA is able to successfully implement a Solarize campaign in several cities and towns, then it can demonstrate a pathway towards lower payback periods for residential customers by reducing the upfront installed costs of solar PV systems while continuing to reduce subsidies.

Sensitivity analyses show that the key driver for lowering the payback period is through cost reductions of the solar PV system. To reduce the installed cost of the solar PV system, CEFIA will be implementing customer aggregation strategies that have demonstrated in other markets (i.e. Oregon and Massachusetts) significant cost reductions. Workforce development training, accreditation, and certification programs will provide support for achieving these goals by helping contractors market solar PV, sell financing, and include energy efficiency.

~~1.2.~~1.3. *Background*

The Connecticut Clean Energy Fund (CCEF) implemented a multi-year residential solar PV program that was launched in 2005. Since the inception of the program it has gone through several iterations and revisions (see Table ~~2~~4). This program provided households with the opportunity to own solar PV systems.

Table ~~33~~24. CCEF Residential Solar PV Rebate Program (2005-2011)

# of Months	Incentive Level ($/kW)	# of Systems	Installed Capacity (kW)	Installed Cost ($/kW)	Average Incentive Paid per Month
31	1st 5 kW = $5.00/W 2nd 5 kW = $0.00/W	180	622	$10,993	$115,000
21	1st 5 kW = $5.00/W 2nd 5 kW = $4.30/W	559	2,674	$10,847	$675,000
1	1st 5 kW = $4.00/W 2nd 5 kW = $2.50/W	123	636	$10,391	$2,300,000
30	1st 5 kW = $1.75/W 2nd 5 kW = $1.25/W	363	1,920	$7,624	$130,000
Total		1,225	5,851	$9,756	$300,000

In 2008, the CCEF launched a first-of-its-kind solar lease program, which achieved extraordinary success (see Table ~~3~~5). This program provided households with an opportunity to lease solar PV systems and pay less on their monthly electric bill.

Table ~~4~~3~~5~~. CCEF Residential Solar PV Lease Program (2009-2011)

# of Months	Incentive Level ($/kW)	# of Systems	Installed Capacity (kW)	Installed Cost ($/kW)	Average Incentive Paid per Month
17	1st 5 kW = $5.00/W 2nd 5 kW = $4.30/W	369	2,053	$9,995	$640,000
4	1st 5 kW = $4.40/W 2nd 5 kW = $3.30/W	246	1,451	$8,579	$1,700,000
13	1st 5 kW = $2.68/W 2nd 5 kW = $2.18/W	194	1,127	$7,425	$290,000
Total		809	4,632	$8,926	$630,000

For Connecticut's residential rooftop solar PV sector, total installed costs have dropped by nearly 40 percent over a five-year period from $11,235 to $6,911 per installed kilowatt. In general, the installed cost of a residential solar PV system is 70% for hardware related costs – 60% panels and 10% inverter – and 30% from non-hardware related costs like labor, permitting, etc. (see Table ~~4~~6)

Table ~~4~~6. Residential Sector Average Solar PV Hardware and Non-Hardware Costs (2007-2011)

Year	Average System Size (kW)	Hardware Costs		Non-Hardware Costs	% of Costs Non-Hardware Costs	$ Installed kW
		Average Module Costs	Average Inverter Costs			
2007	4.39	$28,669	$4,285	$16,266	33%	$11,235
2008	5.07	$33,853	$4,633	$15,098	28%	$10,566
2009	5.54	$34,514	$4,309	$15,345	28%	$9,783
2010	5.63	$27,885	$4,771	$12,855	28%	$8,083
2011	5.59	$22,278	$4,822	$11,516	30%	$6,911

Given the high level of incentives, increase in customer demand, and the lack of the availability of incentive funds, the Connecticut market for residential solar PV deployment experienced some challenging times beginning in 2010. The CCEF was running out of incentive funds and dropped its incentive levels resulting in a significant decrease in customer demand, a departure of local contractors to neighboring states, and contractors going out of business.

It is because of this unfortunate circumstance of too much demand in combination with high incentives and limited incentive funds that the Act now seeks to achieve the goal of sustained orderly development of the residential solar PV industry in Connecticut to develop stable and well-planned growth instead of ebbs-and-flows. The Program being proposed is designed to better manage the growth and development of the residential solar PV industry in Connecticut, while seeking to encourage competition and cleaner and cheaper energy in the marketplace.

~~*1.3.*~~*1.4. Stakeholders*

The people and organizations that will be impacted by the implementation of this program are:

- **Customers** – residential ratepayers of Connecticut Light and Power (CL&P) and The United Illuminating Company (UI) seeking to have solar PV systems installed on their homes

- **Users** – electricians and home improvement contractors working in Connecticut seeking to do the installation work for solar PV systems as well as energy efficiency

- **Partners** – financial institutions, including community, state and national banks, policy-makers (i.e. DEEP) and regulators (i.e. PURA), and companies providing 3rd party financing, and community-based and non-profit organizations assisting in acquiring customers

The staff members at CEFIA that will be actively involved in the implementation of the program include (see Table ~~5~~7):

Table ~~5~~7. CEFIA Staff FTE's in the Program

Position	FTE Equivalent
Director, Renewable Energy Deployment	0.15
Director, Energy Efficiency Deployment	0.10
Director, External and Government Affairs	0.10
Director, Marketing and Outreach	0.25
Senior Manager(s), Marketing and Outreach	0.50
Manager, Clean Energy Deployment	0.80
Manager, EM&V	0.30
Associate, Clean Energy Deployment	0.80
Associate, Marketing and Outreach	0.50
Assistant, Clean Energy Deployment	1.00
Total	**4.50**

~~*1.4.*~~*1.5. Program Goals*

Per Section 106 of the Act, CEFIA's goals with the Program are:

- Deploy at least 30 MW by the end of 2022 at half of the allowable incentives
- Attain stable and well planned growth of the solar PV industry (e.g. sustained orderly development)
- Achieve cleaner and cheaper energy for Connecticut by working towards a zero-subsidy model for solar PV deployment
- Reach a payback period to the customer of between 7 to 10 years over a 5-year period and 5 to 7 years over the next decade by reducing the current installed cost of solar PV systems
- Develop a low interest financing product that is competitive and sustainable and would eliminate the need for subsidies.
- Be transparent with our incentives, processes, and performance
- Create a vibrant market for clean energy innovation

~~1.5.~~1.6. *Organizational Goals*

How does this Program meet the following organizational goals:

- **Attract and deploy capital to finance the clean energy goals for Connecticut** – the Program is designed to leverage limited ratepayer resources by decreasing incentives over time and transitioning towards finance. The Program also encourages third party financing models to enter Connecticut and offer lease financing.
- **Become the most energy efficient state in the nation** – the Program requires participation in the Home Energy Solutions (HES) program or an energy assessment conducted by a certified contractor. It is envisioned that the Program will provide financing whereby cost-effective energy efficiency will be required to improve the economics of the solar PV system.
- **Scale-up the deployment of renewable energy in the state** – the Program is focused on supporting the local in-state deployment of at least 30 MW of solar PV systems in the residential sector.
- **Support the infrastructure needed to lead the clean energy economy** – the Program identifies the barriers to the development of a permanent Connecticut-based solar workforce and provides support for the comprehensive training, accreditation, and certification programs.

~~1.6.~~1.7. *Measures of Success*

1. **Installed Capacity** – install at least 30 MW of residential solar PV systems by the end of 2022 at half of the allowable incentives (i.e. $50 million)

2. **Incentives Leveraged** – deploy $200 million of private capital leveraged by no more than $50 million of ratepayer incentive funds to achieve a leverage ratio of at least 4:1

3. **Financing Leveraged** – launch a revolving clean energy financing program that uses credit enhancements to leverage private capital at a ratio of at least 4.5 to 1.0

4. **Customer Acquisition** – reach at least 7,500 households installing solar PV systems

5. **Model Communities** – demonstrate that 5% of households in a community can install solar PV systems.

6. **Cost Reductions** – reduce ~~non-hardware related~~ costs by ~~at least~~between 20 to ~~15~~40 percent~~%~~ by improving permitting, interconnection, and net metering processes and standards, and undertaking innovative community-based customer acquisition strategies to further lower these costs through aggregation

7. **Energy Efficiency Economics** – homeowners recognizing the importance of and then acting on cost-effective energy efficiency measures as part of a residential solar PV system

8. **Workforce** – increase the trained and employed workforce installing residential solar PV systems as well as selling financing products and undertaking energy efficiency measures

9. **Public Awareness** – Increase the knowledge and awareness of the benefits and availability of clean energy by households

10. **Accessibility** – demonstrate that solar PV systems are accessible by all income classes

~~*1.7.*~~*1.8. Opportunity for Financial Innovation*

Through the Connecticut Solar Lease program, CEFIA has been a national leader in the development of lease financing programs that require no upfront costs and provide a cheaper electricity solution for homeowners. This program has reached over 800 households and has had only two defaults.

CEFIA is developing a technology agnostic residential clean energy financing program that will take the financial innovation of the lease program for solar PV and turn it into a comprehensive program for renewable energy and energy efficiency. In collaboration with the Connecticut Energy Efficiency Fund (CEEF), CL&P and UI, CEFIA will provide

financing support for a long-term loan and/or lease financing program(s) for clean energy installations. Through the use of credit enhancements and investments, a pool of capital will be raised from community banks, community development financial institutions, credit unions, pension funds, impact investors (i.e. foundations, university endowments, etc.), and/or system benefit funds (i.e. CEFIA and/or CEEF) to provide low-cost financing for homeowners. A standard underwriting process and program guidelines will be pursued in order to develop a financial product that has the potential to be securitized and sold to institutional investors (i.e. pension funds).

CEFIA's ownership of renewable energy credits (RECs) and other energy or environmental attributes coming from the residential solar PV projects (i.e. forward capacity market payments) will be monetized. If CEFIA can find a long-term purchaser of its RECs at a reasonable price, then there is the possibility of creating a Clean Energy Victory Bond that will provide capital upfront to invest in cost-effective energy efficiency measures or for interest rate buydowns of a loan as a component of the solar PV system.

~~1.8.~~1.9. *Prior Programs*

~~1.8.1.~~1.9.1. Similar or Related CEFIA Programs

Through ARRA SEP grant funding support, CEFIA administers residential solar thermal hot water and geothermal incentive programs. The programs offer incentives of $275/MMBtu and $1,050 to $1,200/ton for solar thermal and geothermal projects respectively. These programs have reached nearly 1,000 households and created new markets for clean energy deployment.

(See also Section 1.~~2~~ 3 – Background)

~~1.8.2.~~1.9.2. Benchmarking Leaders

Working with the National Renewable Energy Laboratory (NREL), CEFIA was able to benchmark leading residential solar PV programs across the country (see Table ~~6~~8).[7]

Table ~~6~~8. Comparative Analysis of Residential Solar PV Incentive Programs

	AZ	CA	CT	NJ	NY	MA
Electric Rates ($/kWh)	$0.1107	$0.1521	$0.1826	$0.1628	$0.1812	$0.1475
Installed Cost ($/W)	$6.21	$8.23	$5.75	$6.75	$7.10	$5.56

[7] *Comparative Analysis of Residential Solar PV Incentive Programs* by Kim Peterson of the National Renewable Energy Laboratory for CEFIA (December 2011)

# of Residential Solar PV Systems	1,872	56,656	1,887	2,780	3,027	895
Installed Capacity (MW)	9.4	271.6	12.4	23.5	16.3	4.8
Average System Size (kW)	5.0	4.7	7.5	8.5	5.4	6.4
Incentives Budgets (CT Proposed)	$14.4 MM (2011)	$1.167B (2007-2016)	$~~51.0~~44.5 MM		$144 MM (2010-2015)	$8.0 MM
Current Incentive (CT Proposed)	$0.75/W	$0.25-$0.65/W EPBB; $0.03/kWh PBI	$2.45/W≤5kW and $1.25 >5kW and ≤10 kW EPBB; $0.~~34~~30/kWh PBI	$0.40/kWh	$1.75/W	$0.66/W + $0.30-$0.55/kWh
Cap	20 kW	10 kW	10 kW	100% of on-site load	7 kW	No cap, but rebates up to 5 kW
Energy Efficiency	No requirement	Self EE audit	EE audit	No requirement	EE audit encourage but not required	No requirement
REC Ownership	Utility	System Owner	CEFIA	System Owner	NYSERDA then System Owner	System Owner

1.10. Pilot Payback Programs

To support the implementation of the program, the following pilot payback programs for marketing will be pursued:

- **Solarize Campaign** – when communities run their own volume purchasing programs they reduce costs associated with a traditional solar installation. By choosing only one or two contractors, and conducting their own sales and marketing campaign, the project can hand deliver the contractors warm leads in a small geographic area in a constricted period of time. Job grouping, a

constricted time period, and community led sales can contribute to a saving of an additional 15-30 percent of the installed cost of a system based on similar programs in Oregon and Massachusetts.

Purpose of the pilot – demonstrate large-scale customer acquisition and the reduction in the installed cost of a solar PV system resulting in a faster payback period for the customer.

- **Energy Efficiency Challenge** – building on the lessons learned from the Neighbor to Neighbor Energy Challenge, a pilot program that includes cost effective energy efficiency measures as part of a solar PV project will be pursued. A competitive RFP will be issued to identify a contractor(s) that will "prove the case" that including energy efficiency with a solar PV project reduces the payback period for the project.

  Purpose of the pilot – demonstrate the energy savings value from energy efficiency in conjunction with the installation of a solar PV system resulting in a faster payback period for the customer.

- **Ratepayer Payback** – incentives provided by electric ratepayers to residential customers have led to over 2,000 solar PV installations in homes across the state. These incentives are at considerable costs to all ratepayers and benefit a limited participating few. In order to scale-up the deployment of renewable energy systems in the state, new and innovative models will need to be explored to leverage the limited resources provided by the ratepayers. As installed costs for solar PV systems continue to decline, there will be new opportunities for financing these systems through instruments such as power purchase agreements that would cover the costs of systems upfront and be paid back over time through clean electricity sales to the customer.

  Purpose of the pilot – to develop a program that would payback the electric ratepayers for providing incentives to residential customers installing solar PV systems.

Section 2 - Program Structure

2.1. Program Scope

Per Section 106 of the Act, CEFIA is required to design and implement a residential solar PV investment program. The Act requires that the Program result in a minimum of 30 MW of new residential solar PV installations in Connecticut on or before December 31, 2022. The Program is to be funded by no more than one-third of the total surcharge collected annually through the CEF – approximately $9 to $10 million a year or between $90 to $100 million over the life of the Program.

The Program serves customers seeking to install solar PV systems on their homes and contractors that are willing to provide the work to install the systems. The Program includes incentives, financing, marketing, legal, workforce development, technology, and evaluation measurement and verification components.

Incentives are a key component of the Program and are designed to:

- Decrease over time through a seven-step process; and
- Support homeowners that want to either own or lease a system.

Financing and marketing are also key components of the Program and are designed to:

- Provide access to low-cost capital to enable a homeowner to install a system;
- Reduce customer acquisition costs; and
- Scale-up the deployment of clean energy in Connecticut.

As a result of the successful implementation of the Program, Connecticut will not only have achieved the goal of installing at least 30 MW at half of the allowable incentives per the Act, but more importantly CEFIA will have developed a sustainable market for residential solar PV deployment that is not constrained by the need to provide incentives, but is instead driven-by market forces.

2.2. Program Objectives

The following are key objectives for the Program:

- Deploy at least 30 MW by the end of 2022 at half of the allowable incentives
- Attain stable and well planned growth of the solar PV industry (e.g. sustained orderly development)
- Achieve cleaner and cheaper energy for Connecticut by working towards a zero-subsidy model for solar PV deployment

- Reach a payback period to the customer of between 7 to 10 years over a 5-year period and 5 to 7 years over the next decade by reducing the current installed cost of solar PV systems
- Develop a low interest financing product that is competitive and sustainable and would eliminate the need for subsidies.
- Be transparent with our incentives, processes, and performance
- Create a vibrant market for clean energy innovation

2.3. Assumptions

The Program makes assumptions in a number of areas as it pertains to incentives, financing, marketing, legal, workforce development, technology, and evaluation measurement and verification. The two key areas are incentives and financing, which are taken up below.

2.3.1. Incentives

A large part of the Program is the schedule of incentives for the Expected Performance Based Buy-Down Incentives (EPBB) and the Performance-Based Incentives (PBI). To develop the incentives for the Program, the following assumptions were used (see Table 9):

Table 9. Assumptions Used in the Economic Analysis for the EPBB and the PBI

Assumption	EPBB	PBI
System Cost	$5/W$_{STC}$ declining ~~by~~ at a compound rate of 5% ~~from each~~over the 7 steps	$5/W$_{STC}$ declining at a compound rate of 5% over the 7 steps~~$5/W$_{STC}$ declining by 5% from each step~~
Utility Avoided Cost	$0.1826 per kWh increasing by ~~1~~2% annually	$0.1826 per kWh increasing by ~~1~~2% annually
Incentive	Paid during and immediately after in-service date	Paid out on a quarterly basis based on performance over a 6-year period
Federal ITC Calculation	(Installed Cost – EPBB) * ITC	Installed Cost * ITC with PBI as taxable income
Debt Ratio	100%	35% (+ or -)
Debt Rate	~~6~~4%	~~6~~4%
Debt Term	15 years	15 years
Equity Rate	N/A	12%
Depreciation	N/A	5 years MACRS
Tax Rate	N/A	39.5~~4~~%
Inflation Rate	N/A	2%

Source/Servicing Fee	N/A	4% outstanding debt

It should be noted that the statute requires that CEFIA implement a schedule of incentives that provide for a reasonable payback expectation of the residential customer taking into consideration installed cost, value of avoided energy costs, state and federal incentives and tax credits, and renewable energy credits.

~~2.3.2. Financing~~

~~In order to achieve the goal of sustained orderly development, not only do incentives have to decrease over time, but financing must be offered to customers interested in either owning or leasing solar PV systems. To support the Program, the following assumptions of the terms and conditions for the product are being considered for financing:~~

~~Term~~	~~Description~~
~~Size of a loan~~	~~$1,000 – $25,000~~
~~Term of a loan~~	~~60, 120, or 180 months, according to the residential customer's choice – target is 10 years with solar PV and energy efficiency integration.~~
~~Expected average loan size~~	~~$20,000~~
~~Target capital providers~~	~~Community banks, community development financial institutions (CDFIs), credit unions, pension funds, impact investors (i.e. foundations, university endowments, etc.) and/or system benefit funds (i.e. CEFIA and/or CEEF)~~
~~Interest rate charged to the customer~~	~~Seeking to establish a competitive market rate of 5.99%~~
~~Loan coverage to the customer~~	~~Up to and including 80% for renewable energy; up to and including 100% for energy efficiency~~[8]
~~Measures~~[9]	~~Lighting, duct sealing, air sealing, insulation, solar PV, solar thermal, geothermal, small wind, micro fuel cell, micro CHP, furnace replacement, boiler replacement, window replacements, AC systems, heat pumps, electric vehicle recharging station, all cost-effective energy efficiency measures, and measures with SIR≥1 within the terms of the loan~~
~~Loan repayment~~	~~On-bill or direct payment~~
~~Loan underwriter and administrator~~	~~Seeking to identify an underwriter and administrator with experience servicing high volume and high performing residential energy efficiency and/or renewable energy loans.~~

[8] ~~Per Section 99(2)(D) of the Act, "The authority may provide financing support under this subsection if the authority determines that the amount to be financed by the authority and other non-equity financing sources do not exceed eighty percent of the cost to deploy a clean energy project or up to one hundred percent of the cost of financing an energy efficiency project.~~

[9] ~~Subject to change, however the focus of residential measures is on those that have or will receive categorical exclusions for NEPA and NHPA.~~

	~~Identifying a rated servicing entity would be preferable.~~
~~Underwriting cost~~	~~Seeking to identify a competitively-priced underwriter and administrator.~~
~~Underwriting process~~	~~A competitive selection process is envisioned. Identifying a local entity would be preferable.~~[10]
~~Underwriting criteria~~	~~FICO score of 640 if salaried, 680 if self-employed for at least 2 years, 720 if self-employed for less than 2 years, no bankruptcy in the last 7 years, debt to income or monthly obligations to monthly income of 50% for all FICO scores.~~[11] ~~Or, if on-bill repayment, then the underwriting criteria of CL&P and UI are appropriate.~~
~~Source of funds for interest rate buy-down~~	~~ARRA SEP~~
~~Source of loan loss reserve funds~~	~~ARRA SEP~~
~~Eligible customers~~	~~Residential electric, natural gas, heating oil, and propane customers.~~ ~~Customers must have also completed an energy assessment by an insured HES approved vendor or a Buildings Performance Institute (BPI) certified contractor, Certified Energy Manager (CEM), Professional Engineer (PE) on the job who is a registered home improvement contractor with the Connecticut Department of Consumer Protection..~~ ~~Vendors using the HEY or other approved customer interface tool to calculate the energy savings and payback for customer follow-on recommendations.~~
~~Eligible installers~~	~~Renewable Energy – insured, PV-1, E-1, ST-1 and STC-1 solar contractors. For PV installations at least one staff member must have achieved a passing score on the NABCEP entry level PV exam, or hold a full NABCEP certification.~~ ~~Energy Efficiency – insured HES approved program venders or a BPI certified contractor, Certified Energy Manager (CEM), Professional Engineer (PE) on the job who is a registered home improvement contractor with the Connecticut Department of Consumer Protection.~~
~~Evaluation,~~	~~Renewable Energy – real-time advanced metering~~

~~[10] Per the Operating Procedures of CEFIA, grants, loans or loan guarantees, debt and equity investments for clean energy projects are subject to a selection and award process including (1) competitive selection and award, (2) programmatic selection and award, and (3) strategic selection and award.~~

~~[11] Based on the underwriting criteria of the Connecticut Solar Lease program.~~

~~Measurement and Verification~~	~~equipment (i.e. ANSI C12) with online performance data collection and analysis and inspections of all jobs by an independent contractor~~ ~~Energy Efficiency – use of the Home Energy Yardstick or other approved customer interface tool, Program Savings Document of the CEEF, ongoing utility bill analysis for electric and natural gas customers, or inspections of a random sample of jobs by an independent contractor~~ ~~Installation of any data acquisition system or meter may be required by CEFIA for performance measurement and verification. CEFIA will have access to and ownership of this data.~~
~~Third party insurer~~	~~Seeking to identify a third party insurer of energy savings performance to ensure that month-to-month and/or annual savings cash flows match debt service.~~

2.4. Dependencies

There are several areas of dependency that the Program relies on, including:

- **Availability of Resources** – the Program requires a steady stream of resources to support the schedule of incentives. Creating an incentive system that achieves the goal of sustained orderly development is challenging – as running out of incentives as a result of an increase in customer demand requires careful attention. ~~CEFIA has planned it so that Steps 1-4 are achieved through the FY 2012 through FY 2014 budget request.~~

- **Systems** – to administer the expected increase in demand for residential solar PV systems, CEFIA will be developing a more streamlined and automated system for application processing. With the goal of expediting the process, reducing human resource requirements, and collecting and analyzing data, technology systems will need to be developed to handle intake.

- **Regulatory** – regulatory ruling that would allow for the long-term contracting for and purchasing by the electric distribution companies of renewable energy credits created, aggregated, and sold through the Program (see Section 3.4.2 – State Laws and/or Regulations below for Long-Term REC Contracts). If CEFIA can aggregate and sell a 15-year stream of RECs at a reasonable rate (no less than $40 per REC) from the projects supported through the Program, then CEFIA can issue bonds (i.e. Clean Energy Victory Bonds) to raise capital upfront to cover either an interest rate buydown if a homeowner wants to finance a project or to support additional cost-effective energy efficiency measures free of charge. Accessing the long-term value of REC payments today, can be used to reduce the payback period and increase the IRR and NPV of the project for the customer.

These are but a few of the dependencies that will have an effect on the overall success of the Program.

2.5. Constraints

As the Program proposes an innovative, comprehensive and new approach to residential solar PV deployment in Connecticut, there will be a number of constraints that will impact its development, including:

- **Financial Resources** – ensuring that we have funds to support the implementation of the Program.

- **Personnel** – equipping personnel with the systems and training to handle applications, respond to inquiries, and manage the Program.

- **Market Effects** – as the solar PV industry is undergoing dramatic change as a result of U.S.-China relations, there are a number of uncontrollable factors that could positively or negatively effect the Program.

- **Adaptability** – enabling CEFIA to be flexible, adaptable and responsive to changes in the marketplace.

- **Policies and Standards** – unforeseen policy and standard changes could beneficially or adversely impact the Program.

These are but a few of the constraints that will impact the Program.

Section 3 - Implementation Considerations

3.1. Target Market

CEFIA seeks to target residential customers in CL&P and UI service territory seeking to install solar PV systems on their homes.

3.2. Eligibility Criteria

List specific eligibility requirements for this program:

- **PV Systems**:
  - Must be installed on one (1) to four (4) family homes in CL&P or UI service territories.
  - Must be new and grid-tied. Incentives are not available for used equipment or new PV systems that have been partially or completely installed prior to receiving written approval from CEFIA. CEFIA will consider the expansion of existing PV systems on a case-by-case basis.
  - Must comply with applicable federal, state and local law, regulation, code, licensing, permit and inspection requirements, including the Connecticut Building Code and the National Electric Code (NEC).
  - All applicable components must utilize commercially available PV technologies listed on the California Energy Commission (CEC) web site.

All components must be UL listed (or equivalent) where applicable.

  - The kW size limit is per address, not per Homeowner or meter.

- **Homeowners** – must be CL&P or UI customers and agree to:
  - Work with a contractor or third-party system owner approved by CEFIA.
  - Complete an energy assessment through participation in CEEF's HES program, or performed by a BPI certified contractor, CEM or PE.
  - Install a kWh monitoring device to track system performance.
  - Install a revenue grade meter to verify system performance.

- **Contractors** – must be approved by CEFIA to participate in the Program and meet the following criteria:
  - At least one permanent employee or subcontractor must hold an E-1 license.

- At least one permanent employee must hold the NABCEP Entry Level Passing Score Achievement Certificate, or full NABCEP certification.
- Carry at least $1 million in general liability insurance.
- Provide verifiable evidence of financial solvency and health in the form of a bank letter of reference/credit.
- Provide a copy of standard contract or sales agreement.
- Provide a five year workmanship warranty to homeowners. The warranty must cover all components of the generating system against breakdown or degradation in electrical output of not more than 10% from the original rated electrical output, and full costs of labor and repair or replacement of defective components or systems.

- **Third-party system owners** – must be approved by CEFIA to participate in the Program and meet the following criteria:
  - Use a PV contractor approved by CEFIA to install systems under the Program.
  - Carry at least $1 million in general liability insurance.
  - Provide verifiable evidence of financial solvency and health in the form of a bank letter of reference/credit.
  - Provide a copy of standard contract or sales agreement for leases, Energy Services Agreements (ESAs) or Power Purchase Agreements (PPAs). Contracts must include warranty provisions, including energy production and workmanship.

3.3. Partners and Leverage

The partners for the Program include:

- **Financial Institutions** – including community, state and national banks that will provide capital for the Program as a result of credit enhancements offered by CEFIA;
- **Policy-Makers and Regulators** – that will make decisions effecting the Program;
- **3rd Party Financiers** – companies that will enter Connecticut as a result of the Program that will provide 3rd party financing for homeowners to lease systems; and

- **Non-Profit Organizations** – community-based organizations that will assist the Program in acquiring customers.

3.4. Law and Regulations

There are several local, state and federal laws and regulations that provide support for residential clean energy deployment.

3.4.1. Local Laws and/or Regulations

Connecticut has passed several local laws that support clean energy deployment, including:

- **Building Permit Fee Waivers for Renewable Energy Projects** – As of July 2011, Connecticut authorizes municipalities to pass a local ordinance to exempt "Class I" renewable energy projects from paying building permit fees. Class I renewable energy projects include energy derived from solar power, wind power, fuel cells (using renewable or non-renewable fuels), methane gas from landfills, ocean thermal power, wave or tidal power, low-emission advanced renewable energy conversion technologies, certain newer run-of-the-river hydropower facilities not exceeding five megawatts (MW) in capacity, and sustainable biomass facilities. (Emissions limits apply to electricity generated by sustainable biomass facilities.) (Act Section 14)

- **Property Tax Exemption for Renewable Energy Systems** – Connecticut provides a property tax exemption for "Class I" renewable energy systems and hydropower facilities that generate electricity for private residential use. The exemption is available for systems installed on or after October 1, 2007, that serve farms, single-family homes or multi-family dwellings limited to four units. (Conn. Gen. Stat. § 12-81 (57))

3.4.2. State Laws and/or Regulations

Connecticut has passed several state laws that support clean energy deployment, including:

- **Green Loan Guaranty Fund** –Act Section 124 transfers the Green Loan Guaranty Fund to CEFIA from the Connecticut Health and Educational Facilities Authority (CHEFA) to identify eligible energy efficiency and renewable energy projects for residential, non-profit and small businesses (i.e. less than 50 employees).

- **Heating Equipment Replacement Program** – Act Section 116 requires DEEP to establish a residential heating equipment program, allowing customers to finance (via on-bill financing or other mechanism) the installation of energy efficient natural gas or heating oil burners, boilers and furnaces to replace electric heating systems, or burners boilers and furnaces that are not less than 7 years old with an efficiency rating of not more than 75%.

- **Installation of Metering Equipment** – Public Act 07-242 Section 39 (now codified at Conn. Gen. Stat. § 16-243h) states that the electric distribution companies (EDCs), at the request of a residential customer, **shall** provide for the installation of metering equipment that measures electricity consumed by such customer, deducts from the measurement the amount of electricity produced by the customer and not consumed by the customer, and registers, for each billing period, the net amount of electricity produced by the customer.

- **Interconnections Standards** – In December 2007, the Connecticut Department of Public Utility Control (DPUC) approved new interconnection guidelines 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. (Conn. Gen. Stat. § 16-243a)

  Connecticut's interconnection guidelines, like FERC's standards, include provisions for three levels of systems:

  - Certified, inverter-based systems no larger than 10 kilowatts (kW) in capacity (application fees: $100);

  - Certified systems no larger than 2 megawatts (MW) in capacity (application fees: $500); and

  - All other systems no larger than 20 MW in capacity. Note that the guidelines include "additional process steps" for generators greater than 5 MW (application fees: $1000, study fees will also apply).

  Connecticut's guidelines include a standard interconnection agreement and application fees that vary by system type. However, Connecticut's guidelines are stricter than FERC's standards, differing from the federal standards in several significant ways:

  - Customers are required to install an external disconnect switch and an interconnection transformer.

  - 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 DPUC a status report on the research and development of area network

interconnection standards. This report was completed in December 2009, and the DPUC has reached a final decision (03-01-15RE02) on the docket. The DPUC has determined that the utilities can interconnect inverter-based generators (up to 50 kW) on area networks. They also determined that once the IEEE 1547.6 standards are developed (which will address this issue on a national level), they will review the standards for area networks.

- **Locally Manufactured or Assembled and Distressed Municipalities** –Act Section 109 allows the Public Utility Regulatory Authority (PURA) to authorize additional incentives for residential PV projects using system components manufactured or assembled in Connecticut, and additional incentives if manufactured or assembled in distressed municipalities or a targeted investment community.

- **Long-Term REC Contracts** – Public Act 07-242 Section 71 allows EDCs to procure renewable energy certificates (RECs) from Class I, Class II and Class III renewable energy sources through long-term contract mechanisms. The EDCs **may** enter into long-term contracts for not more than 15 years to procure such RECs.

- **Net Metering** - Connecticut's two investor-owned utilities -- CL&P and UI -- are required to provide net metering to customers that generate electricity using "Class I" renewable-energy resources, which include solar, wind, landfill gas, fuel cells, sustainable biomass, ocean-thermal power, wave or tidal power, low-emission advanced renewable-energy conversion technologies, and hydropower facilities up to two megawatts (MW) in capacity. Legislation enacted in June 2007 (Public Act 07-242, Section 39) raised the individual system capacity limit to 2 MW and extended net metering to all customer classes. These changes took effect October 1, 2007. (Conn. Gen. Stat. § 16-243h)

  There is no stated limit on the aggregate capacity of net-metered systems in a utility's service territory. Any customer net excess generation (NEG) during a monthly billing period is carried over to the following month as a kilowatt-hour (kWh) credit. At the end of an annualized period, the utility pays the customer for any remaining NEG at the utility's avoided-cost rate. In January 2008, the DPUC ordered CL&P to calculate the reimbursement for PV systems, for any NEG at the end of an annualized period, on a time-of-use/generation basis. This significantly increases the financial benefits of net metering for PV system owners.

  Net-metered customers with systems greater than 10 kilowatts (kW) are assessed for the state's competitive transition assessment and the state's systems benefits charge, based on the amount of energy consumed by the customer from the facilities of the utility without netting any electricity produced

by the customer.

- **Residential Solar PV Investment Program** –Act Section 106 requires CEFIA to design and implement a residential PV investment program. The program must result in a minimum of thirty (30) megawatts (MW) of new residential PV installations in Connecticut on or before December 31, 2022. This Program will be funded by no more than one-third of the total surcharge collected annually through the Clean Energy Fund.

- **Sales and Use Taxes for Items Used in Renewable Energy Industries** – Connecticut enacted legislation in May 2010 (H.B. 5435) that established a sales and use tax exemption for equipment, machinery and fuels used to manufacture solar thermal (active or passive) systems, solar electric systems, wind-power electric systems, or geothermal resource systems. (Conn. Gen. Stat. §12-412(117)(B))

- **Sales and Use Tax Exemption for Energy Efficient Products** – In Connecticut, *residential* weatherization products *for residential use only* are exempt from the state's sales and use tax. Eligible residential weatherization products include CFLs, programmable thermostats, window film, caulking, window and door weather strips, insulation, water heater blankets, water heaters, natural gas and propane furnaces and boilers that meet the federal Energy Star standard, windows and doors that meet the federal Energy Star standard, oil furnaces and boilers that are not less than 84% efficient and ground-source heat pumps that meet the minimum federal energy efficiency rating. Exemption only applies to in-store sales. (Conn. Gen. Stat. § 12-412k)

- **Sales and Use Tax Exemption for Solar and Geothermal Systems** – Connecticut enacted legislation in June 2007 (H.B. 7432) that established a sales and use tax exemption for solar energy equipment and geothermal resource systems. H.B. 7432 added passive and active solar water-heating systems, passive and active solar space-heating systems, and solar-electric systems to the list of exempt technologies. The sales and use exemption covers both the equipment related to eligible systems, and labor (services) relating to the installation of eligible systems. The exemption has no expiration date. (Conn. Gen. Stat. § 12-412)

- **Solar and Wind Contractor Licensing** - The Connecticut Department of Consumer Protection (DCP) is authorized to issue licenses for solar-thermal work, solar-electric work and wind-electric work. Solar electricity work is defined as "the installation, erection, repair, replacement, alteration, or maintenance of solar PV or wind generation equipment used to distribute or store ambient energy for heat, light, power or other purposes to a point immediately inside any structure or adjacent to an end use." The DPC has adopted regulations governing the following types of licenses:

- A person who holds a PV-1 Limited Solar Electric Contractor license may perform only work limited to solar-electric systems (and wind-energy systems). The requirements to qualify for this license examination are two years (4,000 work hours) as a solar journeyperson (apprentice) and 144 hours of school/year or equivalent experience and training.

- A person who holds a PV-2 Limited Solar Electric Journeyperson license may perform solar-electric work (including wind-energy work) only while in the employ of a licensed electrical contractor. The requirements to qualify for this license examination are the completion of a registered apprenticeship program or one year equivalent experience and training.

It should be noted that an individual licensed as "E-1" or "E-2," (electrical licenses) does not require an additional PV license. That said, the individuals with E-1 or E-2 licenses are not exempt from the additional insurance requirements required under CEFIA's program and, for purposes of the rebate, they must still be experienced or qualified to site and install PV systems (as detailed in legislation, Public Act 10-80). (Conn. Gen. Stat. § 20-330 et seq.)

- **Weatherization** – Public Act 07-242 Section 33 directs annual Conservation and Load Management (C&LM) plans to include an assessment of steps to achieve 80% residential weatherization by 2030.

3.4.3. Federal Laws and/or Regulations

The federal government has passed several laws that support clean energy deployment in Connecticut, including:

- **Energy Efficient Mortgages** – Homeowners can take advantage of energy efficient mortgages (EEM) to either finance energy efficiency improvements to existing homes, including renewable energy technologies, or to increase their home buying power with the purchase of a new energy efficient home. The U.S. federal government supports these loans by insuring them through Federal Housing Authority (FHA) or Veterans Affairs (VA) programs. This allows borrowers who might otherwise be denied loans to pursue energy efficiency, and it secures lenders against loan default.

- **Modified Accelerated Cost-Recovery System (MACRS) + Bonus Depreciation (2008-2012)** – Under the federal Modified Accelerated Cost-Recovery System (MACRS), businesses may recover investments in certain property through depreciation deductions. The MACRS establishes a set of class lives for various types of property, ranging from three to 50 years, over which the property may be depreciated. A number of renewable energy technologies are classified as five-year property (26 USC § 168(e)(3)(B)(vi)) under the MACRS, which refers to 26 USC § 48(a)(3)(A), often known as the energy investment tax credit or ITC to define eligible property. Such property includes solar electric technologies. (26 USC § 48)

The federal *Economic Stimulus Act of 2008,* enacted in February 2008, included a 50% first-year bonus depreciation (26 USC § 168(k)) provision for eligible renewable-energy systems acquired and placed in service in 2008. This provision was extended (retroactively for the entire 2009 tax year) under the same terms by *The American Recovery and Reinvestment Act of 2009*, enacted in February 2009. Bonus depreciation was renewed again in September 2010 (retroactively for the entire 2010 tax year) by the *Small Business Jobs Act of 2010 (H.R. 5297)*.

In December 2010 the provision for bonus depreciation was amended and extended yet again by *The Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010 (H.R. 4853)*. Under these amendments, eligible property placed in service after September 8, 2010 and before January 1, 2012 qualifies for 100% first-year bonus depreciation. For 2012, bonus depreciation is still available, but the allowable deduction reverts from 100% to 50% of the eligible basis.

To qualify for bonus depreciation, a project must satisfy these criteria:

- the property must have a recovery period of 20 years or less under normal federal tax depreciation rules;
- the original use of the property must commence with the taxpayer claiming the deduction;
- the property generally must have been acquired during the period from 2008 - 2012; and
- the property must have been placed in service during the period from 2008 - 2012.

If property meets these requirements, the owner is entitled to deduct a significant portion of the adjusted basis of the property during the tax year the property is first placed in service. As noted above, for property acquired and placed in service after September 8, 2010 and before January 1, 2012, the allowable first year deduction is 100% of the adjusted basis (i.e., the property is fully depreciated and additional deductions under MACRS cannot be claimed). For property placed in service from 2008 - 2012, for which the placed in service date does not fall within this window, the allowable first-year deduction is 50% of the adjusted basis. In the case of a 50% first year deduction, the remaining 50% of the adjusted basis of the property is depreciated over the ordinary MACRS depreciation schedule. The bonus depreciation rules do not override the depreciation limit applicable to projects qualifying for the federal business energy tax credit. Before calculating depreciation for such a project, including any bonus

depreciation, the adjusted basis of the project must be reduced by one-half of the amount of the energy credit for which the project qualifies.

- **Residential Energy Conservation Subsidy Exclusion** – According to Section 136 of the U.S. Code, energy conservation subsidies provided to customers by public utilities, either directly or indirectly, are non-taxable. This exclusion does *not* apply to electricity-generating systems registered as "qualifying facilities" under the Public Utility Regulatory Policies Act of 1978. If a taxpayer claims federal tax credits or deductions for the energy conservation property, the investment basis for the purpose of claiming the deduction or tax credit must be reduced by the value of the energy conservation subsidy (i.e., a taxpayer may not claim a tax credit for an expense that the taxpayer ultimately did not pay). (26 USC § 136)

  The term "energy conservation measure" includes installations or modifications primarily designed to reduce consumption of electricity or natural gas, or to improve the management of energy demand. Eligible dwelling units include houses, apartments, condominiums, mobile homes, boats and similar properties. If a building or structure contains both dwelling units and other units, any subsidy must be properly allocated.

  The definition of "energy conservation measure" implies that utility rebates for residential solar-thermal projects and solar-electric systems may be non-taxable. However, the IRS has not ruled definitively on this issue. Taxpayers considering using this provision for a renewable energy system should discuss the details of the project with a tax professional.

  Other types of utility subsidies that may come in the form of credits or reduced rates might also be non-taxable, according to IRS Publication 525. This publication states: "If you are a customer of an electric utility company and you participate in the utility's energy conservation program, you may receive on your monthly electric bill either: a reduction in the purchase price of electricity furnished to you (rate reduction), or a nonrefundable credit against the purchase price of the electricity. The amount of the rate reduction or nonrefundable credit is not included in your income."

- **Residential Renewable Energy Tax Credit** – Established by the *Energy Policy Act of 2005*, the federal tax credit for residential energy property initially applied to solar-electric systems, solar water heating systems and fuel cells. *The Energy Improvement and Extension Act of 2008* (H.R. 1424) extended the tax credit to small wind-energy systems and geothermal heat pumps, effective January 1, 2008. Other key revisions included an eight-year extension of the credit to December 31, 2016; the ability to take the credit against the alternative minimum tax; and the removal of the $2,000 credit limit for solar-electric systems beginning in 2009. The credit was further enhanced in February 2009 by *The American Recovery and Reinvestment Act of 2009* (H.R. 1: Div. B, Sec. 1122, p. 46), which

removed the maximum credit amount for all eligible technologies (except fuel cells) placed in service after 2008.

A taxpayer may claim a credit of 30% of qualified expenditures for a system that serves a dwelling unit located in the United States and used as a residence by the taxpayer. Expenditures with respect to the equipment are treated as made when the installation is completed. If the installation is at a new home, the "placed in service" date is the date of occupancy by the homeowner. Expenditures include labor costs for on-site preparation, assembly or original system installation, and for piping or wiring to interconnect a system to the home. If the federal tax credit exceeds tax liability, the excess amount may be carried forward to the succeeding taxable year. The excess credit may be carried forward until 2016, but it is unclear whether the unused tax credit can be carried forward after then. The maximum allowable credit, equipment requirements and other details vary by technology, as outlined below. (26 USC § 25D)

3.5. Marketing and Outreach

Historically, customer participation in Connecticut residential solar programs has been driven by rebates and "no money down" financing options and was supported by limited, conventional marketing strategies such as collateral, event exhibits and workshops. As we now seek to scale up solar deployment, introduce innovative financing options and move beyond the "early adopter" customer audience, it is imperative that the Marketing and Outreach for the program also transition to think and act like retailers.

Drawing upon best practices identified by Lawrence Berkeley National Laboratory, National Renewable Energy Laboratory (NREL) and the Clean Energy Group, we will develop a Marketing Plan that will drive demand for residential solar systems.

Specifically, the Plan will:

- Identify community-based customer aggregation strategies that result in not only an increase in customer demand, but also the reduction of the installed costs of solar PV systems.

- Improve the technology's value proposition by creating messages about the affordability of solar, the availability of new financing mechanisms, the opportunity to reduce electric bills, the enhancement of property values and the security of the investment.

- Reinforce the reliability of solar technology through highly visible solar installations, positive testimonials from businesses, institutions and residents that have installed solar power, participation in solar home tours and educational seminars for specific targeted segments.

- Reduce the complexity of the solar decision-making process by simplifying the application process, reducing time for permitting, planning and zoning and

interconnection processes and providing trusted advisors to assist prospective customers during the decision-making process.

- Overcome customer inertia by strong calls for action, promotional incentives and activities and raising awareness as to the program's declining incentive program.

3.5.1. Research

The Marketing Plan will be further guided by an analysis of customer motivations and attitudes toward solar power from a variety of sources including existing market research on solar programs, customer research developed through the statewide energy marketing campaign that will be conducted jointly by the Connecticut Department of Energy and Environmental Protection, the CEEF and CEFIA, and Connecticut-specific surveys of solar customers, "inerts" (customers that are interested in solar but have not yet acted), contractors and financing agents.

3.5.2. Promotion

Promoting the Program through various strategies over time will ensure the program's success by helping households understand the economic and environmental value of clean energy. Various strategies will be pursued, including, but not limited to:

- **Program Brand** – developing a program brand and identity in order to ensure the success of the Program.

- **Program Launch** – organizing a launch event to bring public attention to the Program and help galvanize customers and contractors.

- **Web Page** – creating an innovative and informative web page that provides households with information to act including online leader billboards, "Top 10" and "Worst 10" lists, testimonials, social media pages, etc.

- **Paid Media** – accessing paid media advertising through television, radio and web ads for target markets.

- **Earned Media** – seeking out opportunities for local earned media stories in community papers and television through tactics like ribbon-cutting ceremonies, town events, etc.

Taking the lessons learned from the Neighbor to Neighbor Energy Challenge, a $4.2 million DOE grant that CEFIA is administering in Connecticut, will provide the Program with key marketing insights.

3.5.3. Customer Acquisition

The Program will include a number of innovative and cost-effective customer acquisition strategies taken from national "best practices" including, but not limited to:

- **Program Campaign Brand** – creating a statewide "call to action" for homeowners to take action on energy efficiency and renewable energy. As part of the statewide campaign on energy that CEFIA is collaborating with DEEP and the CEEF on, a program brand will call attention to an action that homeowners can take to participate in the Program.

- **Clean Energy Communities Incentive** – providing performance-based rewards that drive local citizens to action can accelerate market demand and reduce customer acquisition costs.[12] Through the Clean Energy Communities program, cities and towns will receive rewards (i.e. solar PV systems, EV recharging stations, etc.) as more and more citizens, businesses and institutions lead Connecticut's transition to a clean energy economy.

- ~~**Clean Energize Communities**~~**Solarize** ~~**Test Pilot**~~**Campaigns** – a volume-purchasing customer aggregation strategy that uses volunteer-driven community efforts to bring the benefits of solar PV and energy efficiency to homes. The program is anticipated to scale-up up the demand for solar PV deployment while also decreasing the installed cost of the systems. Portland, Oregon and Massachusetts have implemented such successful programs.

- **Energy Coach Program** – engaging households that have installed solar PV systems as "Ambassadors" and providing technical assistance through an expert "Coach" to households considering solar PV, will increase customer acquisition.

- **Better Business Bureau** – providing a mechanism to allow households that have participated in the Program to rate the product and service that they received from a contractor will provide information to advance marketplace trust between potential customers and contractors.

- **Clean Energy Loan Program** – providing households with a low-cost residential clean energy financing program that integrates renewable energy deployment with energy efficiency, will allow the market in Connecticut to move away from subsidies and towards finance – a more sustainable way to advance a market.

These are but a few of the customer acquisition strategies that will be deployed through the Program to scale-up the deployment of residential clean energy systems.

3.5.4. Other Programs

- **SunShot Initiative** – In December of 2011, CEFIA won a $2.1 million grant through the DOE's competitive SunShot Initiative. Round 1 of the $480,000 project is to work with 12 Clean Energy Communities to reduce non-hardware

[12] *Climate Policy and Voluntary Initiatives: An Evaluation of the Connecticut Clean Energy Communities Program*, Matthew Kotchen: National Bureau of Economic Research (June 2010).

related costs for rooftop solar PV by 15 percent. The project will address permitting and interconnection processes that will result in a standardized online permitting application and an online database of local processes, net metering and interconnection standards, and planning and zoning that will result in a model ordinance for condominium associations and historical preservation. If successful in Round 1, then a $1.6 million Round 2 project will ensure scaling up the effort to across Connecticut and into New England. As part of the project, CEFIA will implement Solarize campaigns in participating communities.

- **Neighbor to Neighbor Energy Challenge** – In August of 2010, the CCEF won a $4.2 million 3-year grant through the DOE's competitive Energy Efficiency Conservation Block Grant General Innovation Fund Program. The Neighbor to Neighbor Energy Challenge is a nonprofit community savings program that engages residents in 14 Clean Energy Communities to reduce their home's energy use by 20%. As residents join and take actions to help their household, they earn points that can be redeemed for community rewards. The lessons learned from the challenge will be incorporated into the Program.

3.6. Operational Impacts

Given the comprehensive nature of the Program, there is a need to redirect staff-time to successfully administer various components of the Program, including incentives, marketing, legal, technology, and evaluation measurement and verification. It is planned that between 4.5 to 5.0 FTE's will be required to successfully implement the Program. In order to better support human resources, technology systems will need to be developed to ensure quicker and more thorough processing of applications. It is expected that the financing aspects of the program (i.e. originating and servicing) will be subcontracted out.

3.7. Documentation Plan

In addition to the Program Plan, the Chief of Staff will work with the Director of Renewable Energy Deployment to develop a program manual. The program manual will be a document that changes over time as systems and processes change, but will be used as a guide to train anyone to step into and support the implementation of the Program.

The key documents for the Program include:

- Program Plan
- Program Manual
- Fact sheets and online documentation for customers and contractors
- RFP's for services
- Contracts with subcontractors

These are but a few of the key documents for the Program.

3.8. Workforce Development Impact

3.8.1. Survey

Per Section 106 of the Act, CEFIA will identify barriers to the development of a permanent Connecticut-based workforce and shall make provision for comprehensive training, accreditation, and certification programs through institutions and individuals accredited and certified to national standards.

In December of 2011, CEFIA, in collaboration with the CBIA Education Foundation, conducted a survey of 128 residential solar PV installers, residential solar thermal installers, and HES contractors. 80% of those surveyed were CEFIA approved installers. The key survey findings and barriers to the development of a permanent Connecticut-based workforce are listed below.

<u>Hiring plans:</u>

- **93% of respondents have difficulty hiring workers**

- The top three most difficult positions employers have difficulty finding are
    - Construction (HVAC, general skilled laborers)
    - Technical sales
    - Installation, maintenance, repair

- 63% of the respondents agree that the Act will have positive impact on their businesses

- 49% of the respondents consider adding more workers for existing job titles based on the Act

- 45% of the respondents will be hiring one to two employees next year, 34% will be hiring three to five employees next year, and 17% of the respondents anticipate adding more than 20 workers in the next three and five years

<u>Training requirements; certifications and licenses:</u>

- **65% of respondents believe their current workforce will need to upgrade their skills to continue performing their jobs**

- Desired certifications and licenses include:
    - OSHA Safety Training
    - BPI
    - PV-1 / PV-2
    - ST-1 / ST-2

- E-1

Pre-employment testing:

- 56% of the respondents answered yes when asked whether the company conducts pre-employment testing
- 70% choose a basic knowledge test follows
- 60% use specific skills test such as communication, math, computer proficiency, safety, random problem solving, schematic reading, or NABCEP

Major barriers finding or retaining employees:

- **The major barrier companies faces in finding or retaining employees is applicants' lack job-specific skills and qualifications – 76% of the respondents face this challenge**

Average entry-level wage:

- 26% provide average hourly wages between $10.01 and $14.99
- 41% provide average hourly wages between $15.00 and $19.99
- 20% provide average hourly wages between $20.00 and $24.99
- 2% have entry-level employees with over $40 average hourly wage.

Average age:

- 30% has workforces with an average age between 25 and 29
- 49% of the respondents have workforces with an average age between 30 and 39
- 13% has workforces with an average age between 40 and 49

In January of 2012, CEFIA conducted a Residential Solar PV Investment Program Survey of approximately 100 solar PV industry stakeholders; including contractors and third party energy service providers. The key survey findings are listed below.

Total number of employees:

- 59% have 0-10 employees total
- 15% have a total of over 50 employees
- 65% have 0-10 employees located in Connecticut
- 18% have 11-20 employees located in Connecticut

Highest installation cost associated with PV:

- **73% identified equipment as their highest cost**

- 24% identified labor as their highest cost

Expansion of company to provide energy efficiency services:

- 29% of companies currently offer energy efficiency services
- 18% will be expanding
- **53%will not be expanding**

Types of training employers will be seeking for employees:

- **PV-1 59%**
- E-1 34%
- E-2 34%
- ST-1 22%
- STC-1 9%
- **Solar Sales 81%**
- **Marketing 41%**
- Customer Service 31%
- **Solar Finance 47%**
- BPI 22%
- CEM 16%

3.8.2. Workforce Support

As a result of the Act, customer demand for clean energy in Connecticut, especially rooftop solar PV, will increase significantly. The increase in customer demand will result in an increase in the supply of a skilled clean energy workforce. CEFIA's predecessor, the Connecticut Clean Energy Fund, installed over 10 MW of residential solar PV since 2004. CEFIA is mandated to install *at least* 30MW of residential solar by 2022. The 30 MW mandate, in addition to the Z-REC market, will significantly expand the clean energy economy in Connecticut.

As mandated by statute, CEFIA must make provisions for comprehensive training, accreditation, and certification programs through institutions and individuals accredited and certified to national standards that support the development of a permanent Connecticut-based workforce. In order to maximize the effectiveness of CT's workforce development community training programs need to be expanded; apprenticeship and internship programs must be expanded and/or implemented. CEFIA shall provide support to ensure that Connecticut's workforce has the required credentials (i.e. certifications, licenses) and skills to meet the projected demand by providing the workforce development support suggested below.

- **Training for Contractors**
  CEFIA will offer bi-annual seminars in energy efficiency in collaboration with the CEEF. All renewable energy contractors and energy efficiency contractors (HES vendors) will be invited to participate in the seminar. An overview of energy efficiency measures and example paybacks will be presented. CEFIA and CEEF

programs will be reviewed and there will be time for contractor Q&A. The culmination of the event will include a contractor meet and greet. This time is intended to give contractors an opportunity to meet one another and forge relationships (i.e.: PV contractor working with an HES contractor).

- **Clean Energy Workforce RFP**
  CEFIA seeks to further the development and institution of self-sustaining clean energy training and education programs at public and private community colleges and universities, regional employment boards, community-based nonprofit organizations, and union and labor organizations. By working with these Connecticut entities and by providing funding for the purpose of purchasing clean energy demonstration and training equipment for practical laboratory and/or training space, the CEFIA will support these institutions and further educate students, clients and trainees in real-world scenarios that will prepare them for opportunities in the clean energy sector. Grants made through this solicitation are intended to prepare the Connecticut's training providers to meet the workforce needs of the clean energy sector. Programs must be designed based on local clean energy businesses' workforce needs.

- **Green Technologies Initiatives Program**
  The Green Technologies Initiatives Program incorporates solar PV, solar thermal, weatherization and energy efficiency hands on training. The hands on component, E-Houses, are comprised of renewable energy technologies and energy efficiency technologies. The E-House provides both Weatherization and Building Analyst practical hands on experience, along with all required safety training as required by both NABCEP and BPI. The Green Technologies Program includes training and professional development for technical high school instructors, as well as curriculum and other classroom materials.

- **Clean Energy Sector Internship Program**
  The Clean Energy Sector Internship Program focuses on enhancing the talent pipeline for Connecticut companies engaged in the clean energy industry. The Clean Energy Sector Internship Program will facilitate the placement of current students and recent graduates who are considering career opportunities in clean energy through paid summer internships across the state.

Section 4 - Funding Structure and Amounts

4.1. Funding Level and Type

The Act focuses on CEFIA providing Expected Performance-Based Buy-down Incentives (EPBB) to support households that seek to own solar PV systems and Performance-Based Incentives (PBI) for households that seek to lease solar PV systems. The proposed combined budget for the EPBB and PBI is $~~51.00~~44.50 million – $~~25.50~~22.25 million for EPBB and $~~25.50~~22.25 million for the PBI (see Table ~~7~~10). If achieved, the Program would result in the installation of over 50 MW of residential solar PV systems over a 10-year period and a payback period of between 5 to 7 years for residential customers.

Table ~~7~~10. Proposed Budget for the EPBB and PBI Schedule of Incentives by Steps

Step	EPBB Budget ($MM)	PBI Budget ($MM)	Total Budget ($MM)	Estimated Installed Capacity (kW)	Estimated Systems Installed
1	1.25	1.25	$2.50	1,261	204
2	2.50	2.50	$5.00	3,036	491
3	3.00	3.00	$6.00	4,296	695
4	3.50	3.50	$7.00	5,728	927
5	4.00	4.00	$8.00	9,102	1,473
6	4.00	4.00	$8.50	12,165	1,969
7	4.00	4.00	$8.50	15,764	2,551
Total	**$22.25**	**$22.50**	**$44.50**	**51,353**	**8,309**

Although the EPBB and PBI step budgets are the same, the cash outlay for the PBI differs. Whereas the EPBB incentives are paid out upfront at the completion of a project, the PBI is paid out on a quarterly basis over a 6-year timeframe based on the performance of the system (see Tables ~~8~~ 11 and ~~9~~12). One of the many benefits of a PBI, is that the incentives are spread out over time and therefore do not require a large upfront source of funds.

Table ~~8~~11. Cash Outlay for the EPBB and PBI through the End of the Schedule of Incentives

Step	EPBB Cash Outlay ($MM)	PBI Cash Outlay ($MM)	Total Cash Outlay ($MM)
1	1.25	$0.21	$1.46
2	2.50	$0.63	$3.13
3	3.00	$1.13	$4.13
4	3.50	$1.71	$5.21
5	4.00	$2.38	$6.38
6	4.00	$3.04	$7.04

7	4.00	$3.50	$7.50
Total	**$22.25**	**$12.60**	**$34.85**

Table ~~9~~12. Cash Outlay for the EPBB and PBI Incentives for the Years Following the Schedule of Incentives

Year Following Step 7	EPBB Cash Outlay ($MM)	PBI Cash Outlay ($MM)	Total Cash Outlay ($MM)
1	$0.00	$3.08	$3.08
2	$0.00	$2.58	$2.58
3	$0.00	$2.00	$2.00
4	$0.00	$1.33	$1.33
5	$0.00	$0.67	$0.67
Total	**$0.00**	**$9.66**	**$9.66**

It is anticipated that over a ~~14~~15-year period, a programmatic investment of ~~$51 million will be made in~~no more than half of the allowable incentives will be deployed to support the Program.

4.2. Level of Support for Individual Awards

The EPBB supports local installers and homeowners that seek to own their solar PV system. Starting at an incentive level of $2.45/W for up to 5 kW and $1.25 for greater than 5 kW and up to 10 kW in Step 1 and ending at $0.55/W for up to 10 kW in Step 7, CEFIA seeks to support the installation of nearly ~~26~~ 25 MW of solar PV in over 4,000 homes. EPBB incentives will be provided at various levels up to and including 5 kW for the first level and greater than 5 kW and up to and including 10 kW for the second level. CEFIA will not provide EPBB incentives beyond 10 kW per home.

Projects that incorporate major components that are manufactured or assembled in Connecticut and/or major components that are manufactured or assembled in a distressed municipality or strategic investment community, will receive an additional 5 and 10%, respectively, from the Public Utility Regulatory Authority (PURA) – see Table 13. ~~CEFIA anticipates processing about 35 applications and expending between $400,000 to $500,000 a month through the Program (see Table 10).~~

Table ~~10~~13. Proposed EPBB Schedule of Incentives by Step

Step	EPBB Incentive ≤5 kW ($/W)	EPBB Bonus Incentive of 5%@≤5 kW ($/W)	EPBB Incentive >5 kW and ≤10 kW ($/W)	EPBB Bonus Incentive of 5%@>5 kW and ≤10 kW ($/W)
1	2.45	$0.12	$1.25	$0.06
2	2.10	$0.11	$0.90	$0.05

3	1.75	$0.09	$0.55	$0.03
4	1.40	$0.07	$0.20	$0.01
5	1.05	$0.05	$0.00	$0.00
6	0.75	$0.04	$0.00	$0.00
7	0.55	$0.03	$0.00	$0.00

The PBI supports third-party financiers working with homeowners that seek to lease their solar PV system. Starting at an incentive level of $0.~~34~~30/kWh ~~for up to 5 kW and $0.01 for greater than 5 kW and up to 10 kW~~ in Step 1 and ending at $0.08/kWh ~~for up to 10 kW~~ in Step 7, CEFIA seeks to support the installation of nearly 26 MW of solar PV in over 4,000 homes. ~~PBI incentives will be provided at various levels up to and including 5 kW for the first level and greater than 5 kW and up to and including 10 kW for the second level.~~ CEFIA will not provide PBI incentives beyond 10 kW per home.

Projects that incorporate major components that are manufactured or assembled in Connecticut and/or major components that are manufactured or assembled in a distressed municipality or strategic investment community, will receive an additional 5 and 10%, respectively, from the Public Utility Regulatory Authority (PURA) – see Table 14. ~~CEFIA anticipates processing about 35 applications and expending approximately $400,000 a month through the Program (see Table 11).~~

Table ~~11~~14. Proposed PBI Schedule of Incentives by Step

Step	PBI Incentive ≤~~5~~ 10 kW ($/kWh)	PBI Bonus Incentive of 5%@~~>5 kW and~~ ≤10 kW ($/kWh)
1	$0.300	$0.015
2	$0.243	$0.012
3	$0.209	$0.010
4	$0.198	$0.010
5	$0.137	$0.010
6	$0.107	$0.010
7	$0.087	$0.000

It is envisioned, that as the level of EPBB and PBI as well as installed costs decline over time, that financing programs and energy efficiency will provide the necessary capital to support the sustained orderly development of the residential solar PV industry in Connecticut.

It should be noted that per Section 106 of P.A. 11-80 that the proposed Schedule of Incentives can be changed.

Nothing in this subsection shall restrict the authority from modifying the approved incentive schedule before the issuance of its next comprehensive plan to account for changes in federal or state law or regulation or developments in the solar market when such changes would affect the expected return on investment for a typical residential solar photovoltaic system by twenty per cent or more.

If CEFIA determines that a modification is necessary to the Schedule of Incentives, then it will provide installers with an advanced notification of 8 weeks prior to instituting the change.

4.3. Financing

In collaboration with the CEEF, CL&P, and UI, CEFIA will provide financing support for a long-term comprehensive loan and/or lease Residential Clean Energy Financing Program (the Finance Program).

An American Recovery and Reinvestment Act (ARRA) State Energy Program (SEP) grant in the amount of $8,250,000 will be used for credit enhancements to support the implementation of the program. $7,000,000 in loan loss reserves and interest rate buy-downs will be used for a Residential Clean Energy Financing Program (see descriptions below) and $1,250,000 will be used for a Clean Energy Financial Innovation Program.

The sections below on the Finance Program are still in development. CEFIA is being provided technical assistance by the DOE to develop a comprehensive residential clean energy financing program.

The purpose is to develop a low interest financing product that is competitive and sustainable and would eliminate the need for subsidies.

4.3.1. Sources of Capital

The Finance Program envisions attracting low cost capital from community banks, credit unions, community development financial institutions, pension funds, impact investors (i.e. foundations, university endowments, etc.) and/or through revolving loan funds from system benefit funds like CEFIA and/or CEEF.

The target fund for the Finance Program is $25,000,000 and will provide financing for approximately 1,250 homes with a $20,000 loan.

4.3.2. Financing Mechanism

The Finance Program is expected to be a secured 10 or 15 year loan backed by the solar PV assets and will seek to incorporate cost-effective energy efficiency measures with less than a 5-year payback be included as part of the project. The goal of the Finance Program is to ensure that the energy savings from the solar PV system and the cost-effective energy efficiency measures cover the costs of the debt service payments.

4.3.3. Collection Mechanism

Working with CL&P and UI, CEFIA seeks to establish an on bill repayment capability. It should be noted that the Connecticut Housing Investment Fund's (CHIF) energy efficiency loan program has an on bill repayment feature with CL&P and UI.

If on bill repayment is not an option, then direct billing will be required.

4.3.4. Enhancements

Several credit enhancements will be used for the Residential Clean Energy Financing Program, including an interest rate buydown, loan loss reserves, and renewable energy credits.

- **Interest Rate Buydown (IRB)** – the interest rate buy-down seeks to target an interest rate to the customer of 5.99%. Funds will come from ARRA SEP grants.

- **Loan Loss Reserves (LLR)** – a loan loss reserve seeks to leverage private capital at 4.5:1.0 Funds will come from ARRA SEP grants.

- **Renewable Energy Credits (RECs)** – CEFIA retains the ownership rights to the RECs created from the Program. A present value of a 15-year stream of RECs at the right price[13] may be used to cover either the cost of the interest rate buy-down on their loan or to support cost-effective energy efficiency measures as part of the Program. The creation of a Clean Energy Victory Bond is being considered as a mechanism to generate funds upfront that get repaid over time through the sale of RECs. Per Section 71 of Public Act 07-242, CEFIA seeks to work with DEEP, PURA, and the electric distribution companies to engage in a long-term REC contract for the sale of its residential solar PV RECs.

4.3.5. Eligible Installers

For renewable energy, insured PV-1, E-1, ST-1 and STC-1 solar contractors. For PV installations at least one staff member must have achieved a passing score on the NABCEP entry level PV exam, or hold a full NABCEP certification.

For energy efficiency contractors, insured HES approved program venders or a BPI certified contractor, CEM, or PE on the job who is a registered home improvement contractor with the Connecticut Department of Consumer Protection.

4.3.6. Eligible Measures

The eligible measures for the Finance Program include energy efficiency and renewable energy technologies, including, but not limited to (see Table ~~12~~15):

[13] The present value of 15-years of RECs generated from 1 kW of installed solar PV is $450. This assumes a discount rate of 5% and a REC price of $40.

Table ~~12~~15. Sample List of Eligible Energy Efficiency and Renewable Energy Measures for the Finance Program

Energy Efficiency	Renewable Energy
▪ Lighting	▪ Solar PV
▪ Duct sealing	▪ Solar thermal hot water
▪ Air sealing	▪ Geothermal
▪ Insulation	▪ Micro-wind
▪ Furnace replacement	▪ Micro-CHP
▪ Boiler replacement	▪ Micro-fuel cell
▪ Window replacements	

The goal is to incorporate cost-effective energy efficiency into the economics of solar PV systems. Combining energy efficiency with solar PV results in a quicker payback and higher rates of return and net present values for the solar PV system.

4.3.7. Underwriting Criteria

A FICO score of 640 if salaried, 680 if self-employed for at least 2 years, 720 if self-employed for less than 2 years, no bankruptcy in the last 7 years, debt to income or monthly obligations to monthly income of 50% for all FICO scores.[14]

Or, if on-bill repayment, then the underwriting criteria of CL&P and UI are appropriate.

Section 5 - Process and Timeline

Per the Operating Procedures of CEFIA, there are programmatic, competitive and strategic investments that will be made for various components of the Program:

- **Incentives** – once the Board of Directors approves the schedule of incentives, CEFIA staff will manage those incentives as a program investment. It is expected that the Program will be launched in ~~February~~ March of 2012;

- **Financing** – at a future date, the Board of Directors will approve of the financing program, and CEFIA's Executive Vice President and Chief Investment Officer will manage those resources per the competitive or strategic investment processes. It is expected that the financing program will be launched at the end of Q2 or the beginning of Q3 of 2012;

- **Marketing** – once the CEFIA Board of Directors approves the marketing budget, CEFIA's Director of Marketing and Outreach will manage those resources per the competitive or strategic investment processes. It is expected that the marketing program will be launched at the end of Q2 or the beginning of Q3 of 2012. The launch of the Program will coincide with the financing product;

[14] Based on the underwriting criteria of the Connecticut Solar Lease program.

- **Legal** – once the CEFIA Board of Directors approves the legal budget, CEFIA's General Counsel will manage those resources per the competitive or strategic investment processes;

- **Workforce Development** – once the CEFIA Board of Directors approves the workforce development budget, CEFIA's Director of Renewable Energy Deployment and Director of Marketing and Outreach will manage those resources per the competitive or strategic investment processes. It is expected that a series of workforce development programs will be launched at the end of Q1 of 2012;

- **Technology** – once the CEFIA Board of Directors approves the technology budget, CEFIA's Chief of Staff and Director of Renewable Energy Deployment will manage those resources per the competitive or strategic investment processes. It is expected that technology solutions will be developed on an ongoing basis and that major systems will be launched in Q3 of 2012; and

- **Evaluation, Measurement, and Verification** – once the CEFIA Board of Directors approves the EM&V budget, CEFIA's President and Chief of Staff will manage those resources per the competitive or strategic investment processes. It is expected that by the end of Q4 of 2012, an EM&V program will be in place.

On a quarterly basis, through the Deployment Committee, progress on the Program will be reported and discussed. Through the development of a dashboard, bi-weekly meetings on progress will be held to discuss progress towards goals and objectives.

5.1. Evaluation Criteria

Discuss the intended method and criteria for application evaluation including any weighting factors

5.2. Risk Analysis

Risks associated with the successful implementation of the Program are described below (see Table ~~13~~16).

Table ~~13~~16. Risks and Risk Mitigation Strategies for the Program

Risk	Risk Mitigation Strategy
Too much demand is created from either the EPBB or PBI incentive	▪ Provide contractors notice 6-8 weeks ahead of any decrease in schedule of incentives ▪ Ensure appropriate staffing by shifting resources to manage program administration
Not enough demand is created from either the EPBB or PBI incentive	▪ Increase marketing activities ▪ Provide a financing product ▪ Implement a "solarize" aggregation

	model to reduce system costs
Panel cost volatility	▪ Implement a "solarize" aggregation model to control costs
REC price volatility	▪ Use a conservative forecast of REC prices that under estimates REC proceeds that will support program expenditures
Utility price volatility	▪ Adjust incentives accordingly to provide a reasonable system cost payback with due notice to contractors ahead of any change in schedule of incentive

5.3. Resolution Authorizing Approval of a Residential Solar Photovoltaic Investment Program

WHEREAS, Section 106 of Public Act 11-80 "An Act Concerning the Establishment of the Department of Energy and Environmental Protection and Planning for Connecticut's Energy Future" (the Act) requires CEFIA to design and implement a Residential Solar Photovoltaic Investment Program (Program Plan) that results in a minimum of thirty (30) megawatts of new residential PV installation in Connecticut before December 31, 2022.

WHEREAS, pursuant to Section 106 of the Act, CEFIA has prepared this Program Plan to identify barriers to the development of a permanent Connecticut-based solar workforce and support comprehensive training and accreditation and certification programs.

WHEREAS, pursuant to Section 106 of the Act, CEFIA has prepared this Program Plan to offer direct financial incentives, in the form of performance-based incentives or expected performance-based buydowns, for the purchase or lease of qualifying residential solar photovoltaic systems.

WHEREAS, CEFIA has prepared a declining incentive block schedule ("Schedule") that: (1) provides for a series of solar capacity blocks the combined total of which shall be a minimum of thirty megawatts and projected incentive levels for each such block; (2) provides incentives that are sufficient to meet reasonable payback expectations of the residential consumer; (3) provides incentives that decline over time and will foster the sustained, orderly development of a state-based solar industry; (4) automatically adjusts to the next block; and (5) provides comparable economic incentives for the purchase or lease of qualifying residential solar photovoltaic systems.

NOW, therefore be it:

RESOLVED, that the Board hereby approves of the Program Plan and Schedule as presented by the CEFIA staff and as subsequently modified by the Deployment Committee.

RESOLVED, that Section 2.3.2 - Financing of the Program Plan is hereby deleted and will be reviewed by the Deployment Committee at a later date for approval.

RESOLVED, that the Board approves a total allocation of $8,850,000 (inclusive and not in addition to any previous funding) to be used for (1) incentives supporting steps one and two of the Program Plan and (2) program operations.

RESOLVED, the CEFIA staff will (1) continuously monitor activities pursuant to the Program Plan and (2) provide quarterly updates to the Deployment Committee.

RESOLVED, at the point that $5,000,000 has been committed to projects under the Program, the Deployment Committee will decide whether and how to modify the Program Plan after steps one and two to ensure the sustained and orderly deployment of the residential solar market in Connecticut.

RESOLVED, that this Board action is consistent with Section 106 of the Act.

RESOLVED, that the proper CEFIA officers are authorized and empowered to do all other acts and execute and deliver all other documents as they shall deem necessary and desirable to effect this Resolution.

Section 6 - Evaluation, Measurement and Verification

6.1. Data Format and Collection

The following is a list of some of the key data that will be collected through the Program (see Table ~~14~~17)

Table ~~14~~17. Partial Listing of Data Collection by Method and Frequency

Field Name	Method	Frequency
Customer Information – customer demographic data (i.e. household income, location, square footage, etc.), historical energy consumption (i.e. electricity, natural gas, etc.)	CRM	Once
Project Information – hardware costs, non-hardware costs, process timeline, system details (i.e. size, tilt, etc.), incentives, product type, etc.	Power Clerk	Once
Contractor Information – business, staff, FTEs on the	Power Clerk	Once

job by specialization, etc.		
System Performance – current energy consumption, clean energy production, REC production, time-of-day production, etc.	Metering equipment	Real-time
Energy efficiency – measures undertaken, costs, and estimated energy savings	CRM	Once
Financing – loan amount, interest rate, repayment history, lease rate factor, etc.	CRM	Monthly
Marketing – e-mail,[15] webinar,[16] event,[17] social media,[18] communications,[19] website,[20] online ad,[21] direct mail,[22] and customer[23]	CRM or Salesforce.com	Monthly

Data for the Program will be collected electronically as much as possible so as to automate administrative functions and to analyze data quicker.

6.2. Data Analysis

Data from the Program will be presented in various forms, including, but not limited to:

- **Customer Portals** – a customized public web-page for the customer to see how their system is performing in real-time and to track the economic savings resulting from the installation. Widgets for social media will be created to allow a homeowner to share how their system is performing with friends and family.

- **Program Administrator Portal** – a portfolio manager private web-page for CEFIA to see how a contractor and the program are performing. The web-page will provide a dashboard to the staff and a mechanism to see how progress is being made towards goals. It will include the performance of the system as well as loan repayment performance.

[15] Unsubscribed rate, bounce rate, open rate, and click-through rates
[16] Attendee rate, drop-off rate, and engagement rate
[17] Registration, attendees, and satisfaction
[18] Gross views, connections, mentions, activity, engagement, conversions, and sentiment
[19] Number of releases, number of interviews, number of press events, volume of coverage, share of voice, earned media value
[20] Views, visitors, unique views, backlinks, and conversions
[21] Impressions, cost per click, cost per thousand views, cost per conversion, and cost per action
[22] Eyes on, delivery rate, response rate, and cost per conversion
[23] Churn rate, customer lifetime value, acquisition cost, share of wallet, and customer engagement

- **Virtual Utility** – a public web-page that serves to aggregate all of the installations into an online virtual utility. The virtual utility can be queried to see how a town is performing for example.

- **Cost Index** – a public web-page that provides up-to-date information on hardware and non-hardware related costs, installed costs by geography, size, etc.

Data for the Program will be used to bring transparency to consumers and contractors in the marketplace and for administrative and evaluation purposes.

6.3. Metrics

The following is a list of several of the key metrics for the Program (see Table ~~15~~18):

Table ~~15~~18. Key Metrics for the Program

Metric	Current	Target
Installed capacity	12 MW	At least an additional 30 MW by the end of 2022 at half of the allowable incentives
Payback Period	Greater than 10 years	Between 7 to 10 years in the first 5 years and then 5 to 7 years over the decade
Incentives leveraged	1.0:1.0	Deploy $200 million of private capital leveraged by about $50 million from the CEF for a leverage ratio of 4.0:1.0
Financing leveraged		Leverage private capital at a ratio of 4.5:1.0
Low interest rate	5.5 percent on the CT Solar Lease	TBD
Financing performance	Very low defaults	Maintain very low default levels
Customer acquisition	2,000	At least an additional 7,500
Installed cost	$5,000/kW	Target reduction of between 20 to 40 percent over time
Model community with 5% penetration rate	0	Between 5 to 10
~~Non-hardware related cost reductions~~	~~$2,100/kW~~	~~At most $1,785/kW (a 15% reduction from current costs)~~
Energy efficiency measures	HES	HES or BPI-certified, cost-effective energy efficiency measures (i.e. duct and air

		sealing and insulation)
Workforce	TBD	Increase in the number of trained and employed people in the residential solar PV workforce
Accessibility	TBD	Demonstrate that solar PV system ownership or leasing can be accessible by limited and middle income households

Section 7 - Appendices

7.1. Section 106 of the Act

Sec. 106. (NEW) (*Effective July 1, 2011*) (a) The Clean Energy Finance and Investment Authority established pursuant to section 16-245n of the general statutes, as amended by this act, shall structure and implement a residential solar photovoltaic investment program established pursuant to this section, which shall result in a minimum of thirty megawatts of new residential solar photovoltaic installations located in this state on or before December 31, 2022, the annual procurement of which shall be determined by the authority and the cost of which shall not exceed one-third of the total surcharge collected annually pursuant to said section 16-245n.

(b) The Clean Energy Finance and Investment Authority shall offer direct financial incentives, in the form of performance-based incentives or expected performance-based buydowns, for the purchase or lease of qualifying residential solar photovoltaic systems. For the purposes of this section, "performance-based incentives" means incentives paid out on a per kilowatt-hour basis, and "expected performance-based buydowns" means incentives paid out as a one-time upfront incentive based on expected system performance. The authority shall consider 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. Notwithstanding the provisions of subdivision (1) of subsection (j) of section 16-244c of the general statutes, as amended by this act, the amount of renewable energy produced from Class I renewable energy sources receiving tariff payments or included in utility rates under this section shall be applied to reduce the electric distribution company's Class I renewable energy source portfolio standard. Customers who receive expected performance-based buydowns under this section shall not be eligible for a credit pursuant to section 16-243b of the general statutes.

(c) Beginning with the comprehensive plan covering the period from July 1, 2011, to June 30, 2013, the Clean Energy Finance and Investment Authority shall develop and publish in each such plan a proposed schedule for the offering of performance-based incentives or expected performance-based buydowns over the duration of any such solar incentive program. Such schedule shall: (1) Provide for a series of solar capacity

blocks the combined total of which shall be a minimum of thirty megawatts and projected incentive levels for each such block; (2) provide incentives that are sufficient to meet reasonable payback expectations of the residential consumer, taking into consideration the estimated cost of residential solar installations, the value of the energy offset by the system and the availability and estimated value of other incentives, including, but not limited to, federal and state tax incentives and revenues from the sale of solar renewable energy credits; (3) provide incentives that decline over time and will foster the sustained, orderly development of a state-based solar industry; (4) automatically adjust to the next block once the board has issued reservations for financial incentives provided pursuant to this section from the board fully committing the target solar capacity and available incentives in that block; and (5) provide comparable economic incentives for the purchase or lease of qualifying residential solar photovoltaic systems. The authority may retain the services of a third party entity with expertise in the area of solar energy program design to assist in the development of the incentive schedule or schedules. The Department of Energy and Environmental Protection shall review and approve such schedule. Nothing in this subsection shall restrict the authority from modifying the approved incentive schedule before the issuance of its next comprehensive plan to account for changes in federal or state law or regulation or developments in the solar market when such changes would affect the expected return on investment for a typical residential solar photovoltaic system by twenty per cent or more.

(d) The Clean Energy Finance and Investment Authority shall establish and periodically update program guidelines, including, but not limited to, requirements for systems and program participants related to: (1) Eligibility criteria; (2) standards for deployment of energy efficient equipment or building practices as a condition for receiving incentive funding; (3) procedures to provide reasonable assurance that such reservations are made and incentives are paid out only to qualifying residential solar photovoltaic systems demonstrating a high likelihood of being installed and operated as indicated in application materials; and (4) reasonable protocols for the measurement and verification of energy production.

(e) The Clean Energy Finance and Investment Authority shall maintain on its web site the schedule of incentives, solar capacity remaining in the current block and available funding and incentive estimators.

(f) Funding for the residential performance-based incentive program and expected performance-based buydowns shall be apportioned from the moneys collected under the surcharge specified in section 16-245n of the general statutes, as amended by this act, provided such apportionment shall not exceed one-third of the total surcharge collected annually, and supplemented by federal funding as may become available.

(g) The Clean Energy Finance and Investment Authority shall identify barriers to the development of a permanent Connecticut-based solar workforce and shall make provision for comprehensive training, accreditation and certification programs through institutions and individuals accredited and certified to national standards.

(h) On or before January 1, 2014, and every two years thereafter for the duration of the program, the Clean Energy Finance and Investment Authority shall report to the joint standing committee of the General Assembly having cognizance of matters relating to energy on progress toward the goals identified in subsection (a) of this section.

7.2. Section 109 of the Act

Sec. 109. (NEW) (*Effective July 1, 2011*) The Public Utilities Regulatory Authority shall provide an additional incentive of up to five per cent of the then-applicable incentive provided pursuant to section 106 of this act for the use of major system components manufactured or assembled in Connecticut, and another additional incentive of up to five per cent of the then applicable incentive provided pursuant to section 106 of this act for the use of major system components manufactured or assembled in a distressed municipality, as defined in section 32-9p of the general statutes, or a targeted investment community, as defined in section 32-222 of the general statutes.

Draft 2012 Integrated Resource Plan for Connecticut

Prepared by:

The Connecticut Department of Energy and Environmental Protection

January 2012

EXECUTIVE SUMMARY

Purpose

This Integrated Resource Plan (IRP), the fourth for Connecticut and the first developed by the Department of Energy and Environmental Protection (DEEP), presents a comprehensive vision for improving Connecticut's energy future. Based on analyses of projected future electricity supply and demand, the IRP recommends policies that will help make electricity cheaper, cleaner, and more reliable, while supporting in-state employment.

Ten-Year Energy Outlook

Electricity Demand

Connecticut's electricity consumption declined sharply during the recession. Over the next several years, consumption is expected to grow at approximately 1% per year, not surpassing 2005 levels until 2022. Slightly higher growth rates are expected for peak loads (the electricity demanded during the hour with the highest total demand).

Reliability

This report focuses on "resource adequacy" metrics of reliability, which are various measures of how much generating capacity will be available to serve peak loads. Resource adequacy complements the other important elements of delivering power reliably to customers: transmission security and distribution system resiliency. These other elements are already being reviewed through other processes and are not addressed in this IRP.

Based on reasonable assumptions about market conditions and the completion of transmission projects, we conclude that adequate generating resources will be available in Connecticut to serve electricity loads reliably through 2022 under every scenario analyzed. New England as a whole also will have adequate resources and likely not need new generation until 2022, though depending on market conditions could need it as early as 2018. These findings account for generation retirements that are likely to occur given market conditions and compliance with stricter rules for air emissions being promulgated by the U.S. Environmental Protection Agency (EPA).

This report also examines how the deliverability of natural gas fuel to generators affects the reliability of electricity supply. The regional power supply has become quite dependent on natural gas-fired generation, but most of those generators rely on "as-available" non-firm pipeline capacity for natural gas delivery. Deliverability to generators can be limited during cold winter periods when competing space-heating demands for natural gas are greatest. The amount of non-natural gas capacity plus natural gas-fired capacity currently identified as having either firm pipeline capacity or dual-fuel capability appears to be sufficient to meet winter electric demand, but additional verification of back-up fuel supplies and analysis of wintertime operational challenges may be necessary to assure continued reliability. ISO-NE is currently examining these issues in its strategic planning process.

Customer Rates

After several years of having Generation Service Charges of 10-12 ¢/kWh, Connecticut is beginning to experience some rate relief and can expect the downward trend to continue over the next five years. Generation Service Charges should remain at or below 8 ¢/kWh through 2017 (in constant 2012 dollars) as expanding shale gas supplies moderate wholesale natural gas and power prices. However, from 2017 to 2022, Generation Service Charges are projected to rise by more than 3 ¢/kWh in real terms. There are several components which are projected to comprise this future price increase. Rising capacity prices will add 1.9 ¢/kWh, as region-wide demand growth increases wholesale prices to a level sufficient to attract new resources; rising energy prices will add 0.6 ¢/kWh, mostly due to expected natural gas price increases; and rising Class 1 Renewable Portfolio Standards (RPS) targets and higher renewable energy credit prices (due to anticipated scarcity) also will add 0.6 ¢/kWh over that time period. Rates in 2022 could turn out to be higher or lower depending on market conditions, but are still expected to increase from projected 2017 levels. Policy options to mitigate the effects of the projected rate increases are addressed below. The downward rate trend for the next 5 years provides policy makers an opportunity to put into place long-term policies to alleviate projected price increases.

Environmental and Other Policy Objectives

Air pollution emissions in Connecticut have fallen largely because low-cost natural gas-fired generation is displacing coal and oil-fired generation. 2010 emissions of NOx, SO_2, and CO_2, fell 36%, 70%, and 10%, respectively, from 2007 levels, and they are projected to fall another 49%, 45%, and 12% by 2015. New England emissions likewise will fall from 2010 levels until 2015. Thereafter, emissions in New England and Connecticut rise very slowly as electricity demand grows, but remain below 2010 levels through 2022.

Connecticut has the highest target for renewable generation (20% by 2020) of all New England states, but few native resources apart from a set of in-state projects that depend on special state-sponsored contracts. Connecticut load-serving entities satisfy these renewable requirements mostly by purchasing renewable energy credits generated elsewhere in New England, competing with other states in a regional renewable energy credit market. However, unless more renewables are developed across New England than are projected currently, a gap between projected available supply and mandated demands will emerge in 2018. Unless regional development of renewable resources and enabling transmission accelerates, Connecticut customers could face Alternative Compliance Payment obligations of more than $250 million (in 2012 dollars) annually by 2022.

Recommendations

In light of expected rate increases from 2017 to 2022, the State should pursue **resource strategies** that: (1) help customers reduce the volume of consumption and, thus, save money when market-wide cost factors pressure rates; (2) facilitate the development of low-cost, clean resources that are economic but may face barriers to implementation; (3) find more effective ways to meet the clean energy objectives of the renewable targets without exposing customers to potentially excessive costs; and (4) support in-state jobs.

To those ends, this IRP evaluates several resource options and develops the following complementary and mutually reinforcing recommendations:

- *Expand Energy Efficiency to Attain All Cost-Effective Energy Savings.* Specifically, increase Conservation and Load Management (C&LM) budgets from $105 million annually under a business-as-usual budget to $206 million annually. In parallel, initiate complementary policies to enable and motivate participants, including providing low-cost financing, implementing more aggressive codes and standards, and motivating behavioral changes through information and training. Connecticut should aim to be recognized as the national leader in innovative approaches to achieving cost-effective energy efficiency.

  The analysis which supports this recommendation is based on the 2010 study sponsored by Connecticut's Energy Conservation Management Board, *Connecticut Electric Residential, Commercial, and Industrial Energy Efficiency Potential Study.* The Potential Study estimates the amount of energy efficiency savings that can be achieved cost-effectively. We find that achieving this potential would cause Connecticut's energy consumption to decline by 0.4% per year while supporting a growing economy. Net of all program and participant costs, customers would save $534 million per year by 2022 compared to a business-as-usual Base Case. The savings arise from reduced consumption of energy, capacity, and renewable credits, and also from reductions in market prices resulting from expanding this low-cost resource. Projected air emissions would decline between 5% and 10%. The expanded efficiency programs and associated customer savings would support an additional 5,500 in-state jobs by 2022.

- *Increase Flexibility in Meeting Renewable Energy Targets* to reduce the risk that customers would pay large amounts of Alternative Compliance Payments without achieving Renewable Portfolio Standard objectives. Specifically, given the relative cost-effectiveness of energy efficiency as a clean energy resource, allow new energy efficiency to meet a portion of the "Class I" goal. Future stakeholder discussions will have to develop the specific provisions, such as how providers of energy efficiency would be compensated relative to Class I resources. Stakeholders might also consider allowing other resources, such as out-of-region large hydropower, to serve clean energy goals. Adjusting the Alternative Compliance Payment level could also be considered.

  To illustrate the value of adding flexibility, we analyzed the implications of allowing new energy efficiency to meet one quarter of the Class I requirement. We found $152 million greater customer savings than in the Expanded Energy Efficiency scenario alone, due to a reduction in Alternative Compliance Payments and in Class I renewable energy credit prices (assuming prices are no longer at a scarcity level set by the Alternative Compliance Payment).

Implementing these policies will enable Connecticut ratepayers to avoid much of the expected cost increases in the 2017 – 2022 time frame, further reduce air emissions, and increase jobs in Connecticut compared to maintaining current policy. Because neither of these policies relies on large, irreversible investment commitments, they can be implemented in phases and adjusted to evolving market conditions, if necessary.

In addition to these long-term resource policies, DEEP will continue to examine critical **reliability issues** and to collaborate with regional entities on solving them. These activities will include:

- DEEP will establish a process to review and monitor the adequacy of resource supplies for providing reliable generation service during peak demand periods. DEEP will work with ISO New England to ensure that its market structures provide proper incentives to retain and develop new resources when needed. Although we identified no resource need in the near-term, if an unexpected shortage arises, DEEP will have a mechanism in place for conducting a backstop solicitation.
- DEEP will also work with ISO New England to maintain reliability during winter cold snaps, when natural gas availability for generation is lowest. To support preparedness with backup fuels, DEEP will assess the compliance of Connecticut generators with their Siting requirements and contractual obligations regarding fuel capabilities.
- Pursuant to Governor Malloy's Two Storm Panel Review and recent announcement of additional potential measures for Connecticut to address storm disaster preparedness and recovery, DEEP will continue to investigate the deployment and funding of smartgrid technology in city centers and the use of energy improvement districts as a mechanism to support micro-grids.

TABLE OF CONTENTS

I. INTRODUCTION

A. Purpose

The Connecticut Department of Energy and Environmental Protection (DEEP) developed this Integrated Resource Plan (IRP), as mandated by Public Act 11-80.[1] This IRP assesses the state's energy and capacity resource outlook, articulates a vision for improving Connecticut's energy future, and recommends policies to ensure that electricity in Connecticut is affordable, clean, and reliable.

The IRP is a foundational study to inform energy policy development, not necessarily a detailed tactical plan to implement such policies. Identified opportunities may be pursued subsequent to the IRP, through specific legislative and regulatory proceedings and procurement plans. The IRP should also inform the triennial Comprehensive Resource Plan, the first of which will be completed in 2012.

B. Process

DEEP produced this report in consultation with the Electric Distribution Companies (EDCs) and with analytical assistance from *The Brattle Group*, an economic consulting firm. DEEP led a Steering Committee, which met regularly with representatives from the EDCs and *The Brattle Group*. DEEP led eight sub-teams that included subject area experts from other state agencies, the EDCs, natural gas distribution companies, and *The Brattle Group*. The sub-teams addressed resource adequacy and electricity market modeling, energy efficiency, renewables, natural gas, environmental issues, transmission, emerging technology, and macroeconomic analysis. DEEP also solicited input from diverse stakeholders through a series of meetings that addressed all of the topic areas.

II. INDUSTRY CONTEXT AND SCOPE OF THIS IRP

In developing effective State energy policy, it is critical to recognize the current regulatory and market context. Figure 1 shows a picture of the electricity system and describes the primary players in each component of the system: from generation to transmission to distribution to the customer. Some key observations:

- Following Connecticut's electricity restructuring law in 1998, electricity is generated by independent power producers and sold to customers via the Electric Distribution Companies or competitive retail providers at market-based prices. The wholesale market and the transmission system are administered by the New England Independent System Operator ("ISO New England" or "ISO-NE") and regulated by the Federal Energy Regulatory Commission (FERC). ISO New England and FERC provide for open transmission access so that the lowest-cost

[1] This marks the fourth IRP for Connecticut. The Connecticut Electric Distribution Companies produced (and the Connecticut Energy Advisory Board reviewed and modified) the first three IRPs per Section 51 of Public Act 07-242, *An Act Concerning Electricity and Energy Efficiency*, which became effective July 1, 2007.

available resources can be utilized subject to transmission constraints, and they ensure that market price outcomes are competitive. Thus, the State does not directly determine how electricity is generated or transmitted, and it does not set prices charged for generation or transmission services.

- The State's role focuses on overseeing energy efficiency programs, regulating the distribution system, implementing environmental policies, setting renewable targets on the types of supply purchased by retailers, occasionally soliciting contracts for particular generation resources on behalf of all customers, and engaging with ISO-NE in developing market rules and planning transmission.
- There are many secondary players not included in the figure, such as lenders, energy traders, energy service companies, curtailment service providers (who help customers manage their peak loads and sell "negawatts" into the wholesale markets), customer on-site generation, *etc*.

Figure 1
The Electricity System

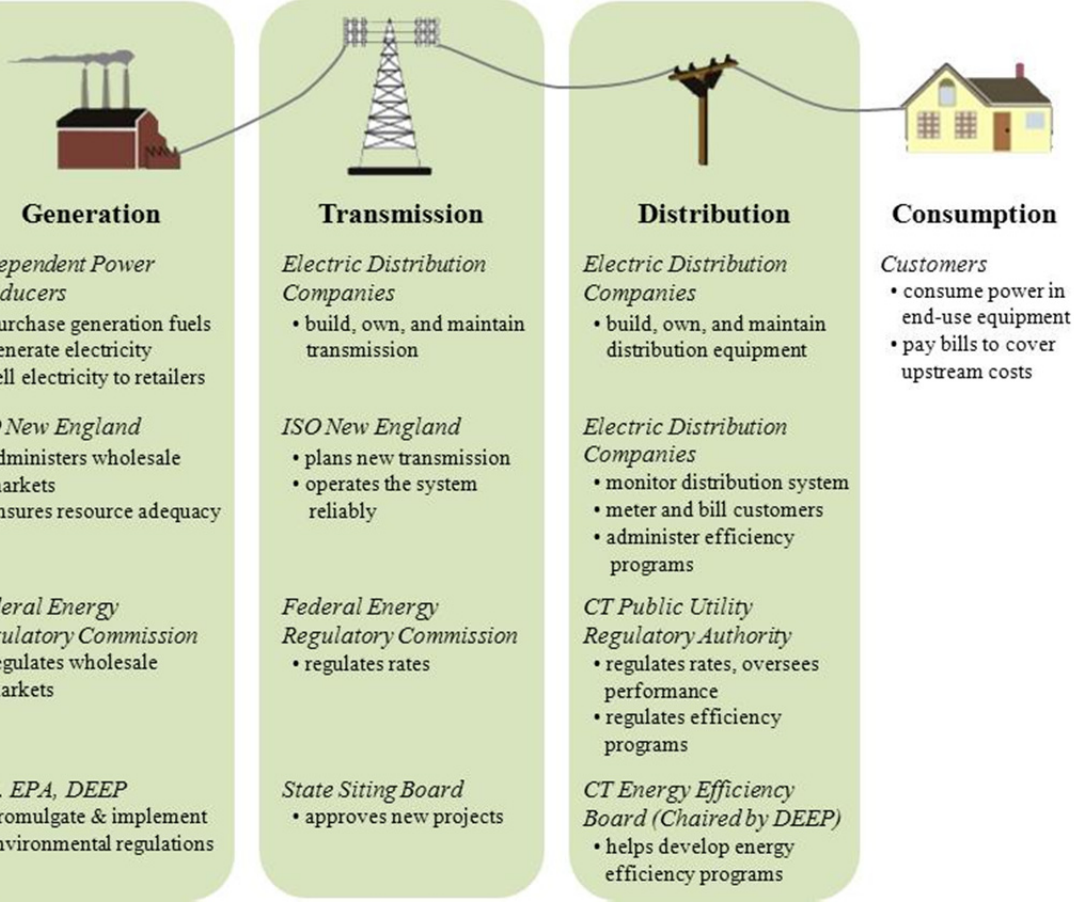
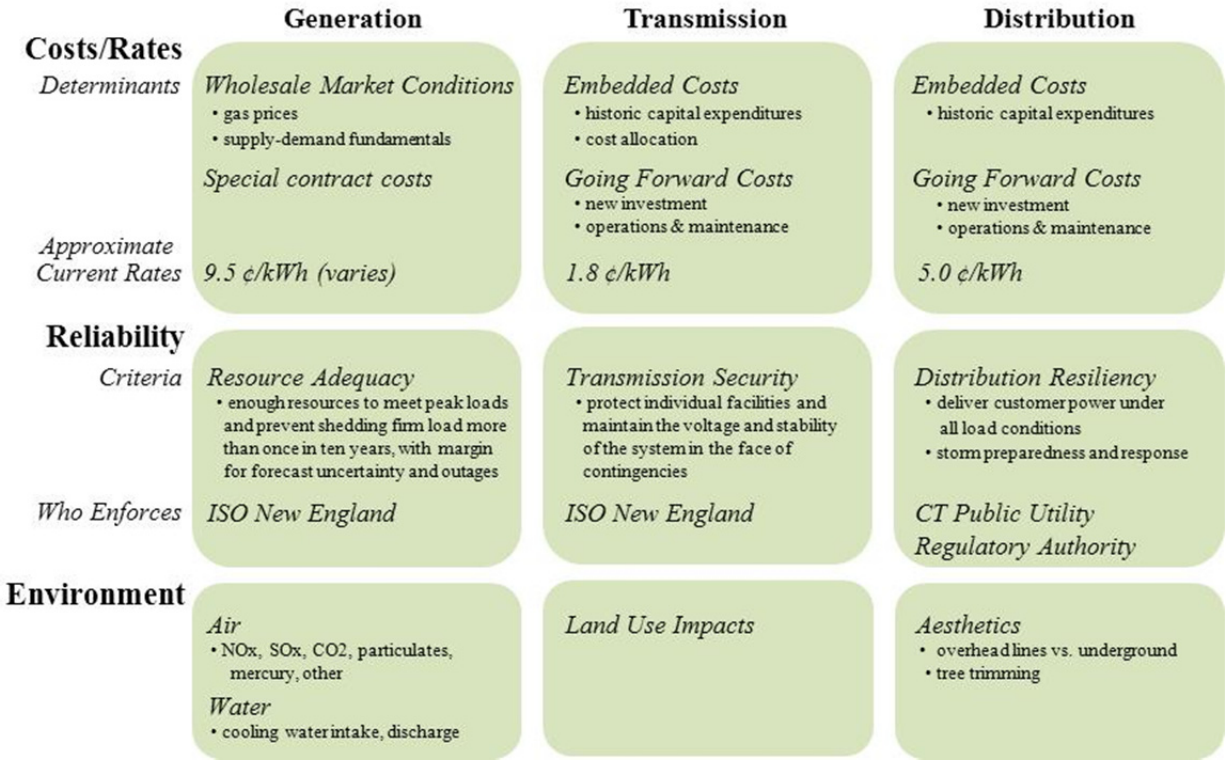


Figure 2 describes how each of the elements in Figure 1 contributes to the cost, reliability, and environmental impacts of the system. Several key observations follow from Figure 2:

- Generation accounts for the largest (and most variable) portion of rates and all of the emissions.[2] Market-based generation rates reflect wholesale market prices, which are largely driven by gas prices, regional supply-demand fundamentals, and market rules.
- Reliability must be maintained at three levels: "resource adequacy," "transmission security," and "distribution resiliency."
- Energy efficiency programs, not shown in Figure 2, have long been funded primarily through a 0.3 ¢/kWh "systems benefits charge" on all customers' bills. These programs and other state policies have been recognized by the American Council for an Energy Efficient Economy (ACEEE) as the 8th best in the country, indicating success with room for improvement.

Figure 2
Costs, Reliability, and Environmental Impacts of Electricity



The purpose of the IRP is to identify opportunities for the State to make electricity cheaper, cleaner, and more reliable. To that end, the IRP focuses on the state-jurisdictional areas identified above, particularly on the subset of areas that involve potential resource investments. It excludes a few important areas because they are being addressed concurrently outside of the IRP. For example, distribution resiliency and storm response are excluded because they are the subject of an ongoing investigation by the Governor's office; and the procurement of wholesale

[2] Approximate rates shown are representative for a typical residential customer in Connecticut in 2012. The "Generation" rate includes the Generation Service Charge and charges for special contracts.

power to serve customers who choose to buy generation from the Electric Distribution Companies is also excluded because it will be addressed by DEEP's new procurement manager.

III. ANALYTICAL APPROACH

The analytical approach includes four sequential steps, which this report mirrors in Sections IV through VII:

1. Develop Base Case assumptions and a three, five, and ten-year outlook for Connecticut's and New England's resource needs, certain aspects of reliability, customer rates, and emissions. Analyze the drivers of likely changes in Connecticut customer rates as a starting point for identifying improvement opportunities.

2. Analyze how outcomes could change under alternative Futures regarding market conditions the state cannot directly control, including natural gas prices, broad economic growth, and generation supply.

3. Evaluate several Resource Scenarios and policy options the state could pursue — involving energy efficiency, renewable generation including remote resources and associated transmission, and new conventional generation — to reduce costs and emissions while supporting in-state jobs. Test the robustness of Resource Scenarios against the Base Case and alternative Futures. Consider ways to enable emerging technologies that may be part of a longer-term solution.

4. Develop policy recommendations based on the above.

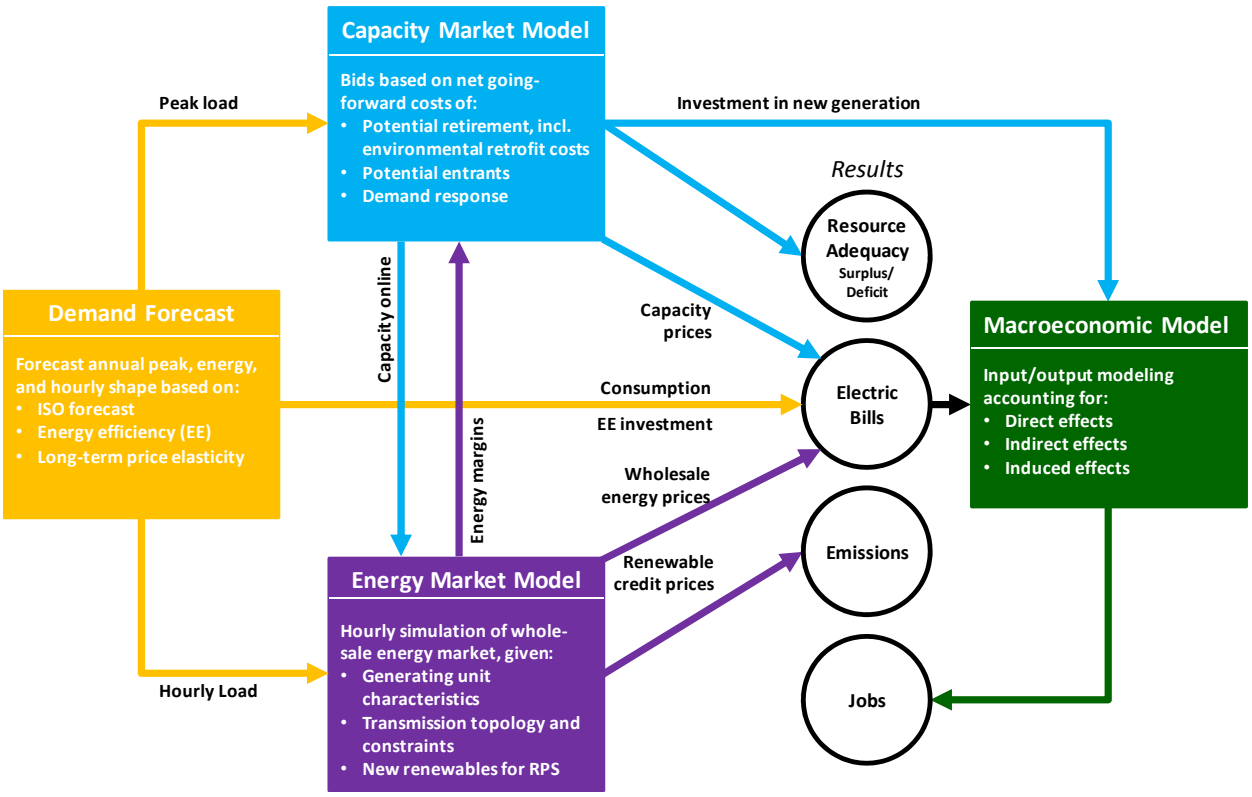
The analyses presented in this report are based on publicly available data about the Connecticut and broader New England electricity markets. Projections and impact analysis also rely on a modeling system with four major interconnected components, as depicted in Figure 3: a demand forecast; a capacity model to simulate capacity prices in ISO New England's Forward Capacity Market and to project new resource entry and retirement decisions; the DAYZER[3] model to simulate ISO New England's energy market, generator operations, and locational marginal prices (LMPs) in Connecticut, with a closely-linked renewables model to project renewable energy credit (REC) prices; and a macroeconomic model (REMI) to analyze impacts on in-state jobs. The electricity models were developed in past IRPs and employed again by *The Brattle Group* under DEEP's direction. The REMI analysis was conducted by the Connecticut Department of Economic & Community Development.

Complementing the modeling system, DEEP directed extensive research and analysis of publicly available information on resource adequacy, energy efficiency, renewables, natural gas, environmental issues, transmission, and emerging technology. Detailed explanations of the various components of the analysis are provided in Appendices A through I.

All dollar figures in this report are presented in 2012 dollars except where noted otherwise.

[3] DAYZER is a commercially available model developed by Cambridge Energy Solutions.

Figure 3. Schematic of the Modeling System



IV. BASE CASE TEN-YEAR OUTLOOK

A. Supply and Demand for Capacity

Because electricity cannot be stored in meaningful quantities, the industry must maintain an intentional surplus of resources to be able to serve customer demand every hour, even under severe conditions such as the hottest summer days when demand spikes and when generating units unexpectedly break down. Resources can take many forms — generating capacity, transmitting power from other regions, predictably curtailing demand when needed — and various metrics are used to measure resource adequacy and to quantify expected reliability.

The projected supply of capacity resources is greater than needed to meet peak electricity load reliably over the next decade.[4] That is, resource adequacy requirements set by ISO New

[4] "Peak load" refers to the maximum amount of power (measured in megawatts) used by customers over the course of a year. In New England, the peak load hour usually occurs during July or August. In general, "MW" refers to capacity, or power, while "megawatt-hours" (MWh) refer to energy produced or consumed. One MWh is equal to a MW of power produced or consumed over one hour. Common prefixes for both Watt and Watt-hour measures include "kilo" (k = 1,000), "mega" (M = 1,000,000), "giga" (G = 1,000,000,000) and "tera" (T = 1,000,000,000,000).

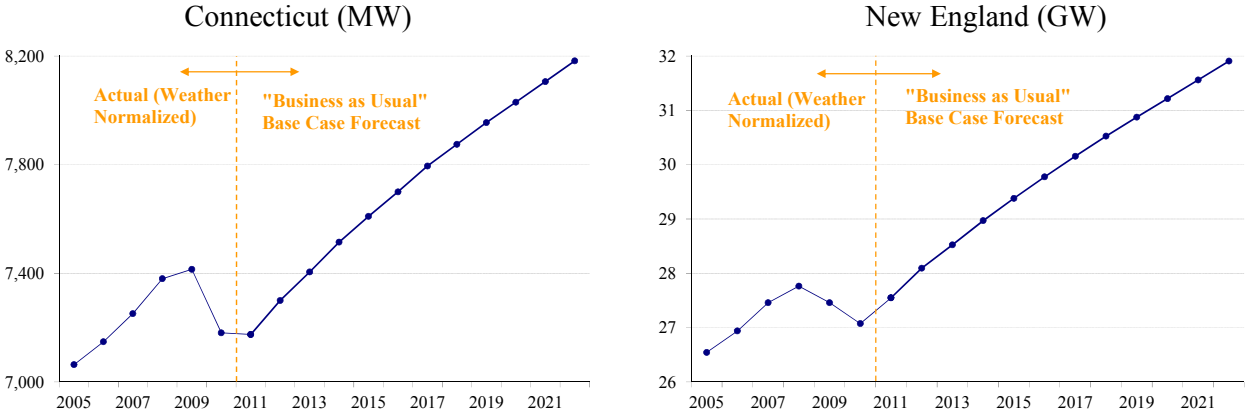
England are projected to be satisfied for ten years in both the Connecticut sub-area and in the New England region. Thus, additional generating resources will not be needed for resource adequacy purposes. Later sections of this report evaluate whether new resources could serve other policy objectives, including reducing costs and emissions and supporting in-state jobs.

The expected attainment of resource adequacy requirements is attributable to several factors: (1) an existing regional capacity surplus of more than five thousand megawatts; (2) forecasted slow demand growth, partly due to the current economic conditions and partly because of continued utility energy efficiency programs and new codes and standards; (3) new transmission into Connecticut helping to meet local adequacy requirements; and (4) a large enough current capacity surplus to withstand the effect of likely generation retirements resulting from the implementation of EPA's proposed Air Toxics rule in 2015/16 and the elimination of the capacity price floor in 2016/17. These and related factors are described in more detail below and in Appendix B (Resource Adequacy).

Peak Load Forecast

Peak load in Connecticut declined during the recession, but ISO New England forecasts an annual growth rate of 1.7% (125 MW/year) over the next few years, decreasing to 0.9% (75 MW/year) by 2020. The New England system peak load is forecast to grow at an annual rate of 2.0% initially (545 MW/year), decreasing to 1.1% growth (340 MW/year) by 2020, as shown in Figure 4.[5] These peak load projections do not deduct the effects of energy efficiency, most of which is counted separately as a supply-side resource in ISO New England's Forward Capacity Market and in the supply-demand projections in this IRP.[6]

Figure 4
Peak Load — Historical and Forecast



[5] The Connecticut 2010 peak value is a *Brattle* estimate based on data from ISO New England.

[6] These are ISO New England's "gross" forecasts, before accounting for demand-side resources that have cleared in forward capacity auctions. However, as discussed in Appendix B (Resource Adequacy), these forecasts do implicitly include some level of business-as-usual efficiency improvement.

Connecticut and New England Reliability Requirements

ISO New England defines several resource adequacy requirements affecting Connecticut:

- **Connecticut Local Sourcing Requirement.** ISO New England defines two requirements for local capacity in Connecticut: the Local Resource Adequacy requirement and the Connecticut requirement under the Transmission Security Analysis.[7] Whichever requirement is more stringent determines the local requirement. Because the capacity required under the Transmission Security Analysis has historically been greater, this IRP's resource adequacy analysis focuses on that measure.
- **Net Installed Capacity Requirement (NICR) for the New England region.** The Net Installed Capacity Requirement is the total amount of capacity needed to achieve the applicable reliability target specified in ISO New England's Planning Procedures (and by the North American Electric Reliability Corporation) to limit the probability of disconnecting non-interruptible customers due to resource deficiency to no more than once in ten years. The Net Installed Capacity Requirement also sets the total demand for capacity in ISO New England's forward capacity auctions. Notably, ISO New England has recently changed the methodology for determining the requirement, which has increased the Net Installed Capacity Requirement from 11.4% above forecast peak load to 14.4% above peak, approximately a 1,000 MW increase. This higher required reserve margin will tend to increase capacity costs and reduce energy costs.
- **Connecticut Locational Forward Reserve Market Requirement**. This requirement ensures enough quick-start capacity within Connecticut to recover from a second contingency occurring in Connecticut; commonly, the second contingency protection for this market requirement is an unexpected outage of the Millstone 3 nuclear unit.

Existing, Planned, and Assumed Future Resources

To analyze compliance with the Net Installed Capacity Requirement and Connecticut reliability requirements, we first consider "known" generating and demand-side resources, *i.e.,* those that currently exist or new resources expected to be online based on currently available information:

- *Existing Generating Capacity.* As of January 1, 2011, there are 8,150 MW available in the Connecticut sub-area and 32,027 MW available region-wide to meet reliability requirements.[8]
- *Planned Additions*. Planned additions fall into two categories — capacity built to help satisfy Renewable Portfolio Standards (RPS) and those built for other reasons. The non-RPS Planned Additions include the 130 MW New Haven

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[7] See http://www.iso-ne.com/genrtion_resrcs/reports/nepool_oc_review/2011/icr_2014_2015_final_report.pdf

[8] Capacity online is documented in the ISO-NE "2011-2020 Forecast Report of Capacity, Energy, Loads and Transmission" (2011 CELT Report).

Harbor gas turbine plant scheduled to come online on June 1, 2012 and an 88 MW expansion to Northfield Mountain pump-storage plant in Massachusetts scheduled to be completed by summer 2015. Planned Additions to satisfy RPS are 46 MW (46 MW capacity value) in Connecticut and 170 MW (69 MW capacity value) region-wide.[9] These include projects being developed for Project 150 in Connecticut as well as additional onshore wind and solar PV that are currently being developed or have announced plans to build. In addition, we assume 343 MW (150 MW capacity value) of renewables that are not yet planned will be developed in Connecticut and 2,470 MW (766 MW capacity value) region-wide to help meet RPS requirements, as discussed in the "Outlook for Renewable Generation Supply and Demand" section below.

- *Retirements*. Based on publically-available information and third-party data, we assume the retirement of 183 MW in Connecticut (AES Thames) and 1,366 MW in the rest of New England (Salem Harbor, Vermont Yankee, Holyoke 8/Cabot 8, and Holyoke 6/Cabot 6). Additional economic retirements are discussed below.
- *Demand Resources*. Demand resources include active demand response, and passive demand response. "Active demand response" is the ability to reduce participating customers' loads when called upon by ISO New England if committed generating resources are insufficient to meet the peak demands. Curtailment service providers sell these active demand response "negawatts" into the forward capacity auctions. "Passive demand response" is primarily energy efficiency. Both are treated as supply resources in the Forward Capacity Market. We counted all demand response resources committed in the forward capacity auction for delivery year 2014/15, but limited real-time emergency generation (RTEG) to 600 MW in accordance with ISO rules. Active demand response clearing in that forward capacity auction totaled 1,982 MW region-wide and 521 MW in the Connecticut sub-area. Passive demand response clearing in that auction will provide 1,486 MW region-wide, including 419 MW in Connecticut.
- *Net Imports*. Net imports into New England are assumed constant at 1,911 MW for years 2015 through 2022, consistent with amounts cleared in ISO New England's first five forward capacity auctions. This reflects 2,011 MW of imports and 100 MW of exports.

Projected Economic Retirement, Entry, and Active Demand Response

The IRP analysis recognizes the market context wherein many key outcomes cannot be ensured or planned, but instead will be determined by the decisions of market participants, and therefore can only be projected. Projecting market participants' potential entry (new generation or additional demand response resources) and exit (retirement of generation and attrition of demand response) requires modeling their financial decisions, which are based primarily on likely market prices and the ongoing costs of providing the capacity service. *The Brattle Group's* capacity market model simulates ISO New England's forward capacity auctions and economic entry/exit

[9] Divergence between equipment capacity ratings and capacity values assigned by ISO New England in resource adequacy analysis occurs because some resources (*e.g.*, solar and wind) frequently are not fully available during peak hours.

decisions simultaneously, since the capacity prices both influence individual economic decisions *and* reflect the combined results of those decisions. In the model, the annual demand for capacity is given by the Net Installed Capacity Requirement projections; supply includes most existing and planned generation bidding as price takers (offering capacity at zero price and accept whatever price results), while potential retirement candidates, active demand response resources, and potential new entrants submit bids that reflect their net avoidable going-forward costs. The marginal capacity needed to meet the requirement sets the equilibrium capacity market price; resources that offer capacity at a higher price than the market price (do not "clear" the auction) either retire or do not enter.[10]

The model results did not show that the Connecticut capacity price would separate (differ) from the New England capacity price, since the New England East-West Solution (NEEWS) transmission project scheduled for completion in 2016 would allow Connecticut to meet its Transmission Security Analysis requirement even if all fossil steam units in Connecticut retired. However, there would be price separation in the Northeast Massachusetts/Boston area due to a 533 MW shortfall by 2022, which we assumed would be met by incremental energy efficiency (an amount that is less than called for by the Massachusetts Green Communities Act) although ISO-NE is considering a proposal to meet the need with new transmission.

Generation retirement decisions are driven largely by capacity market prices and evolving environmental regulations — specifically the control of hazardous air pollutants (HAPs) such as mercury, which the analysis assumes will require generators without certain pollution controls to install costly retrofits (Maximum Achievable Control Technology — MACT) or retire in 2015. The U.S. EPA has also proposed many other regulations that will affect generators, but none yet clearly imposes widespread, inflexible requirements for retrofits as does the rule that controls hazardous air pollutant emissions. The Cross-State Air Pollution Rule (CSAPR), which was recently stayed, would exempt Connecticut and Massachusetts and, in any case, would impose allowance costs, not stringent control requirements. The EPA's plan to tighten ozone standards, which could lead to strict emissions rate limits, has been delayed and will likely not have a significant impact until the end of the 10-year study horizon. The proposed rules under the Clean Water Act Section 316(b) on cooling water intake structures appear to have flexibility and state implementation discretion.

In order to determine which generation units would have to install specific controls to comply with Maximum Achievable Control Technology requirements for hazardous air pollutants, DEEP consulted with Connecticut generation owners and environmental agencies from other states.[11] DEEP assumes that an electrostatic precipitator (ESP) would likely be needed on Middletown 4 and Montville 6 in Connecticut, and Yarmouth 1-3 in Maine to capture mercury emissions. DEEP assumes the Schiller coal plant in New Hampshire and the Mt. Tom coal plant in Massachusetts would likely need activated carbon injection (ACI) to improve the effectiveness of their fabric filters or ESPs in capturing mercury. DEEP assumes the Bridgeport Harbor 3 coal unit would need dry sorbent injection (DSI) to control acid gases, as would the Schiller coal

[10] The forward capacity auctions have so far had a price floor that has determined the price in surplus conditions. This price floor will expire in the 2016/17 forward auction, which will be conducted in 2013.

[11] These estimates are only intended for the purpose of this analysis, not as a regulatory determination of control requirements.

plant in New Hampshire. The capital costs of such retrofits range from $12/kW to $226/kW, as documented in Appendix E (Environmental Regulations).

The capacity model evaluates the economics of retiring versus retrofitting each unit by comparing the sum of retrofit costs and ongoing fixed operations and maintenance costs to the short-term (3-year) net present value of energy margins and capacity revenues expected from continued operation. Energy margins are estimated in the DAYZER model, and capacity prices are estimated within the capacity model. The result was 1,687 MW of economic retirements regionally (in addition to the 1,549 MW already planning to retire) mostly occurring in 2015, the assumed compliance deadline. In Connecticut, there would be 938 MW of economic retirements in 2015, in addition to 183 MW already planned. However, many of the old steam units in Connecticut that are not projected to need capital-intensive controls to comply with the hazardous air pollution rules would likely remain online because their going-forward fixed operations and maintenance costs are less than the projected capacity price: the Middletown 2-3, Montville 5, New Haven Harbor and Norwalk Harbor 1-2 steam oil units. The Bridgeport Harbor 3 coal unit is projected to remain online despite the cost of installing dry sorbent injection.

The amount of active demand response in the market also requires estimation because market participants decide how much to provide largely based on capacity prices. Intuitively, one would expect that supply of active demand response would decrease when capacity prices fall (after the price floor is eliminated) and increase when they subsequently rise. For forecasting purposes, an active demand response supply curve was constructed with a fixed cost component, and a variable cost component (per MWh of expected interruption) that increases as total market demand response penetration increases to account for a greater probability of being called. The result of including this supply curve in the capacity market simulations is that active demand response would decrease from 1,982 MW already cleared in the fifth capacity auction for 2014/15, to 1,006 MW in 2016/17 when the price floor is eliminated, but then rise to 2,588 MW in 2022 when capacity prices are substantially higher.

New generation entry is assumed to occur only when the capacity price rises to the Net Cost of New Entry (Net CONE) of the most economic generation technology in New England, a gas-fired combined-cycle plant. The Net Cost of New Entry of a new combined-cycle plant is given by the annual capital carrying charges and fixed operating and maintenance costs, minus (*i.e.*, net of) the energy margins and ancillary services revenues it would earn, as estimated in the DAYZER model. The annual capital carrying charges and fixed operating and maintenance costs are assumed to be $138/kW-year (in 2012 dollars), based on the costs *The Brattle Group* recently estimated for PJM Interconnection LLC for a new combined-cycle plant in New Jersey, then increased 4.7% to account for higher labor costs in Connecticut.[12] At these costs, no new combined-cycle capacity would enter until 2022/23 in the Base Case, with other lower cost

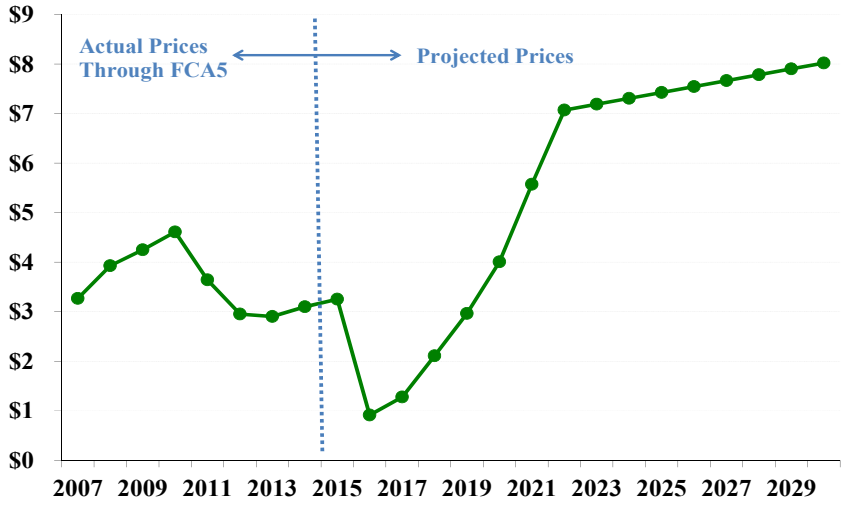
[12] The key parameters are $929/kW overnight cost, 13.1% level-real capital charge rate (based on 8.5% merchant ATWACC and 20-year economic life), and $17/kW-yr fixed operations and maintenance costs, for a 656 MW combined cycle. These estimates are based on "Cost of New Entry Estimates for Combustion Turbine and Combined Cycle Plants in PJM," adjusted to account for higher labor costs in Connecticut. See http://www.pjm.com/~/media/committees-groups/committees/mrc/20110818/20110818-brattle-report-on-cost-of-new-entry-estimates-for-ct-and-cc-plants-in-pjm.ashx.

resources such as active demand response meeting the Net Installed Capacity Requirement and setting capacity auction clearing prices in the meantime.

Projections for Capacity Prices and Resource Adequacy

Capacity prices through 2015/16 are given by the administratively determined price floor.[13] Thereafter, prices reflect the supply and demand conditions summarized above — in fact, the capacity model is considered solved when the market clears, with capacity prices that are consistent with the modeled economic exit and entry decisions. In 2016/17, projected prices fall below $1/kW-month to clear most of the capacity surplus that the price floor was supporting. As Figure 5 shows, prices then rise as load grows and higher-cost demand response re-enters. Capacity prices become progressively higher until new generation is needed and prices reach the Net Cost of New Entry level ($7.1/kW-month) in 2022/23.

Figure 5
Projected Capacity Prices (2012$/kW-month)



The resulting supply and demand for resources is described in detail in Appendix B (Resource Adequacy). The bottom line is that all of ISO-NE's reliability requirements affecting Connecticut can be expected to be met through 2022, without having to plan or facilitate new generation resources:

- *Connecticut Local Sourcing Requirement*. There are adequate resources in Connecticut to meet the Transmission Security Analysis criteria well beyond 2022, with 600 MW of surplus in 2015/16 then 1,900 to 2,000 MW of surplus in 2016/17 and beyond. Resources are shown as stacked bars in Figure 6, clearly exceeding the requirement shown in black. Projected retirements, shown as empty boxes at the top of the stacked bars, are not enough to eliminate the surplus. However, a critical element is the completion of the various components of the New England East-West Solution (NEEWS) transmission project that is

[13] Capacity prices paid to generators are pro-rated when the price floor is binding and surplus capacity clears.

being planned to address several transmission security reliability issues. These transmission enhancements will also support locational resource adequacy in Connecticut once they are completed between 2013 and 2016 — they will increase the Connecticut import capability by 1,100 MW (shown on the figure as a reduction in the requirement) and electrically incorporate the Lake Road generating facility (745 MW) into the Connecticut sub-area. With this project, local resource adequacy would be maintained even if all 2,716 MW of the fossil steam capacity in Connecticut retired when the price floor is eliminated in 2016/17, compared to the 1,112 MW assumed in this analysis.

As much as a 550 MW shortfall could occur in a very unlikely worst-case scenario where: (1) all fossil steam units retire; (2) the Central Connecticut portion of the New England East-West Solution is not constructed (that is the only portion of the transmission project still being evaluated by ISO-NE) reducing the import limit by 200 MW; (3) ISO New England's "high economic growth" forecast is realized (about 350 MW higher in CT than the Base forecast by 2022); and (4) all 400 MW of old aero-derivative combustion turbines retire due to potential future NOx regulations. So many steam and combustion turbine retirements are very unlikely, because these units appear to be economic under future market conditions where capacity market price adjustments would improve the prospects for some units if others retired, and ISO New England could resort to offering reliability must-run contracts for those potential retirements that might pose a local reliability concern. Nevertheless, DEEP should monitor the situation and ensure measures would be in place to mitigate any shortfalls.

- *Locational Forward Reserve Market*. There are more than adequate resources projected to meet Connecticut's Locational Forward Reserve Market requirement. The ISO's 2011 Regional System Plan indicates that through 2015 Southwest Connecticut will have no such requirement, while Greater Connecticut may have a need of 400 to 1,000 MW of quick-start capacity.[14] We project 1,501 MW available in Greater Connecticut, including 949 MW in Southwest Connecticut, well above the projected need in each area.

- *Net Installed Capacity Requirement for New England*. Adequate resources are projected for meeting the Net Installed Capacity Requirement through 2022. As

- Figure 7 shows, the stacked bar depicting supply exceeds the requirement through 2015. Thereafter, without a capacity price floor to maintain surplus capacity, the forward capacity auctions clear just enough supply to meet the requirement. Generation retirements and demand response attrition are sufficient to eliminate the surplus in 2016. Re-entry of existing demand response compensates for load growth through 2020, and additional demand response meets further load growth through 2021. By 2022, new generation entry begins to become economic. These conclusions are based on our simulated generation retirements and entry by demand response providers, as discussed above.

[14] See http://www.iso-ne.com/trans/rsp/2011/index.html.

Even if these projections and assumptions (such as assuming regional imports remain constant at approximately 1,900 MW) turn out to be wrong, the capacity market is designed to self-correct such "errors" and restore a balance between resources and prices. For example, if an additional generating unit retired, capacity prices would increase, which would reduce the incentive for any further retirements and would enhance incentives for additional demand response to enter the market.

Figure 6. Locational Resource Adequacy in Connecticut

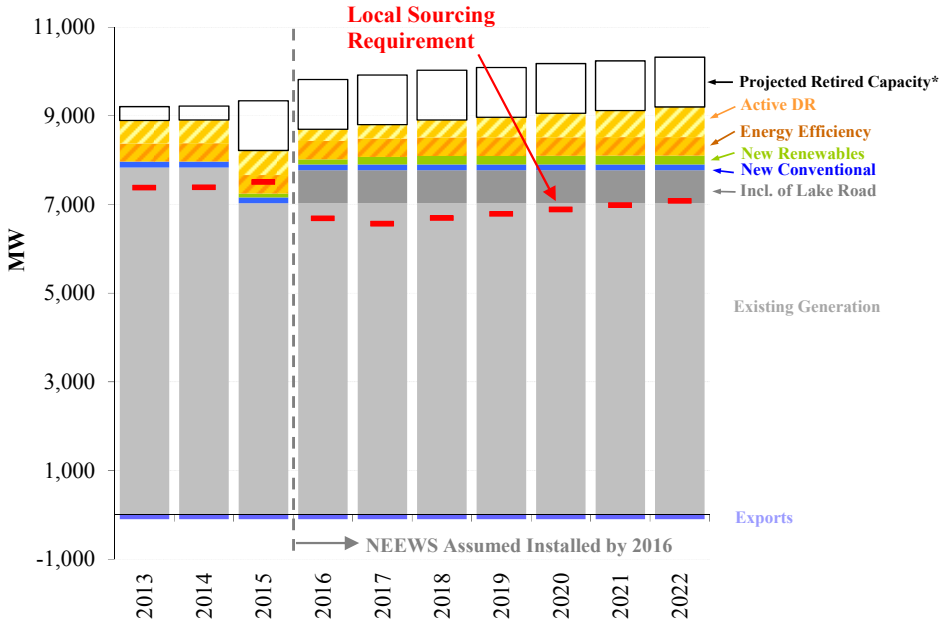
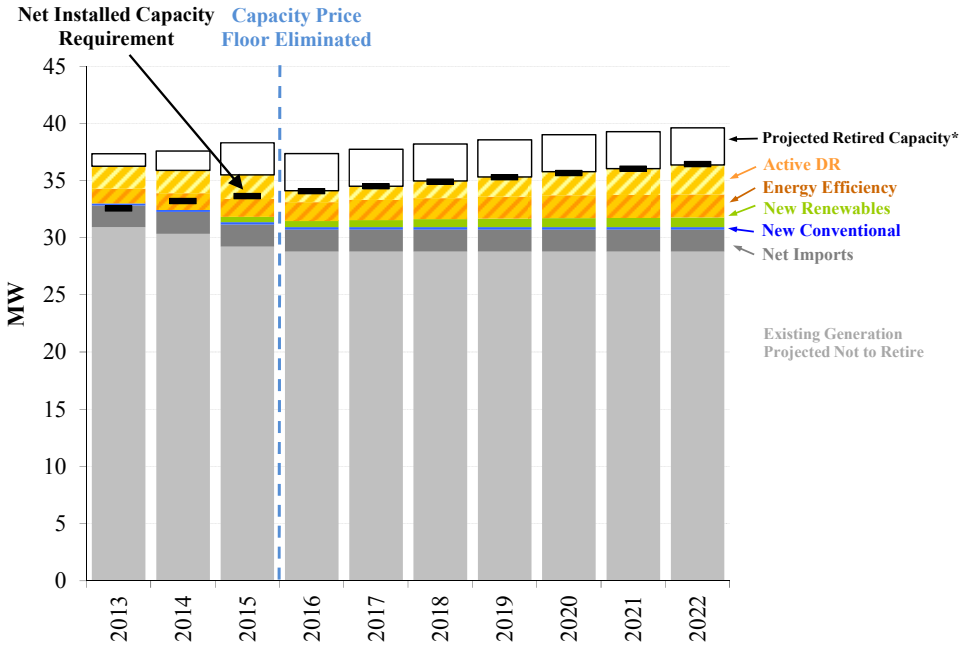


Figure 7. Resource Adequacy in New England



Winter Generating Fuel Availability

There is another type of resource adequacy that does not correspond to any current ISO-NE requirement: preparedness for severe winter cold snaps, when there may be limited natural gas available for natural gas-fired generating units. Most natural gas-fired generators lack firm gas pipeline delivery, although Mystic 8 and 9 (1,679 MW winter capacity) have their own liquefied natural gas (LNG) supply source, and over 1,600 MW of other generators currently have firm mainline gas transportation in New England.[15] An additional 5,300 MW of capacity has dual-fuel capability, yielding over 8,500 MW of natural gas-fired generators that currently have nominally reliable fuel supplies.

In the IRP Base Case energy market simulations, some level of natural gas-fired capacity is required to meet peak winter electricity loads in each of the three study years. Although a substantial amount of natural gas-fired capacity currently has dual-fuel capability or firm gas supplies, there is no requirement for generators to maintain reliable access to fuel, and thus the firmness of these fuel supplies may not be verified or regularly tested. In addition, the "just-in-time" natural gas delivery system stresses both the natural gas system (*e.g.*, pressure problems, unavailability of non-firm capacity) and the electric system (*e.g.*, operational issues) during tight winter conditions.

For the longer term, the issue of natural gas reliance in winter warrants continued close attention, since a number of uncertain factors influence the degree to which the electric system depends on natural gas-fired capacity that may lack firm fuel supplies or dual-fuel capability. These factors include retirements of oil and coal-fired generation, the extent to which natural gas units with firm fuel or dual-fuel capability maintain that capability, and the extent to which the electric system can rely on natural gas-fired generators without firm fuel supplies. This is a complex issue that requires further analysis, potentially including modeling of cross-system dependencies between the electricity and gas systems to fully understand their interactions under stress conditions.

ISO New England is currently investigating this issue through its strategic planning process and may make changes to its rules and operations, potentially modifying the Forward Capacity Market rules to account for winter gas availability. Connecticut should participate in this process. DEEP should also assess the compliance of Connecticut generators with their Siting requirements and contractual obligations regarding backup fuel capabilities.

Shortly before publication of this IRP report, ISO New England released a presentation based on a draft report assessing New England's natural gas pipeline capacity to satisfy power generation needs.[16] That presentation suggested that regional natural gas supply capability is inadequate to satisfy regional gas demands on a winter design day over the next decade. However, it did not focus on electric reliability; for instance it did not explicitly take into consideration that a

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[15] Of this 1,655 MW with firm gas capacity, about 500 MW is in Connecticut: Lake Road (246 MW worth of firm gas), Milford Power (218 MW), and Wallingford/Pierce (35 MW).

[16] "Assessment of New England's Natural Gas Pipeline Capacity to Satisfy Short and Near-Term Power Generation Needs," presented by ICF International to ISO-NE Planning Advisory Committee, December 14th, 2011.

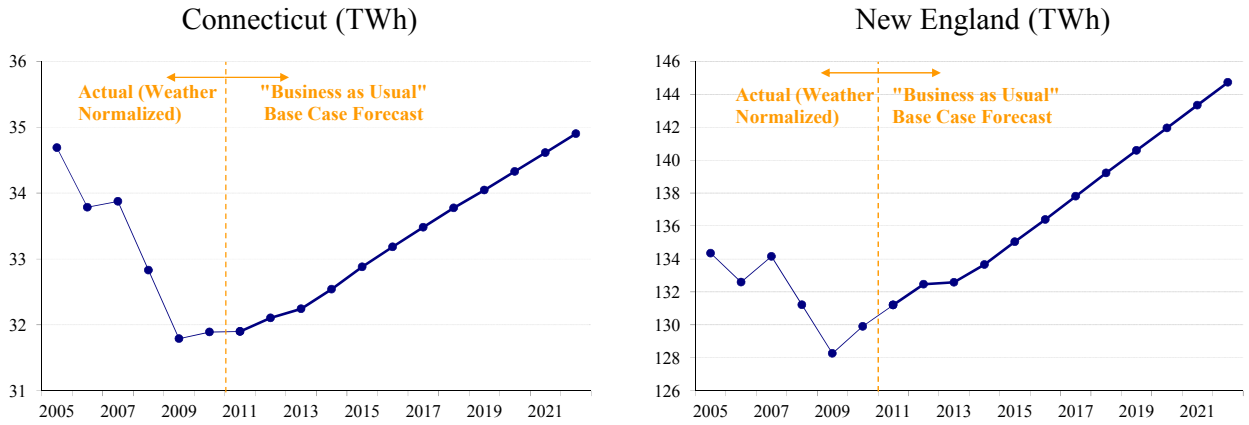
substantial amount of natural gas-fired capacity is dual-fuel capable and can operate on its alternative fuel if necessary.

B. Demand and Supply of Energy

Connecticut's electric energy consumption has declined sharply since 2005 due to the economic slowdown, continued implementation of energy efficiency measures, and other factors. Looking forward, consumption is expected to grow at approximately 1% per year, not reaching 2005 levels again until 2022. The rest of the New England region has not declined as much and is projected to recover at 1.1% annually, as shown in Figure 8.[17]

The finding that adequate capacity will be available means that energy requirements can be met reliably. *How* energy is produced — and the wholesale price of that energy — will depend on fuel prices, the types of resources that are developed or retired in the future, and transmission constraints. This study uses the DAYZER market simulation model to analyze how energy is produced. DAYZER includes all of the key elements of energy supply and demand, as well as all existing and planned transmission facilities in the ISO-NE system.

Figure 8
Annual Energy Consumption — Historical and Forecast for CT and New England[18]



One of the most important inputs is natural gas prices, with the prices of coal, oil, and emissions allowances also influencing wholesale market outcomes to a lesser extent. Delivered natural gas prices are based on NYMEX Henry Hub futures through 2021 ($4.10/MMBtu today, rising to $5.21 by 2015, $5.40 by 2017, and $5.92 by 2022), plus a basis differential based on historical prices and NYMEX basis swaps ($1.06/MMBtu on average, with a January high of $3.12/MMBtu), plus a $0.30/MMBtu local distribution company (LDC) charge for generators

[17] These figures are net of energy efficiency that has been implemented to date, some future energy efficiency measures that will be implemented to fulfill commitments made in ISO-NE's forward capacity auctions through 2014/15, and some amount of energy efficiency impacts that are embedded implicitly in the forecast as a continuation of "business-as-usual" trends. There are a number of challenges to fully and accurately account for energy efficiency in the load forecast that are discussed in Appendix B (Resource Adequacy) and Appendix C (Energy Efficiency).

[18] Year 2009 and 2010 weather normalized energy consumption figures for Connecticut are *Brattle* estimates.

served by local gas distribution companies instead of directly by a pipeline.[19] Oil prices are much higher, based on current forward prices. Coal prices, affecting approximately 2,000 MW of capacity in New England with Salem Harbor and AES Thames retired, are $4/MMBtu, which is high in historical terms. Coal prices are based on NYMEX Central Appalachian futures plus transportation costs.

Emissions allowance prices for NOx are assumed to stay at $0/ton due to Connecticut's exclusion from the Cross-State Air Pollution Rule (CSAPR) and the unlikelihood that the anti-backsliding provisions of that rule would be invoked under projected emission levels. (CSAPR was recently stayed by the D.C. Circuit Court of Appeals, but the analysis for this IRP assumes it will eventually proceed.) Prices for SO_2 allowances also are assumed to be $0/ton because of Connecticut's exclusion from the Cross-State Air Pollution Rule and emission reductions in other states will keep emission allowance prices under the Clean Air Act Title IV acid rain program essentially at zero. Prices for CO_2 allowances are assumed to stay at roughly $2/ton, set by the Regional Greenhouse Gas Initiative (RGGI) price floor.[20] No national climate policy based on cap-and-trade or carbon taxes is assumed over the 10-year study horizon.

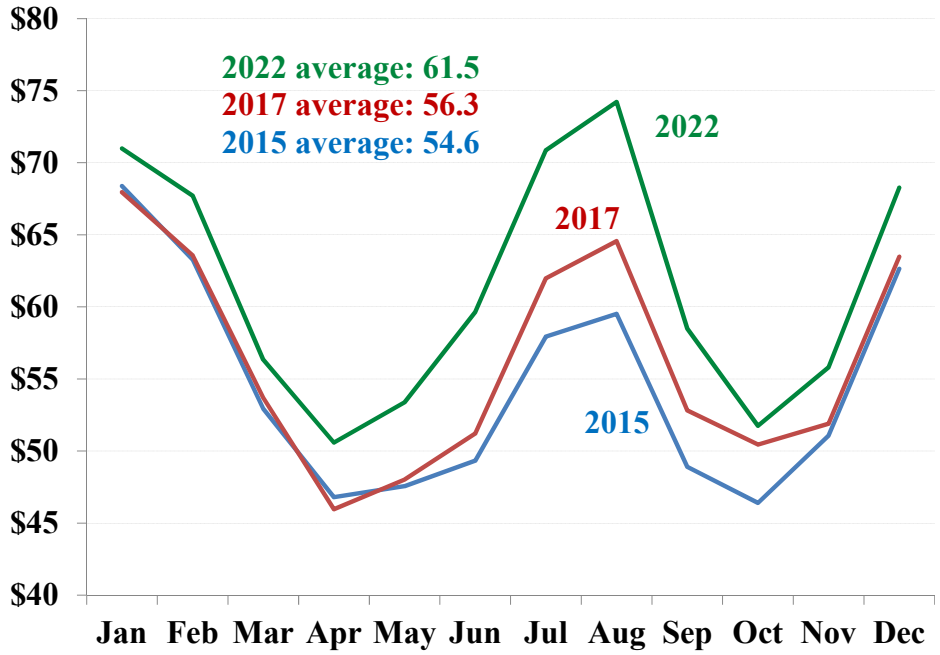
Using these data inputs, DAYZER simulates the ISO-NE's operation of the system and its administration of the energy market. The outputs of the model include hourly locational marginal prices (LMPs), dispatch costs, generation and emissions for every generating unit in New England, and transmission flows and congestion costs. The resulting annual average wholesale energy prices paid by Connecticut loads are $54.6/MWh in 2015, $56.3/MWh in 2017, and $61.5/MWh in 2022 in constant 2012 dollars, as shown in Figure 9, which also depicts monthly wholesale energy prices.[21] For comparison, annual average prices in 2008 were $87/MWh (when natural gas prices were much higher) then dropped to $45/MWh in 2009 before rising to $52/MWh in 2010 (all in 2012 dollars). About two thirds of the expected increase over time is due to rising natural gas prices, and the remaining third is due to less efficient generators setting market prices in more hours (higher "market heat rate") as the initial capacity surplus shrinks and load grows.

[19] "Henry Hub" is a common reference pricing point located in Louisiana. "MMBtu" is one million British Thermal Units. All prices shown are annual averages, expressed in 2012 dollars.

[20] RGGI expires in 2018. This analysis assumes CO_2 prices remain the same thereafter, but such a low price has a trivial effect on the results.

[21] Load-weighted annual average energy prices are $65.3/MWh in 2015, $59.2/MWh in 2017, and $57.1/MWh in 2022 in constant 2012 dollars. Load-weighted average prices are greater than simple average prices because load is frequently higher when prices are higher.

Figure 9
Base Case Projection of Energy Prices (2012 $/MWh)



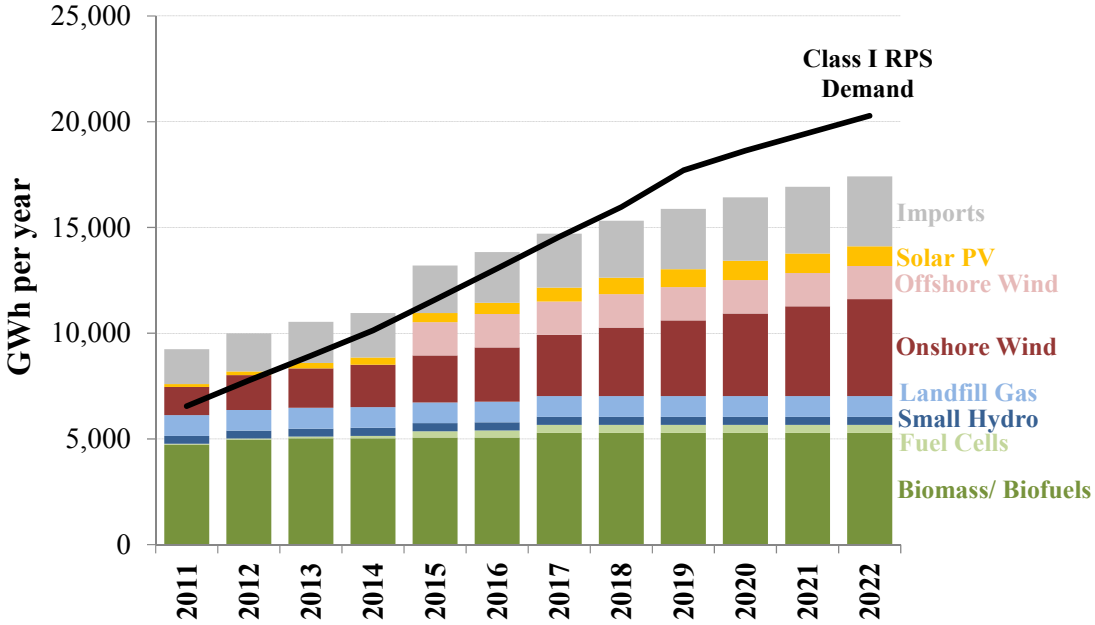
C. Supply and Demand for Renewable Generation

The demand for Class I renewable energy resources in New England is expected to almost triple over the next 10 years based on current state Renewable Portfolio Standard (RPS) rules and regulations. Among New England states, Connecticut has the most ambitious Class I target as a percentage of load (12.5% in 2015, increasing up to 20% by 2020) and accounts for approximately one-third of the regional renewable energy demand (second only to Massachusetts). Load serving entities in New England rely on a regional market for Class I Renewable Energy Credits (RECs) to comply with RPS requirements. However, Connecticut's regulations have some unique eligibility characteristics, with some resources qualifying for Class I status only in Connecticut. In estimating the supply and demand balance of the regional Class I REC market, we take into account resources that are specific to Connecticut.

While the technical potential of renewable resources in the overall New England region remains high, the tighter financial conditions over the past three years have made it increasingly difficult for new renewable resources to secure funding for construction. Based on information that is currently available, our Base Case projection of Class I renewable energy resources build-out shows that New England is likely to meet the regional demand through 2017, but will be short for years beyond 2017. Our projection through 2015 is based on information on projects that are currently under development and state-specific programs (including Connecticut Project 150, ZREC, LREC, and other programs). For years beyond 2015, we present a "likely" trajectory of renewable development based on recent historical trends and expected near-term additions. These assumptions include: (a) growing onshore wind capacity by about 115 MW per year; (b)

adding new solar resources to meet carve-outs from targeted state programs; (c) not building new landfill gas and small hydro resources; and (d) increasing the eligible Class I REC imports from New York and Canada at approximately 10% per year. Figure 10 summarizes supply and demand for Class I renewable energy in New England.

Figure 10
New England Class I Renewable Resource Supply and Demand Balance



Under the Base Case Class I renewable cost assumptions and simulated REC market, the market price for Class I RECs would be approximately $23/MWh while the market is in relative surplus (2012 through 2017). Beyond 2017, however, the REC shortfall implies that REC prices would rise to the level of the Connecticut Alternative Compliance Payment (ACP), which currently is the lowest in New England.[22] REC prices would clear the market at $45/MWh (real 2012 dollars), which is the level of the Connecticut Alternative Compliance Payment. Under these conditions, Connecticut utilities would satisfy nearly half of their RPS obligations through Alternative Compliance Payments.

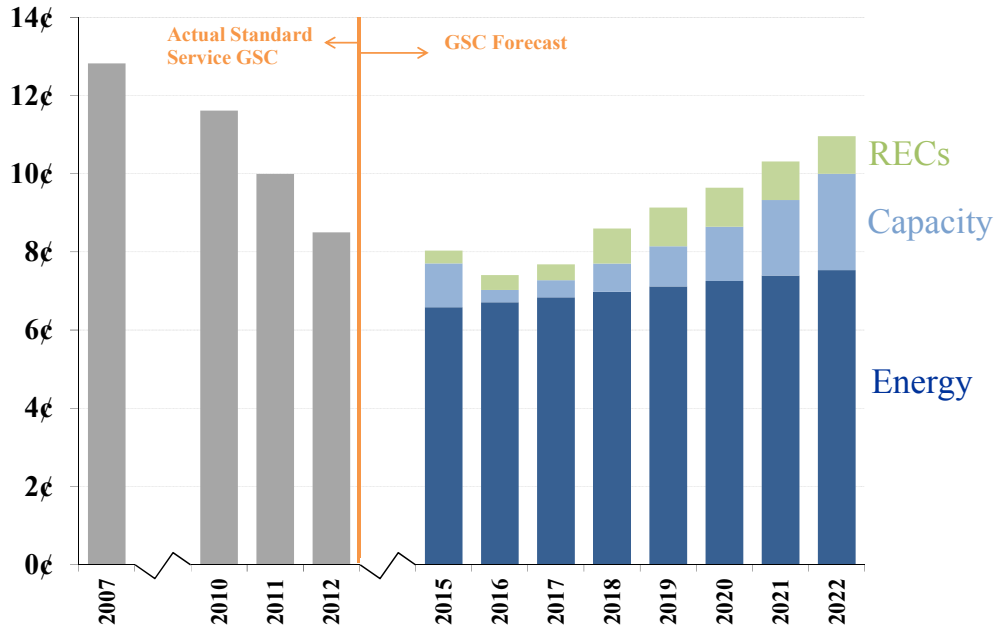
D. Outlook for Customer Rates

The IRP analysis projects Generation Service Costs (GSC) for Connecticut customers, averaged across all rate classes. Generation Service Costs currently comprise approximately half of the total customer bill, which also includes transmission and distribution and other costs.

[22] Alternative Compliance Payments (ACP) represent an administrative cap on REC prices, which entities can pay to states in lieu of purchasing RECs if they are unavailable or too expensive. Other New England states have indexed their ACP to inflation, while Connecticut set the level at $55/MWh without providing for any inflation adjustment. Other New England states' ACP levels for Class I requirements are currently $62/MWh, escalating at the consumer price index.

Based on the capacity, energy,[23] and REC market projections described above, Generation Service Costs should remain relatively constant in real terms, at approximately 8 ¢/kWh from 2012 through 2017, as shown in Figure 11.[24] That is substantially lower than rates experienced over the past several years, primarily because Henry Hub natural gas prices remain below $6/MMBtu and capacity prices stay below $4/kW-month. For comparison purposes, Figure 11 shows estimated historical and current rates for Standard Service for residential and small commercial and industrial customers in 2007, 2010, 2011, and 2012.[25]

Figure 11
Connecticut Customers' Annual Average Generation Service Costs (2012 ¢/kWh)
Base Case Projection



However, from 2017 to 2022, Generation Service Costs are likely to increase by slightly more than 3 ¢/kWh, as shown in Figure 11. This projected increase is driven by three factors:

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[23] In the figure, "energy" costs include the costs of electrical loss net of loss refunds, congestion costs net of financial transmission rights (FTR) revenues, and an estimated 10 percent adder to account for other ISO charges and a risk premium.

[24] The Generation Service Costs shown in Figure 11 do not include other components of customer bills, such as transmission and distribution (T&D) costs, the net costs of mandated renewable investments (ZREC, LREC, or Project 150 programs), or the cost of long-term contracts with the Kleen Generation, AMERESCo energy efficiency, Waterbury Generation or Waterside Generation and the new peaking facilities.

[25] Estimated Standard Service rates shown in Figure 11 are based on a weighted average of filed rates for CL&P (80%) and UI (20%), converted to 2012 dollars. These rates apply only to residential and small commercial and industrial customers that choose to take retail service from the Electric Distribution Companies. Hence, these rates are not strictly comparable to the projected future rates shown in Figure 11, which represent an average across all customers in the state.

- 1.9 ¢/kWh of the increase is from rising capacity prices. In 2017, prices will likely reach their lowest levels of about $1/kW-month after the current price floor expires and the market price drops to clear the existing capacity surplus. Thereafter, prices will rise as regional load grows. By 2022, prices will likely rise to $7/kW-month, near the equilibrium levels customers can expect to pay on a long-term average basis in order to attract new generation resources.
- 0.6 ¢/kWh of the increase is from the cost of Renewable Energy Credits (RECs) and Alternative Compliance Payments (ACP). The volume of renewables purchased increases as the Class I requirement increases, but the price also increases as the scarcity of regional supply causes the REC price to be set by the Connecticut Alternative Compliance Payment. In addition, outside the Generation Service Charge, there would be approximately a 0.2 ¢/kWh increase for transmission to support increased Class I resources, although the cost is highly uncertain and the modest rate impact assumes Connecticut pays for only its 25% load-ratio-share of the total estimated transmission costs.
- 0.6 ¢/kWh of the increase is from rising energy prices, approximately two-thirds of which is caused by natural gas prices rising, and one-third by market heat rates increasing as load grows.

This IRP identifies and evaluates opportunities to counteract some of the rate increases projected for the 2017-2022 period. One general approach is to help customers reduce the volume of consumption, and thus save money, especially when rates are higher. The other approach is to facilitate the development of low-cost resources that are economic (but may face barriers to implementation), which could defer the market price increases necessary to attract higher-cost resources. A third is to find more cost-effective ways to meet the clean energy objectives of the RPS. The Resource Scenarios section of this report addresses all of these approaches. As discussed below, increased energy efficiency can help meet all of these objectives and counteract more than half of the projected cost increases through 2022. The potential savings are particularly large if the RPS recognizes the cleanness of expanded energy efficiency by allowing it (and potentially other clean resources) to help satisfy a portion of the Class I requirement.

In addition to these resource approaches, it is important for Connecticut to continue to participate actively in the ISO New England stakeholder process. Connecticut needs to ensure the market is working effectively to achieve its reliability objectives at reasonable cost, and also that it reasonably accommodates state energy policy objectives.

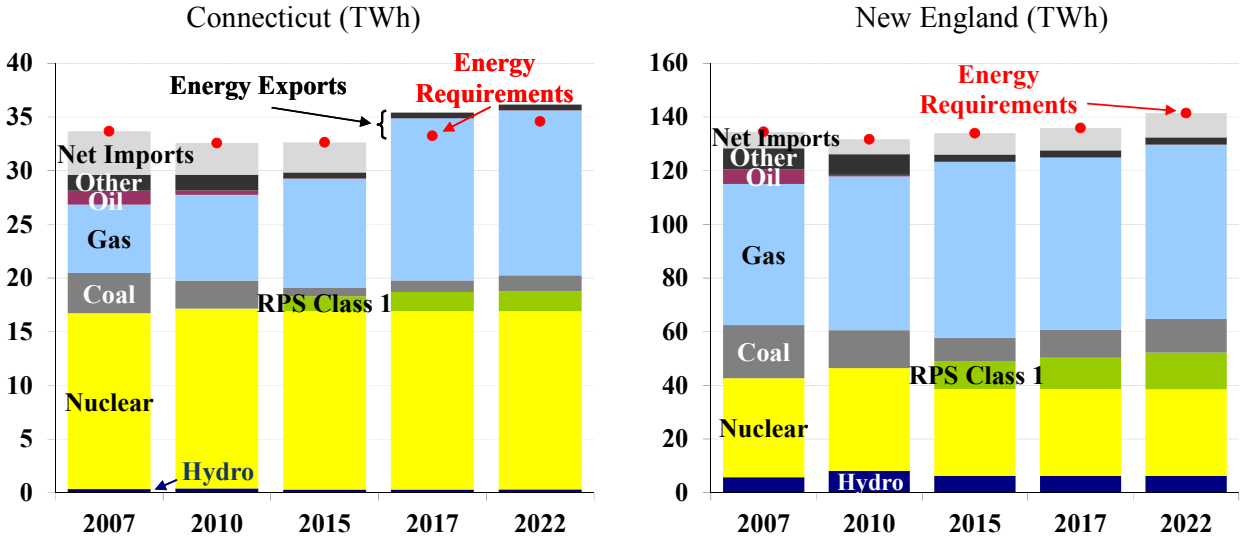
E. Fuel Use and Emissions Outlook

Electricity production and prices in New England today are markedly different from what the region experienced in the past decade, and further changes are expected over the next ten years. The primary reason for these past changes are dramatic shifts in relative fuel prices (low natural gas prices coupled with high coal and oil prices) while environmental retrofits, economic retirements, and new renewable generation will have increasing influence in the coming decade. For example, oil-fired generation decreased after 2007 partly because of increased availability of lower-cost natural gas-fired generation and renewables, but also because of changes in fuel

prices — oil prices have risen dramatically relative to natural gas prices, and are expected to remain high.

The combined effect on total generation by fuel type is shown in Figure 12 below, which includes 2007 actual data and projections for 2015, 2017, and 2022 for Connecticut and New England.[26] This shows the increase in renewable generation from 6% of total New England supply in 2007 to 10% in 2020, a 36% reduction in coal generation, and a steep decline in oil generation. Total generation in Connecticut is increasing, mostly because of the 2011 addition of the Kleen generation facility, an efficient 620 MW natural gas-fired combined-cycle plant, and the electrical incorporation of Lake Road (a 745 MW natural gas-fired combined-cycle plant) into the Connecticut sub-area upon completion of the Interstate portion of the New England East-West Solution transmission project at the end of 2015. These changes turn Connecticut from a net energy importer to a net exporter by 2017.

Figure 12. Base Case Projection of Annual Generation by Fuel Type



Displacement of coal and oil generation by gas and renewable generation will continue to produce a dramatic reduction in regional NOx, SO_2, and CO_2 emissions relative to historic levels.

- *CO_2.* As shown in Figure 13, Connecticut CO_2 emissions have already decreased from 9.7 million tons in 2007, and are projected to decrease to 7.8 million tons by 2015 then slowly rise to 8.5 million tons by 2022. New England as a whole will follow a similar curve, staying well below the targets established under the Regional Greenhouse Gas Initiative.[27]

[26] Regional natural gas and oil generation for historical years are estimated by *Brattle* based on publicly-available data from ISO-NE. For forecast years, generation is simulated in the DAYZER model.

[27] In Figure 13 through Figure 16, "RPS Class I" includes biomass and fuel cells that are RPS-qualified. "Other" includes refuse and biomass that are not RPS qualified.

- *SO_2*. As shown in Figure 14, Connecticut's power sector SO_2 emissions are expected to be a small fraction of past emissions. For example, 2010 emissions were 70% lower than in 2007; 2015 emissions are projected to be another 45% lower than 2010 emissions. By 2022, emissions are projected to grow back to 90% of 2010 levels, but still 73% below 2007 levels.
- *Annual NOx*. Figure 15 shows a substantial reduction in Connecticut's power sector NOx emissions, with only modest increases after 2015 as load grows. For example, 2010 emissions were 36% lower than 2007 emissions; 2015 emissions are projected to be half of that. After 2015, emissions are projected to grow slowly back to two-thirds of the 2010 level by 2022.
- *High Energy Demand Day NOx*. Figure 16 shows NOx emissions on just the top 10 High Energy Demand Days (HEDD), both for Base Case normal weather and for "90/10" weather representing a hottest summer expected in 10 years. These projections compare favorably to an average of 30 tons per day (TPD) experienced on the 4 hottest days in each of 2007 through 2010, and the target level of 42.7 tons per day Connecticut has committed to the Ozone Transport Commission (OTC).

Figure 13. Annual CO_2 Emissions

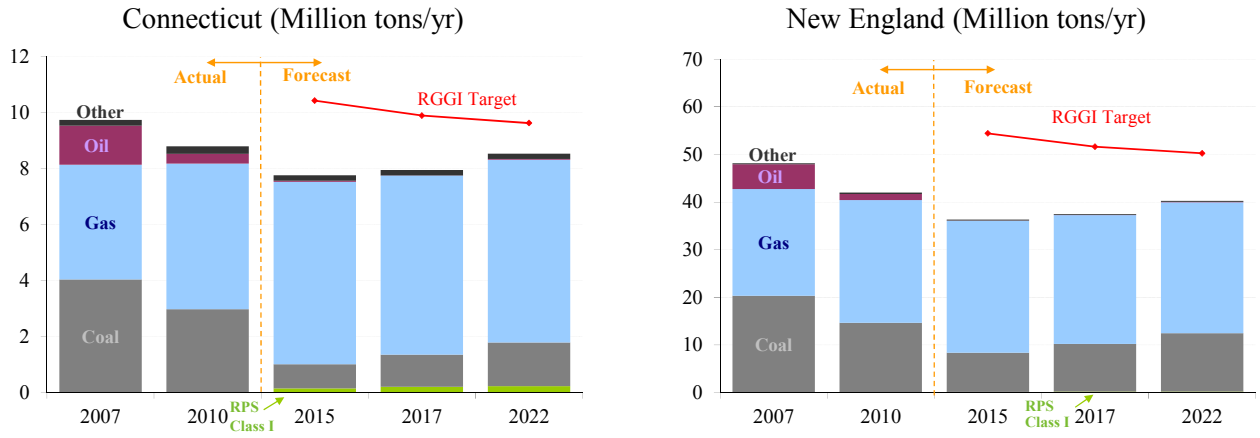


Figure 14. Annual SO_2 Emissions

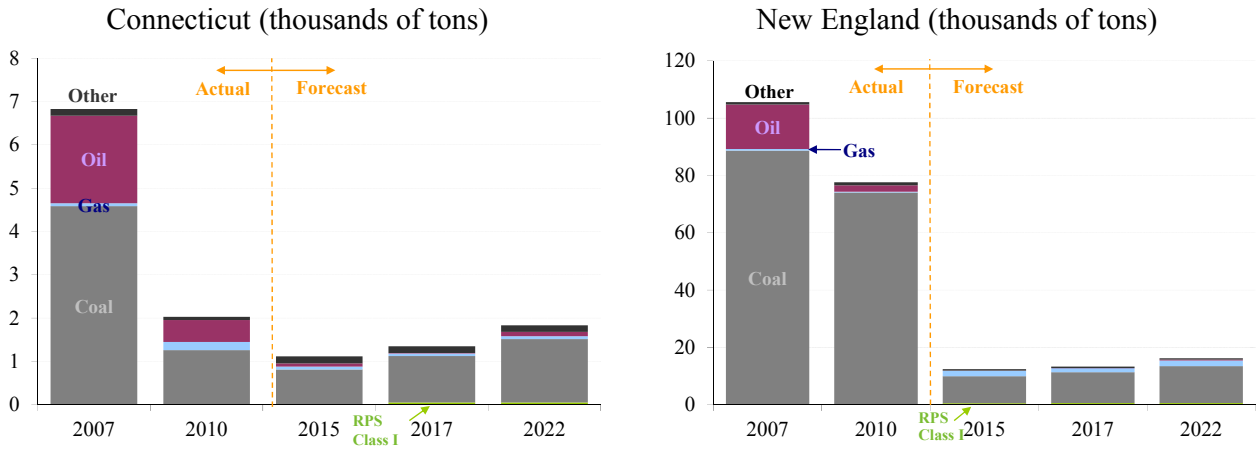


Figure 15. Annual NO_X Emissions

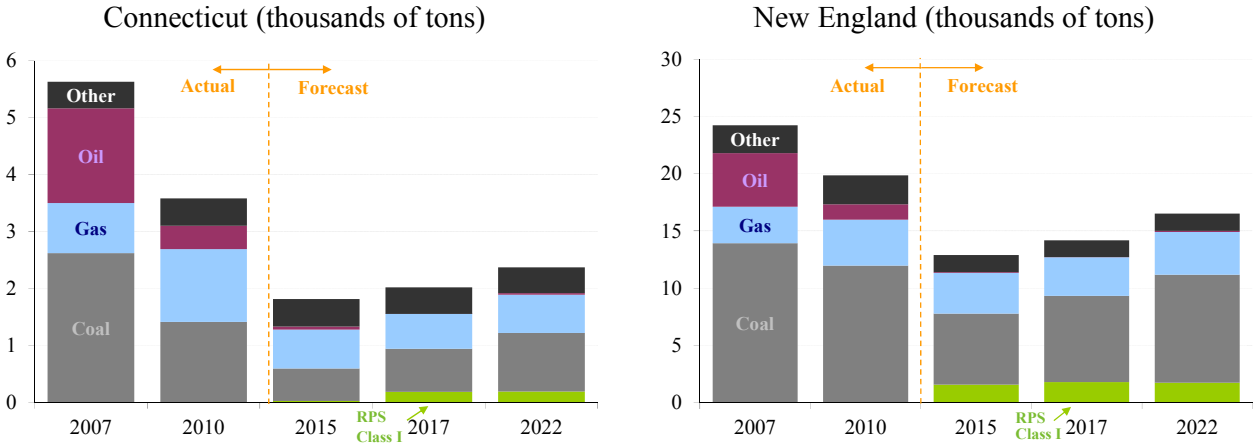
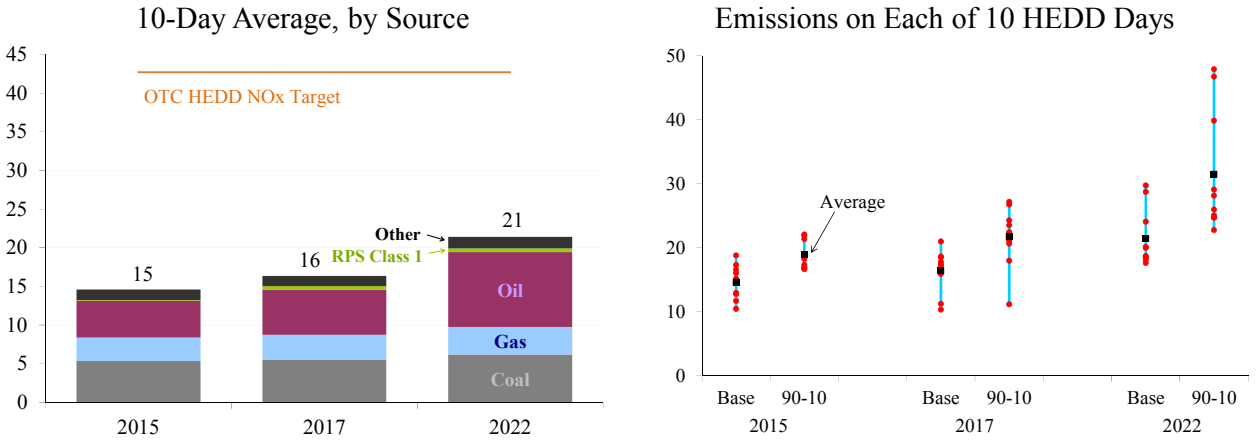


Figure 16. HEDD NOx Emissions in Connecticut (tons per day)



V. ALTERNATIVE FUTURES

A. Definition of Futures

Long-range planning analysis must address uncertainty in order to be useful. Regardless of the effort and attention that goes into the analysis, key external factors over which regulators and utilities do not have direct control but that nevertheless affect market outcomes — such as natural gas prices and economic growth — cannot be predicted perfectly. This translates into substantial uncertainty about important outcomes such as resource needs, rates, and emissions. Moreover, the costs and benefits of alternative resource strategies often differ as external factors vary. Hence, understanding the value of potential resource strategies requires assessing such strategies under a range of external factors. Simply setting each external ("exogenous") factor to a single most likely value seldom provides insight into how strategies might perform under alternative market conditions. An analysis that addresses uncertainty provides a more informed basis upon which to make decisions.

This IRP analyzes uncertainty by constructing scenarios, which we call "Futures" to distinguish from "Resource Scenarios," which are evaluated in the next section. The Futures are based on

varying natural gas prices and the relative amounts of supply and demand while holding all other variables at their Base Case values.[28]

Supply and Demand. The "Tight Supply" future incorporates ISO New England's high economic growth load forecast (1,150 MW higher by 2020), does not allow active demand response to adjust to capacity price changes, and assumes Boston's local resource adequacy problems are solved with transmission instead of adding internal resources. The "Abundant Supply" future incorporates ISO New England's low economic growth load forecast (1,150 MW lower by 2020) and assumes the Vermont Yankee nuclear plant remains in service during the study period. These two Futures thus span a large range representing any number of unanticipated changes that have similar effects on the regional supply-demand balance, *e.g.*, new imports of Canadian hydropower, changes in retirements, imports, demand response, new capacity, *etc.* They are useful for testing the robustness of alternative Resource Scenarios against a range of very different pressures on resource adequacy.

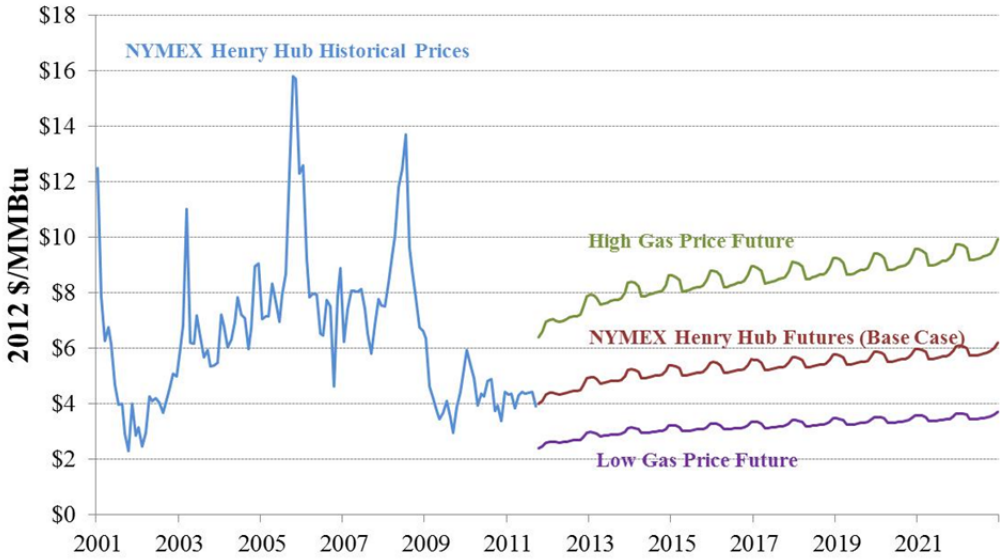
Natural Gas Prices. Natural gas price uncertainty directly affects electricity price projections. In developing the high and low commodity price cases, we evaluated several factors including available high and low natural gas price forecasts from the U.S. Energy Information Agency (EIA), Wood Mackenzie, implied volatility from natural gas options prices, and historical "forecast errors" derived from comparing historic projections to realized gas prices. Considering all of the available data, it was determined that a high/low range relative to the Base Case commodity price forecast of roughly +60% to -40% captured a reasonable range of long-term natural gas prices suitable for planning purposes. The resulting price trajectories are shown in Figure 17, which also includes historical prices for comparison purposes. (Figure 17 does not show transportation basis differentials or LDC charges, which are assumed to be identical to those in the Base Case.)

In implementing these natural gas price Futures, elasticities of demand were applied to account for likely customers' responses to large, long-term natural gas price-induced changes in electricity prices.[29] A long-term elasticity of *energy* demand of -35% reduces energy consumption in the High Gas future by 13.4 terawatt-hours (TWh) in 2015 (10.0%) and by 14.4 TWh in 2022 (10.2%). It increases load in the Low Gas future by 8.9 TWh in 2015 (6.7%) and by 9.6 TWh in 2022 (6.8%). A long-term elasticity of *peak* demand of -17.5% reduces peak load in the High Gas future by 1,400 MW in 2015 (5.0%) and by 1,500 MW in 2022 (5.1%). It increases peak load in the Low Gas future by 900 MW in 2015 (3.3%) and by 1,000 MW in 2022 (3.4%).

[28] Varying the Cost of New Entry was also considered and analyzed, but not used to construct an alternative Future because it had only a small effect on the outcomes.

[29] Elasticity is a measure of quantity response to price changes expressed as a quotient of percentage changes over a given time period. For example, if price increases by 1% and quantity demanded falls by 0.5%, then the elasticity of demand is -50% (-0.5/1).

Figure 17
Natural Gas Price Trajectories at Henry Hub



B. Costs and Emissions under Alternative Futures

The four alternative Futures described above were evaluated using the same modeling system used to develop the Base Case. Cost and emissions metrics are shown in Figure 18 through Figure 26, below. Some of the most salient observations from these figures are as follows:

- *Resource Adequacy*: whereas new generation entry is not economic for meeting the region's Net Installed Capacity Requirement in the Base Case until 2022, economic entry could occur in 2018 in the Tight Supply future, and 2019 in the Low Gas future as a consequence of higher load growth. The resulting range in capacity prices is shown in Figure 18. In all Futures, new generation is not necessary in Connecticut specifically in order to meet the Local Sourcing Requirement.

  In interpreting the Resource Scenarios presented below, it is helpful to recognize that, in the Tight Supply and Low Gas futures, some of the expected effects of introducing candidate resources are offset by the displacement of new generation that would otherwise have entered.

- *Costs and Rates*: the High Gas future has higher rates and the Low Gas future has lower rates than the Base Case primarily because of differences in wholesale energy prices shown in Figure 19. However, cost impacts are partially mitigated by demand elasticity effects, as shown by the smaller variation in the costs in Figure 20 compared to the rates. Costs and rates are also lower in the Abundant Supply future. Note that the rate increases over time are *greater* than the uncertainty across Futures in any particular year, as shown in Figure 20.

- *Generation*. As load varies across the Futures, most of the variation in generation occurs in gas-fired units. Little dispatch switching occurs between fuels, except

in the High Gas future, where coal generation increases at the expense of natural gas. In all of the Futures, the old, high-emitting oil-fired steam units do not generate at significant levels, as shown in Figure 25 and Figure 26.

- *Emissions*. The Futures with higher load (Tight Supply and Low Gas) have higher emissions, except High Gas, which has higher SO_2 and NOx emissions, as shown in Figure 21, Figure 22, Figure 23, and Figure 24. The relative emissions levels across cases are driven by a number of factors. For example, in the Abundant Supply future, emissions decrease from 2015 to 2017 because the low load and presence of Vermont Yankee cause many retirements when the capacity price floor expires, including coal retirements. In the Tight Supply future, CO_2 emissions decrease from 2017 to 2022 because of the addition of 2,100 MW efficient combined-cycle plants; NOx is higher than in the High Gas future because high-emitting units are needed to meet a much higher peak load. In the Low Gas future, High Energy Demand Day NOx is higher than in the High Gas future because peak load is much higher.

Figure 18. Capacity Prices in New England (2012 $/kW-Year)

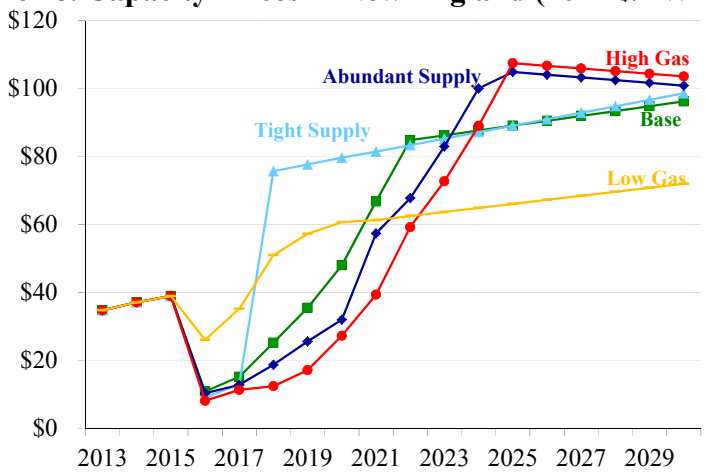


Figure 19. Annual Average Energy Prices in Connecticut (2012 $/MWh)

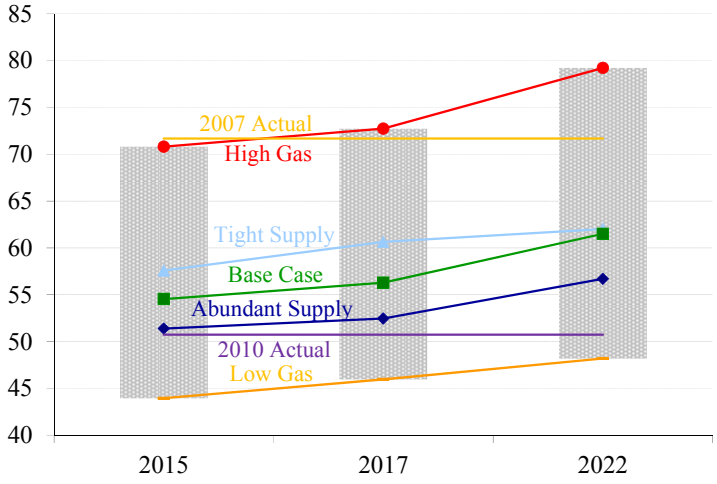


Figure 20. Connecticut Customers' Power Supply-Related Costs
(Includes GSC costs, EE charges, and Transmission charges associated with remote renewable generation)

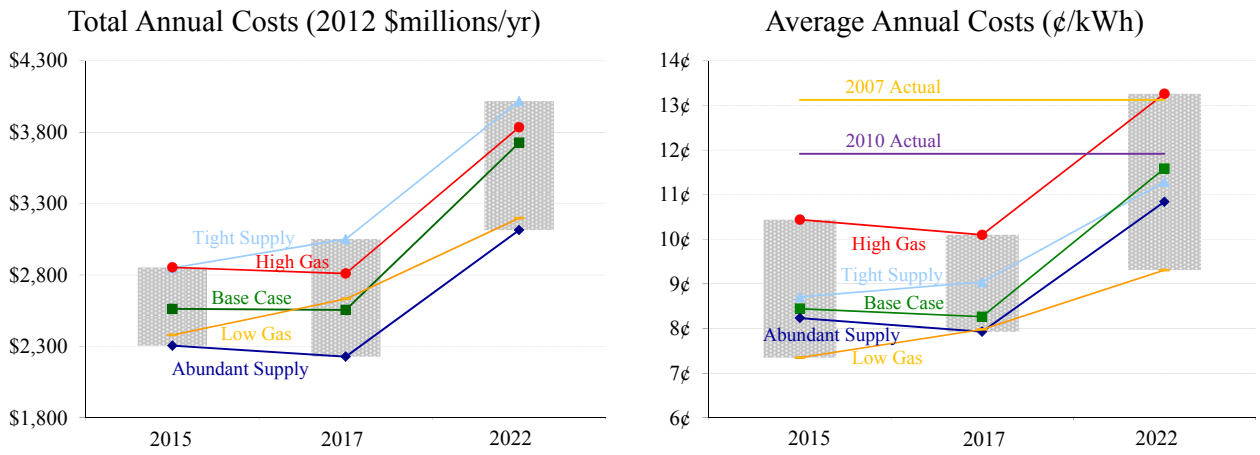


Figure 21. Annual CO_2 Emissions

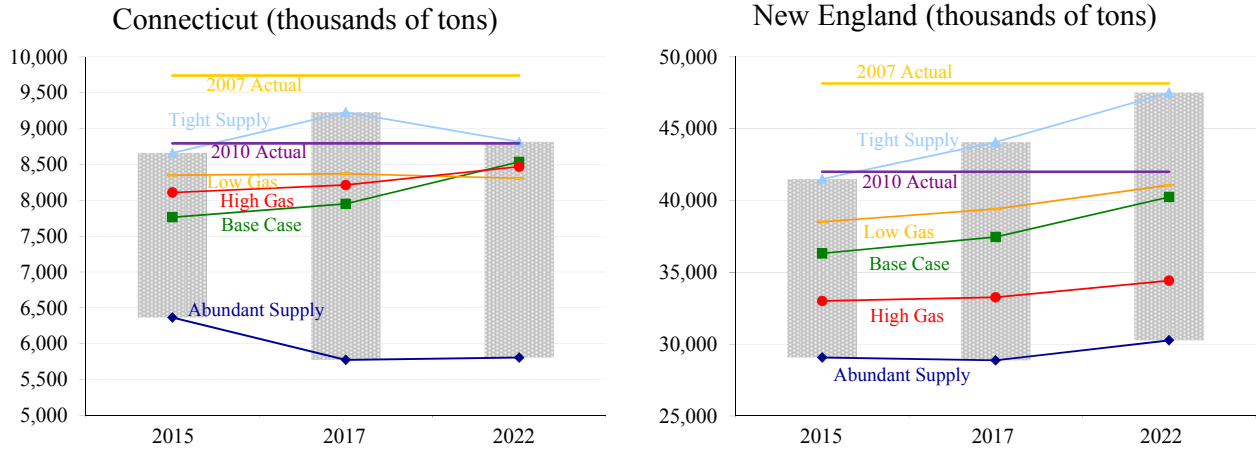


Figure 22. Annual SO_2 Emissions

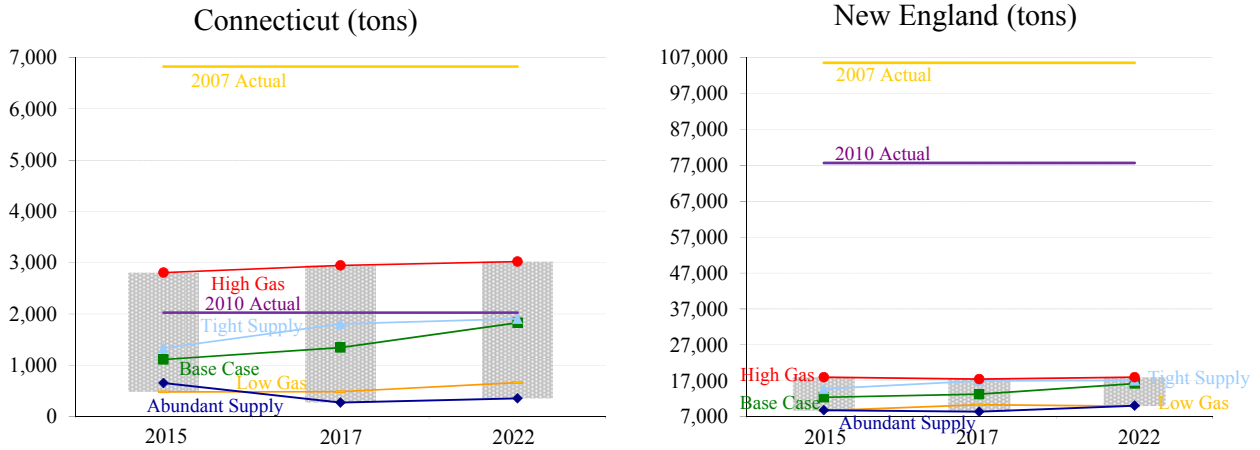


Figure 23. Annual NO_X Emissions

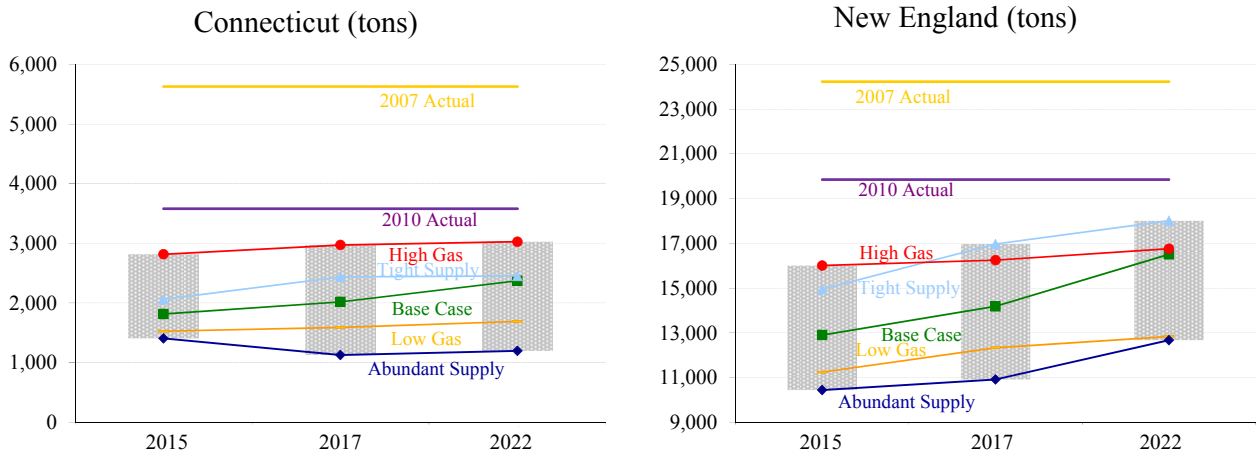


Figure 24
Connecticut HEDD NOx Emissions on Each of 10 HEDD Days (Daily Tons)

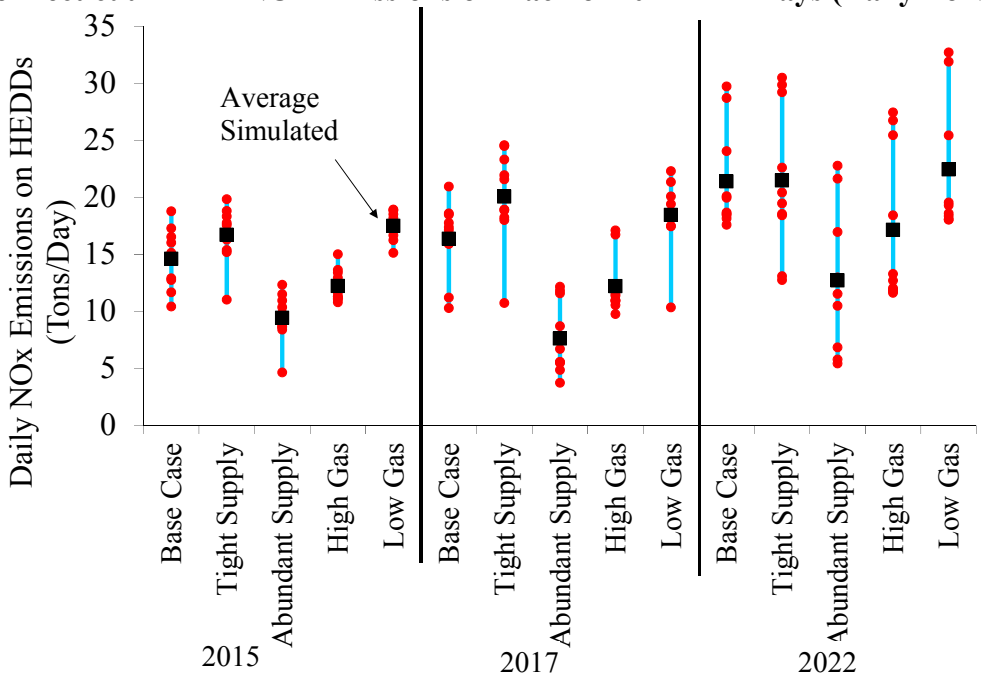


Figure 25
Connecticut Generation by Fuel Type (TWh)

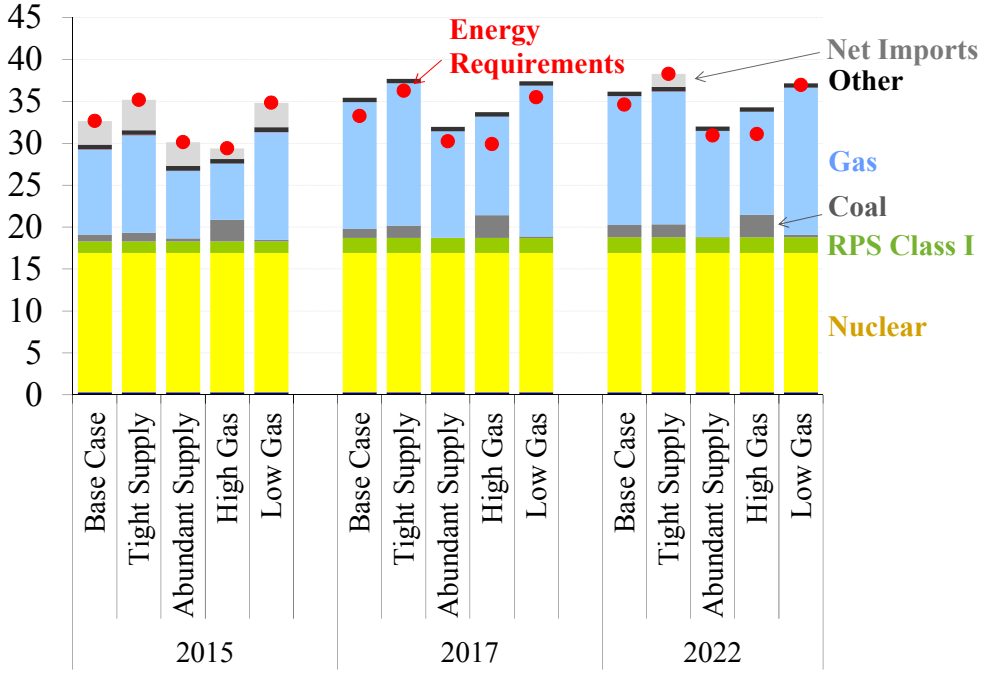
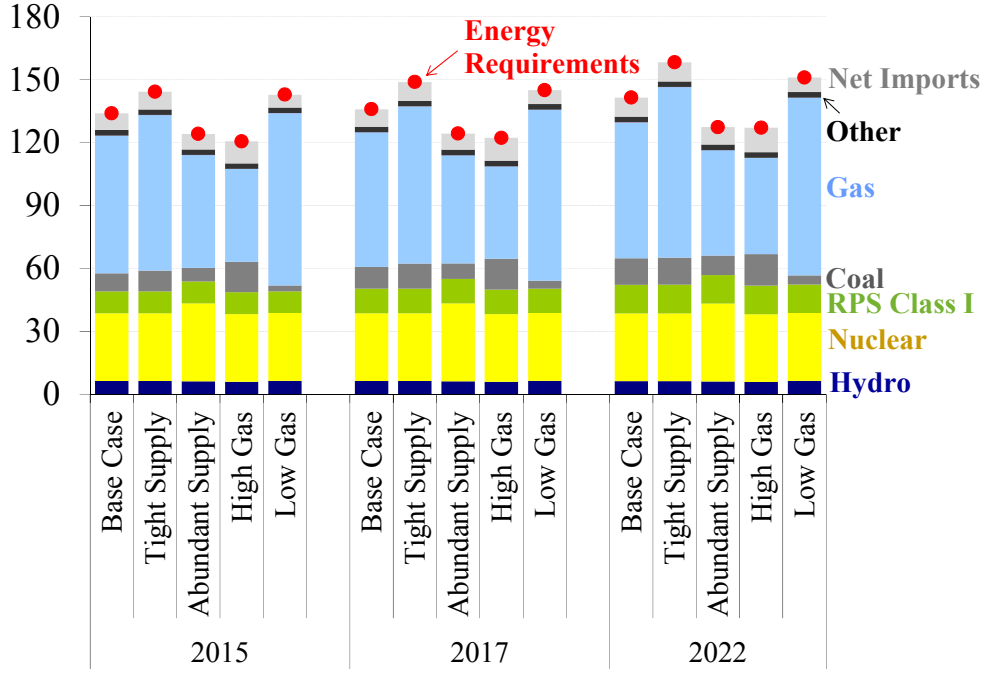


Figure 26
New England Generation by Fuel Type (TWh)



VI. EVALUATION OF RESOURCE SCENARIOS

One of the most important objectives of the IRP is to inform policymakers about how the state can undertake actions that could lower rates, reduce emissions, and/or create jobs. Such opportunities may be in the areas of promoting more energy efficiency through various policy approaches, meeting and/or redefining the RPS standards in various ways, fostering the development of new transmission, and facilitating the entry of new generation.[30] This IRP defines opportunities as "Resource Scenarios," acknowledging the fact that the State cannot fully control all of the factors examined, even if it can influence them.

The Resource Scenarios evaluated in this IRP are defined as follows:

- *Expanded Energy Efficiency:* While the Base Case assumes continuation of energy efficiency programs at current levels, the Expanded Energy Efficiency resource scenario nearly triples that amount over the next decade. The opportunities for increased efficiency and the costs of achieving them are based on the Potential Study commissioned by the Energy Conservation Management Board (ECMB), dated April, 2010.
- *RPS Scenarios:* Two alternative pathways to achieving the RPS objectives are evaluated: (1) Maintain Current RPS Requirements, recognizing the uncertainty of meeting the requirements through the examination of three levels of Class I development: a Low Case, a Base Case, and a Full Renewables Buildout; (2) Increase Flexibility in Meeting Class I Targets, by allowing Expanded Energy Efficiency to sell Class III credits that can satisfy a limited portion of Class I requirements.
- *New Cost of Service (COS) Generation:* This scenario assumes the development of one new, efficient 656 MW gas-fired combined-cycle plant in Connecticut in 2017 (for $929/kW cost in 2012 dollars, excluding interest during construction), backed by power purchase agreements or other support from Connecticut customers. The concept of this strategy was to examine the value to Connecticut customers of paying the full cost of new conventional generation and receiving its full market value, and doing so before such a resource would have been developed by merchant developers.

The subsections below describe the Resource Scenarios and their impacts on costs, rates, emissions, and jobs. Resource scenario evaluations are presented here for the Base future but were also evaluated across alternative futures, the results of which are included in Appendix A (Detailed Tables).

[30] Procurement and risk management strategies can also affect customer rates, but they are not considered here because Public Act 11-80 addresses procurement outside of the IRP.

A. Expanded Energy Efficiency Resource Scenario

Description of Expanded Energy Efficiency Resource Scenario

The Expanded Energy Efficiency resource scenario is based on the "Potential Study" sponsored by the Connecticut Energy Conservation Management Board (ECMB),[31] conducted by KEMA Consulting, and filed in 2010. The Potential Study estimates the savings that could be achieved based on a detailed bottom-up analysis of hundreds of individual measures in each customer sector, and then applies a benefit-cost test to each measure to estimate an economic potential. Most of the measures are extensions of ones already being implemented by the Electric Distribution Companies; many would involve significantly expanding the more innovative parts of existing programs, such as offering technical training to commercial customers on more efficient practices.

The resulting achievable, cost-effective annual savings from expanding the current efficiency programs, quantified in the study's "Program Achievable Potential" scenario, exceeds Base Case Energy Efficiency program savings by 1,071 MW and 4,339 GWh by 2022.[32] This is the basis for the Expanded Energy Efficiency scenario in this IRP. We assume an eleven-year implementation schedule, as shown in Figure 27.[33] Because each program measure saves energy over the entire multi-year life the equipment is installed, the savings from each year's measures accumulate on top of prior years' accomplishments as the electricity-using capital stock becomes increasingly efficient.

The annual cost of achieving this higher level of energy efficiency is $243 million more than the Base Case, with an incremental $105 million program budget and $138 million increased out-of-pocket spending by participants.[34] The total implementation cost per kWh saved under the Expanded Energy Efficiency scenario is similar to that in the Base Case. However, the participant is assumed to pay a larger share of total costs (*i.e.*, receive lower program incentives than in the Base Case). This is consistent with an assumption of more aggressive codes and standards and the availability of financing, *e.g.*, through the Green Bank being developed by the Connecticut Clean Energy Finance and Investment Authority (CEFIA). If the program incentives were similar to those in the Base Case, rates would have to be 0.2 to 0.3 ¢/kWh higher.

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[31] The ECMB is now named the "Energy Efficiency Board."

[32] The Potential Study reports 6,616 GWh of program savings in the Program Achievable Potential, but only 4,339 is incremental to 2,277 GWh of program savings in the Base Case (with the "absolute" savings in each case measured relative to having no programs). Both the Base Case and the Expanded Energy Efficiency cases are assumed to have the same amounts of naturally-occurring energy efficiency and compliance with existing/planned codes and standards already implicitly embedded in the load forecast.

[33] The reason the annual *incremental* savings from Expanded Energy Efficiency appears lower in the initial years is that the Base Case Energy Efficiency savings against which it is measured were assumed to decline over time.

[34] The annual costs of achieving Expanded Energy Efficiency are $206 million in program costs and $192 million in participant out-of-pocket costs, which are $105 million and $138 million more than the $101 million in program costs and $54 million in participant costs in the Base Case.

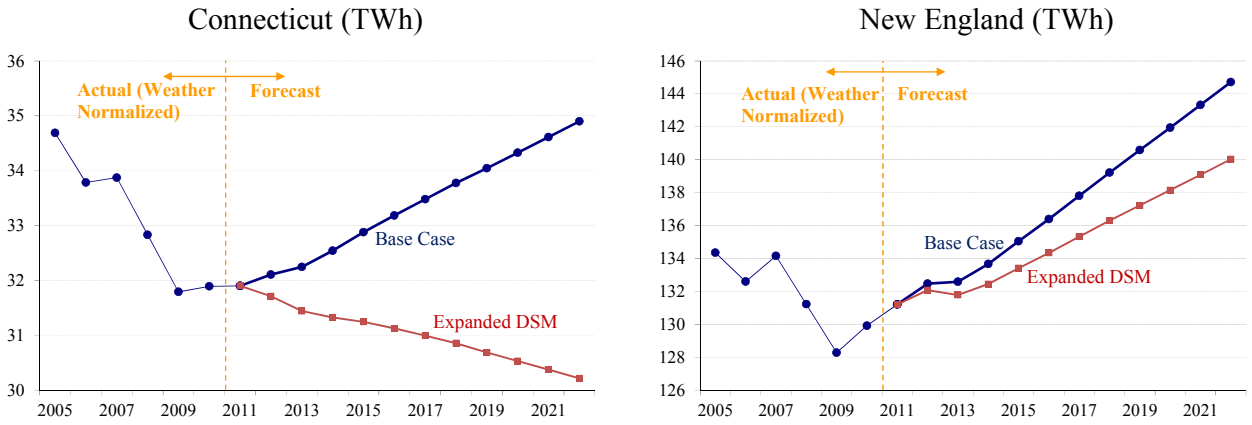
Figure 27 shows the incremental savings and utility costs in the Expanded Energy Efficiency scenario relative to the Base Case (the $138 million in annual participant costs is not included in the table). These costs and savings are the quantities that are analyzed below in our economic evaluation of the Expanded Energy Efficiency scenario compared to energy efficiency assumed in the Base Case.

Figure 27.
Incremental Savings and Costs of Expanded Energy Efficiency
(Incremental to Base Case Energy Efficiency)

		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Annual Savings from Just This Year's Incremental Measures	*(GWh)*	366	377	383	388	392	397	401	407	408	409	411
Annual Savings from the Cumulative Effect of All Incremental Measures to Date	***(GWh)***	**366**	**743**	**1,126**	**1,515**	**1,906**	**2,303**	**2,704**	**3,111**	**3,518**	**3,928**	**4,339**
Annual Savings from Just This Year's Incremental Measures	*(MW)*	95	96	97	97	97	98	98	98	98	98	99
Annual Savings from the Cumulative Effect of All Incremental Measures to Date	***(MW)***	**95**	**191**	**288**	**385**	**482**	**579**	**677**	**776**	**874**	**972**	**1,071**
Annual Incremental Utility Budget	***($Mil)***	**105**	**107**	**107**	**107**	**106**	**106**	**106**	**106**	**106**	**106**	**106**

Expanded Energy Efficiency would support a growing economy that uses less energy both per unit output and in absolute terms. Figure 28 shows that realized energy consumption in Connecticut would continually decline by about 0.4% per year and result in 4,339 GWh savings in 2022.[35] This downward outlook highlights the need to consider new business models for utilities to be able to continue making adequate returns in the face of declining sales from successful programs. Some of the elements of a new business model that should be discussed include: decoupling the transmission and distribution (T&D) revenues from the volume of sales and shareholder incentives for successfully achieving energy efficiency savings. Appropriate rate mechanisms and performance metrics would have to be developed.

Figure 28.
Effect of Expanded Energy Efficiency on the Energy Forecast



[35] In order to isolate the impacts of Connecticut investing in Expanded Energy Efficiency, utility programs in the rest of ISO-NE were assumed to remain the same as in the Base Case.

EXPANDED ENERGY EFFICIENCY — THE BASICS

What is "energy efficiency"?

Energy efficiency refers to using less energy to achieve the same level of service. For instance, installing efficient lighting in homes and businesses results in the same illumination while drawing less energy from the grid. Insulating a home allows one to maintain a given temperature by using less heating or cooling energy.

Why are energy efficiency programs needed?

Energy efficiency is implemented partly through end-users' own initiatives and partly through codes and standards. However, this is typically not enough to achieve all possible cost-effective energy efficiency due to various well-known barriers: poor customer information about energy efficiency; split incentives between building developers, owners, and tenants; lack of access to capital; and an inability of the individual customer to capture all of the benefits associated with reduced system transmission and distribution investment needs, reduced emissions, and increased energy security. Energy efficiency programs are intended to help overcome such barriers.

What do energy efficiency programs do?

Programs are designed to help customers install more efficient devices and adopt more efficient practices. In both residential and commercial sectors, lighting and cooling end-uses are the primary targets for improvement. In the industrial sector, motors and process heating are widely targeted end-uses. Some examples of the kinds of programs to capture these opportunities include:

- *Energy audits*. Typically, an authorized contractor performs an energy assessment for homes and businesses. They make on-the-spot improvements and, depending on customer's eligibility, provide exclusive money saving rebates on appliances, HVAC systems and insulation.
- *Equipment incentives*. Residential customers receive discounts and rebates on efficient light bulbs and appliances (*e.g.*, refrigerators, freezers, and dishwashers). For commercial customers, there are incentives to bridge the gap between the standard and more efficient lighting, air conditioners, refrigeration, and other kinds of equipment.
- *Financing programs*. Programs may offer customers low-interest loans and financing for energy efficiency improvements, often repaid through extra charges on the individual customers' bills.

What is the process for developing and approving and funding programs?

Each year, the Electric Distribution Companies prepare Conservation and Load Management plans with the advice and assistance of the Connecticut Energy Efficiency Board (chaired by the DEEP Commissioner) and its consultants. They then submit the plans to the Public Utility Regulatory Authority. To the extent that the programs and requested budgets are approved, the Electric Distribution Companies administer the programs and recover the costs primarily through a special component of customer rates.

How much energy efficiency has Connecticut accomplished already?

Connecticut has been actively implementing energy efficiency programs for many years now. Connecticut's successful record in implementing programs and policies is manifested in the rankings of American Council for an Energy Efficient Economy (ACEEE). ACEEE evaluates each state based on its energy efficiency program spending, energy savings, targets, development of incentives, and removal of barriers (as well as policies, initiatives, etc.). According to ACEEE's 2011 State Energy Efficiency Scorecard, Connecticut remained tied for 8th with Minnesota but improved its total score by 5 points from 2010. This IRP examines whether Connecticut should pursue energy efficiency more aggressively.

Evaluation of Expanded Energy Efficiency Resource Scenario

The modeling system described in Figure 3 estimates the effects of resource scenarios on costs, rates, emissions, and in-state jobs. Analysis of the incremental savings and costs of the Expanded Energy Efficiency scenario shows substantial benefits in all of these categories relative to the Base Case. As Figure 29 shows, the net cost savings appear modest or negative initially, but then become very substantial. This figure depicts the annual incremental level of program and participant costs in the red bars, which are constant for the three years shown (2015, 2017 and 2022). The green bars indicate the annual incremental gross savings, shown as an offset to the costs. The clear bar indicates net costs if above the zero dollar axis and net benefits or savings if below the zero dollar axis. Benefits multiply over time because efficiency measures each save energy for many years (12 years, on average), and each year's measures build on the prior years'.

- In 2017, gross energy savings of approximately $238 million per year compared to the Base Case appear less than the $243 million incremental costs. However, such a comparison does not recognize the multi-year benefits of the measures.
- By 2022, Expanded Energy Efficiency would save customers $778 million per year in energy, capacity, and RPS costs compared to the Base Case. At an annual incremental cost of $105 million in program costs and $138 million in participant out-of-pocket costs, customers' annual net savings would be $534 million. The $778 million gross savings can be explained in terms of quantity and price components:
    - $425 million of the savings is the direct effect of consuming smaller quantities of costly commodities: $329 million less energy consumed, $56 million less capacity costs incurred, and $40 million less Alternative Compliance Payments. These estimates are derived by multiplying the change in quantity by the original (Base Case) prices.
    - $350 million of the customer savings reflects reductions in market prices that occur in 2022, brought about by lower demands for energy and capacity: $87 million of the savings derives from a 2.9 $/MWh reduction in average energy prices, and $263 million in savings results from a 2.4 $/kW-month reduction in capacity prices. The capacity price impact is so large because the peak load reduction from energy efficiency forestalls the need for new generation and defers the rise of capacity prices to a level sufficient to attract new generation into the market.[36]
- In subsequent years, customers would continue to save money from the more efficient equipment installed in their homes and businesses. The gross savings would continue until the end of the measure lives (about 12 years on average) even if no further measures were undertaken.[37] However, it is likely that

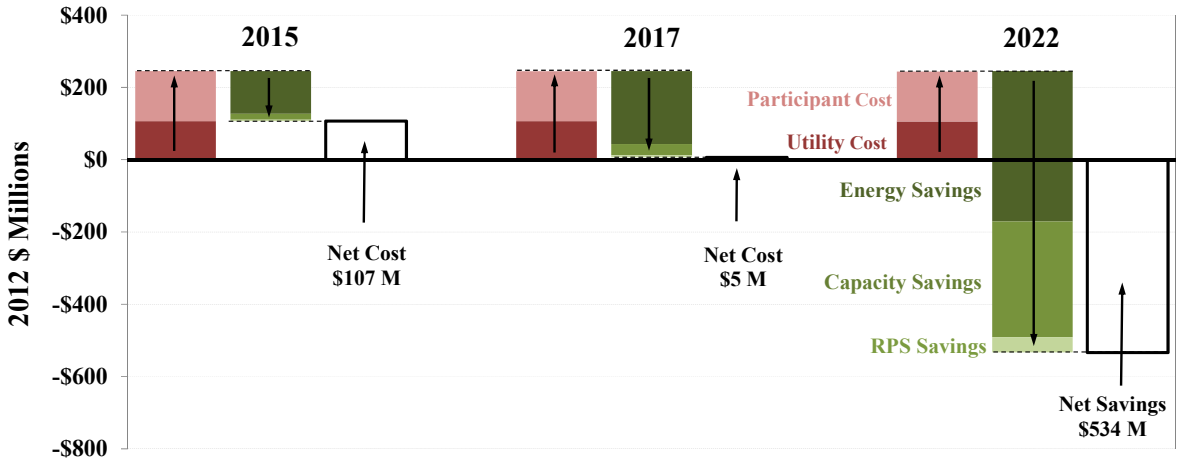
[36] In the capacity model, energy efficiency was modeled as a supply-side resource, not a demand reduction, consistent with how energy efficiency participates in ISO New England's forward capacity auctions.

[37] Annual benefits might be less than those estimated in 2022 once the supply-demand balance reaches a long-term equilibrium where generation supply adjusts and there is little wholesale price impact from

programs would continue as old measures expire and as new technologies and practices provide opportunities for new savings not yet envisioned in the Potential Study.

Although the quantity effect is durable, the price reduction benefits would be temporary until the supply side of the market adjusts. Because every dollar customers save due to reduced prices means a dollar less paid to suppliers for the same product, suppliers may retire more capacity, delay the construction of new generation, and/or have to offer capacity into the capacity auction at higher prices. The IRP modeling system analysis incorporates these effects at least through 2022, with Expanded Energy Efficiency leading to 547 MW more retirements in 2016, and with the entry of new combined-cycle generation being delayed from 2022 to 2025 (with 714 MW less in 2025). Thus, the price effects would significantly diminish after 2022, and earlier in the Tight Supply and Low Gas futures that need new generation before 2022. Because the price reduction benefits are temporary, it is important to recognize that the customer net savings from Expanded Energy Efficiency is substantially positive even without including price impacts: approximately $425 million in gross savings 2022 compared to $243 million in incremental utility and participant costs. The price impacts can be viewed as a supplemental, but transient benefit obtained from facilitating the development of low-cost resources.

Figure 29
Incremental Annual Costs and Savings of Expanded Energy Efficiency
(Relative to the Base Case)



When customers save money on energy expenditures, they can spend that money on other goods and services, which has a major and widespread effect on the Connecticut economy. Based on macroeconomic modeling conducted by the Connecticut Department of Economic and Community Development for this IRP, each $100 million reduction in net customer energy costs supports or creates 780 in-state jobs (based on a weighted average of residential, commercial,

changes in demand. However, the quantity effects would still apply, with customers benefitting from reduced purchases.

and industrial sectors). Thus, the annual net savings of $534 million in 2022 would support 4,200 more in-state jobs than in the Base Case for as long as the savings persists. In addition, Expanded Energy Efficiency would add 1,500 direct, indirect, and induced jobs. The direct jobs are associated with implementing measures, and the indirect and induced jobs are in the rest of the economy for each year the program endures. However, spending and jobs associated with in-state renewable investments are reduced by 250 because load reductions translate into fewer ACP payments. The net result is 5,500 more in-state jobs per year than in the Base Case.

Overall customer costs, which are the product of rates and the quantity of energy services consumed, ultimately matter more to the economy and to overall consumer well-being than do rates alone. However, rates themselves may be important to customers that participate less in energy efficiency programs. With Expanded Energy Efficiency, 2017 rates would be 0.21 ¢/kWh higher than the Base Case; overall rates in 2022 would *decrease* by 0.60 ¢/kWh because of greater capacity and energy price effects.[38]

Emissions under the Expanded Energy Efficiency scenario are also lower than in the Base Case. In Connecticut, emissions of NOx and SO_2 decrease by more than 10%. In Connecticut and New England, CO_2 emissions decrease more than 5%. It also is notable that emissions are also slightly lower than those estimated under a Full Renewables Build-out scenario (described below) that costs Connecticut customers considerably more than the Expanded Energy Efficiency resource scenario.

Recommendations Regarding Expanded Energy Efficiency

These analytical results point strongly toward the widespread economic and environmental benefits of achieving all cost-effective energy efficiency. To capture this opportunity, the increased savings plan in the 2012 Conservation and Load Management (C&LM) filing should be approved as part of a provisional longer-term plan to maintain that level of investment for ten years. The programs should be funded through charges on customers' bills, complemented by continued self-support from capacity credits earned in the forward capacity auctions, and with revenues from CO_2 allowance sales under the Regional Greenhouse Gas Initiative program. The charges on customers' bills can be expected to decline over time as the quantity and price of forward capacity market credits increase.[39]

Realizing the potential savings will, however, require more than just funding. Under the direction of DEEP and the Energy Efficiency Board, utilities will have to continue to further develop the innovative components of their programs, especially those that address energy

[38] The overall impact on rates is the combination of higher program costs offset in part or wholly by the lower generation service charges that reflect energy and capacity prices. In 2017, the Expanded Energy Efficiency scenario requires a 0.37 ¢/kWh increase in program funding, which is only partially offset by lower energy and capacity charges. This analysis does not quantify another related rate impact: reduced energy consumption would slightly increase the rate component necessary to recover fixed transmission and distribution costs; however some future transmission and distribution costs might also be avoided due to lower consumption, partially offsetting this effect.

[39] Another approach that could be considered for adjusting the time profile of rates to better match the time profile of benefits would be to add utility program costs to utility ratebases. This is being considered in a separate study by the Connecticut Public Utilities Regulatory Authority.

conservation opportunities with relatively high non-cost barriers, such as training commercial customers in efficient operating practices. More aggressive codes and standards can also help achieve the desired results without increasing rates. Innovative financing may also be important to enable participants to bear more of the measure costs and to spread their cost burden over time. Rate structures that encourage efficiency, such as inclining block rates, should also be considered. These and other approaches are discussed further in Appendix C (Energy Efficiency).

It must be recognized that the ultimate size and cost of the energy efficiency opportunity is uncertain. The savings potential depends on assumptions about equipment and practices in place today and the cost of improving them. Moreover, actually achieving the potential depends on the ability to enable and motivate participants to change and overcome non-cost barriers. Finally, the amount of energy efficiency that is cost-effective, or the cost-effectiveness of any particular measure, depends on market conditions. For example, under the High Gas future, saving 4,339 GWh per year under the Expanded Energy Efficiency resource scenario is worth $178 million more per year in 2022 than in the Base future. In the Low Gas future, Expanded Energy Efficiency is worth $403 million less than in the Base future in 2022, but $105 million more than in the Base future in 2017 because Expanded Energy Efficiency avoids capacity prices having to rise to attract new entry to meet higher loads occurring with load gas prices (and, it should be noted, overall customer costs in 2022 are lower in the Low Gas future compared with the Base Case, regardless of the impact of Expanded Energy Efficiency).

In the face of uncertainty, flexibility is valuable. Energy efficiency is a flexible resource as it is pursued incrementally (although rapidly ramping programs up or down can be costly and disruptive). This IRP therefore recommends embarking on a promising path to begin in 2012, but not locking in to a rigid plan. The details can be adjusted over time as updated information becomes available about the success of expanded programs, and about market conditions, technology costs, penetration levels and innovation, federal standards, and non-cost barriers to efficiency. Such information should be gathered through future Conservation and Load Management proceedings, market studies, and updated potential studies.

B. Renewable Portfolio Standard Scenarios

The Connecticut Renewable Portfolio Standard (RPS) policy was instituted in 1998, with the objectives to reduce reliance on fossil fuels and reduce emissions from the power sector. Since then, the Class I renewable development in New England has grown sufficiently to meet the region's current requirement, with short-term renewable energy credit (REC) prices hovering around $20-30/MWh during most of the recent year.[40] Looking forward, while the resource potential in the region remains high (particularly for wind power in northern New England), many uncertainties remain. First, substantial additional transmission would be needed to deliver and integrate large additional amounts of remote wind resources; but viable transmission options,

[40] One renewable energy credit (REC) is created from one MWh of qualifying renewable electricity generated. Electric suppliers in New England can satisfy their RPS obligations by purchasing RECs or making alternative compliance payments. REC revenues supplement energy and capacity revenues received by generators. REC prices climbed to between $35-40/MWh in November and December of 2011, in part owing to uncertainty surrounding Massachusetts' proposed biomass eligibility rules.

their costs, transmission planning processes, and transmission cost allocation rules present issues that are not yet resolved. Second, the adverse financial conditions over the past three years have made it increasingly difficult for new renewable energy resources to secure funding. In addition, federal budgetary issues have compounded the perennial uncertainty regarding the future of federal production tax credits, after the current ones are set to expire at the end of 2012.

Recognizing Connecticut's continued commitment to reduce emissions from the power sector and diversify its fuel mix, this IRP considers two alternative pathways to achieving these objectives. Each is evaluated based on environmental performance, costs to Connecticut customers, and in-state job creation. The two alternative pathways are:

- **Maintain Current RPS Requirements.** There are significant uncertainties about the costs and achievability of the Class I requirement. To analyze these uncertainties, three levels of Class I compliance are evaluated: a Low Renewables case with very little additional Class I development; the Base Case, with more than 2,500 MW of projected renewable additions based on extrapolating observed development trends; and a Full Renewables Buildout case in which enough Class I resources (along with necessary transmission expansions) are developed to meet Class I demand in Connecticut and the rest of New England.
- **Increase Flexibility in Meeting Renewable Energy Targets**. Given the increasing costs and uncertainties around meeting Connecticut's expanding Class I RPS target, and considering that increased Energy Efficiency can reduce customers' costs while providing environmental benefits and creating in-state jobs, we explored alternative ways to achieve the clean energy objectives of RPS Class I requirements with greater emphasis on energy efficiency as a mechanism for continuing to seek cleaner - and cheaper - ways to meet our energy needs.

Evaluation of RPS Scenarios

Various Levels of Class I, without Changing RPS. Under the Base Case, the region is short of Class I requirements for year 2018 and beyond, with Connecticut paying high REC prices, Alternative Compliance Payments for substantial REC shortfalls, and a portion of new regional transmission costs. From the standpoint of clean energy development, likely customer costs and in-state job creation, this outcome would fall well short of ideal.

Two alternative development paths for Class I compliance also show mixed results for clean energy development and costs, as shown in Figure 30. Under the Low Renewable scenarios, annual customer costs in 2022 are $100 million lower than the Base Case, with similarly high REC prices and Alternative Compliance Payments but reduced transmission costs associated with reduced wind development. This potential scenario, however, represents a failure of RPS, with customers still paying more than $250 million per year in Alternative Compliance Payments while receiving minimal environmental benefits.[41]

[41] The ACP revenues were assumed to fund rooftop photovoltaic installations, fuel cells, and other behind-the-meter projects that do not displace as much fossil generation as grid-connected renewables that create RECs.

Figure 30. Alternative Renewable Market Outcomes

Scenario	Class I Demand *(GWh)*	Class I Supply *(GWh)*	REC/ACP Price *($/MWh)*	Class I RECs *($Mil)*	Class I ACPs *($Mil)*	Tx for RPS *($Mil)*	CT Renew. Prog. Net of Mrkt. Revs. *($Mil)*	Total RPS Costs *($Mil)*	Emissions Reduction
Full Class I Achieved	20,281	20,281	$17	$115	$0	$179	$92	$385	High
Base Case Class I Achieved	20,281	17,428	$45	$168	$130	$81	$67	$445	Medium
Low Class I Achieved	20,281	13,496	$45	$57	$257	$0	$51	$365	Low

Note: "CT Renew. Prog Net of Mrkt. Revs." reflect the annual payments needed to support in-state Class I programs (Project 150, residential solar PV, ZREC, LREC, and other Class I projects) net of energy, capacity and Class I market revenues.

RENEWABLE PORTFOLIO STANDARDS — THE BASICS

What are Renewable Portfolio Standards?

Renewable Portfolio Standards (RPS) are state-specific policies for requiring a certain portion of the electricity consumed to be sourced from renewable generation or low-emission resources. Connecticut's RPS requires electric suppliers to serve at least 20% of the state's retail load with new wind, solar, fuel cell, landfill gas, small hydro, and biomass resources (called "Class I"), 3% with existing renewable resources (called "Class II"), and 4% with combined heat and power or energy efficiency (called "Class III") by 2020. Maine, Massachusetts, New Hampshire, and Rhode Island also have similar Class I RPS requirements. Failure to meet the requirements results in Alternative Compliance Payment penalties, which Connecticut would use to fund in-state renewable programs.

What renewable resources does Connecticut have?

Although Connecticut has very limited in-state renewable energy resources, it has the potential to build some small-scale wind, solar, fuel cell, hydro and biomass projects. To date, Connecticut has relied on existing resources, largely located outside of Connecticut to meet its Class I RPS requirement. As the magnitude of the Class I requirement grows, Connecticut's purchase of RECs from outside resources will likely continue to increase.

What mechanisms does Connecticut use to develop in-state renewable energy?

Connecticut uses several approaches to support in-state development of Class I resources, including requiring utilities to enter into long-term contracts with projects located on the customer-side of the meter. A *Clean Energy Finance and Investment Authority* (CEFIA) has been established to promote investment in and commercialization of clean energy technologies.

What out-of-state resources are important to Connecticut?

Northern New England, especially Maine, is rich with wind resources. However, a large build-out of wind energy projects in Maine will require significant new transmission investments to integrate and balance that wind power onto the New England grid. Numerous transmission projects have been proposed to help meet regional Class I RPS requirements.

How is renewable energy paid for?

In addition to federal tax credits that help offset the cost of qualified renewable energy projects, producers receive renewable energy credits, "RECs," for every MWh of renewable or clean energy produced. Electric suppliers that need the RECs to satisfy their RPS requirements will buy them from producers at a market price. These payments help producers earn revenues in addition to those from selling the associated power. Connecticut also has several special programs to provide additional financial support for developing in-state projects for which the value of RECs and power alone would be insufficient.

The Full Renewable Buildout scenario performs somewhat better, but realizing these estimated benefits requires a large-scale, coordinated and timely investment in transmission that would be needed to develop a significant amount of wind power in northern New England, as well as strong assumptions regarding the costs of building transmission and the allocation of those costs to Connecticut customers. In other words, achieving the Full Renewable Buildout scenario will depend on the favorable resolution of many difficult issues that are not directly within the State's control. Under the "Full Renewables" scenario, the region meets the existing Class I requirement, with REC prices set by the levels required to support the development of onshore wind, which are significantly lower than the Connecticut Alternative Compliance Payment. Transmission costs (which are uncertain) are higher under the Full Renewable scenarios than in the Base Case, and could be even higher if Connecticut were allocated more than its load-ratio-share of transmission costs. Assuming 25% allocation to Connecticut (based on its New England load share) however, the higher transmission costs are more than offset by the reduced REC prices and the absence of Alternative Compliance Payments. Overall, the customer costs are about $160 million less than in the Base Case (including market price impacts), with greater emissions reduction and greater positive employment effects due to lower customer bills than in the Base Case.

In the Full Renewables scenario, the development of remote generation and transmission would support minimal jobs in Connecticut. However, in the Low Renewables scenario, the use of the annual Alternative Compliance Payments of almost $260 million to install in-state renewable projects would support approximately 800 jobs (including associated indirect and induced effects on the broader economy), plus an additional 800 jobs resulting from lower customer costs compared to the Base Case (mostly from not having to pay for as much transmission). The downside of the Low Renewables scenario is that it would still be costly without substantially achieving the environmental objectives of RPS.

Together, these scenarios featuring different levels of Class I development demonstrate the implications of depending on large amounts of remote resources that require regional cooperation to develop the necessary transmission. Transmission and renewable resources may be developed, in which case the environmental objectives would be achieved, but with uncertain transmission costs and shares of that cost allocated to Connecticut customers. If the necessary transmission and resources are not developed, Connecticut customers would be paying large Alternative Compliance Payments without fully achieving the RPS objectives.

Increase Flexibility in Meeting Class I Targets. Compliance with an expanding Class I RPS requirement entails increasing costs and uncertainties for Connecticut customers. If a portion of the Class I requirement could be met by a broader array of clean resources, customers could save money and achieve the RPS objectives more successfully. Clean resources that could be considered for adding flexibility to the Class I requirement (or reducing the requirement for Class I resources) include new energy efficiency and out-of-region resources such as large hydro.

In order to illustrate the potential impacts of increasing flexibility, we analyze a policy that would allow up to one quarter of the current Class I requirement to be met through Expanded Energy Efficiency. The exact policy mechanisms could take many forms, and would require careful consideration. For example, incremental efficiency investments with demonstrated savings could receive Class III RECs, which load serving entities could buy (at Class III REC

prices) toward meeting a portion of their Class I requirement. Perhaps more than one MWh of Class III resources would be needed to offset a MWh of Class I generation.

Allowing up to one quarter of the current Class I requirement to be met through Expanded Energy Efficiency would produce significant benefits beyond the Expanded Energy Efficiency scenario alone. Adding flexibility to the Class I requirement would save customers $152 million annually by 2022 compared to the Expanded Energy Efficiency scenario alone. $106 million of the $152 million savings is the direct result of reducing the quantity of Class I RECs purchased and Alternative Compliance Payments made. The other $46 million derives from reducing the Class I REC price from a $45/MWh scarcity level (set by the Alternative Compliance Payment) to an $18/MWh market price set by the long-run marginal net cost of onshore wind.[42]

Compared to the Base Case, the RPS flexibility policy combined with Expanded Energy Efficiency would save customers $686 million by 2022. Figure 31 shows that net savings are realized by 2017, and that substantial RPS savings are realized by 2022. While net savings in 2015 are negative, by 2017 gross savings of approximately $252 million exceed the $243 million incremental costs. The RPS savings gained from increased flexibility are greatest in later years because the costs associated with a region-wide Class I REC shortage would be avoided. Absent reform, we project a shortage will begin in 2018.

Customer rate impacts would also be considerably more favorable than with Expanded Energy Efficiency alone and also compared to the Base Case. Relative to Expanded Energy Efficiency alone, 2017 rates would be 0.06 ¢/kWh lower, and 2022 rates would be 0.55 ¢/kWh lower. Relative to the Base Case, 2017 rates would be 0.15 ¢/kWh higher than the Base Case, whereas 2022 rates would be 1.15 ¢/kWh lower.[43] The rate reduction in 2022 derives from lower Class I prices and volumes, but also from lower energy prices (-$2.9/MWh) and lower capacity prices (-$2.4/kW-month) already discussed in the Expanded Energy Efficiency Resource Scenario section.

These customer bill savings would further add to in-state economic activity and employment. The $686 million annual customer savings relative to the Base Case would support 5,400 jobs for as long as savings persist. This is in addition to approximately 1,500 jobs from $243 million in incremental annual spending on measures for each year the program endures. However, avoided Alternative Compliance Payments reduce 815 jobs that would be created by installation of behind-the-meter projects supported by those funds. On net, Expanded Energy Efficiency with

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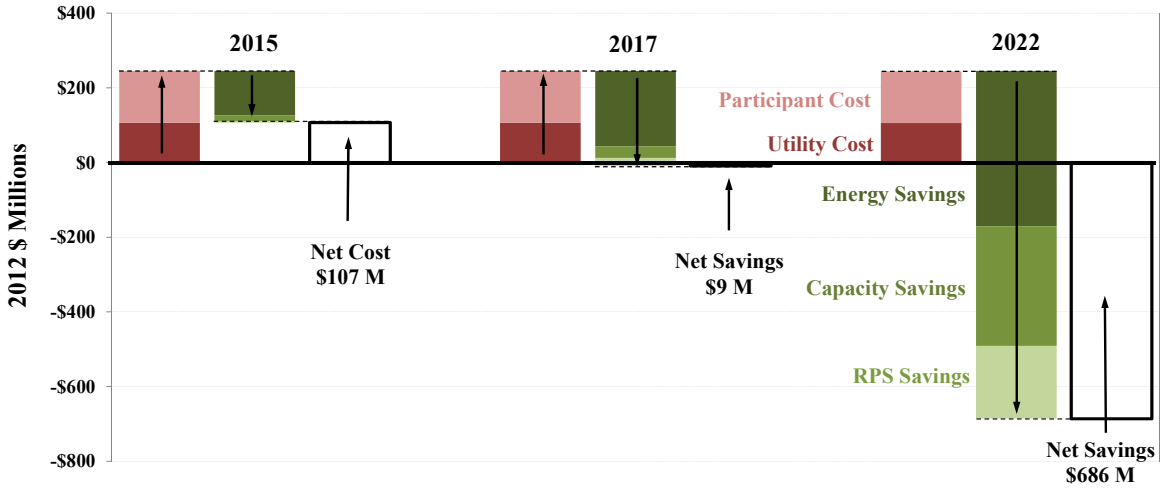
[42] The lower Class I price does not save customers money on net for approximately 1,150 GWh of Class I RECs created by Connecticut-specific ZREC, LREC, Project 150 and Other Class I programs. Reductions in Class I revenues increase the amount of customer support that must be collected through special charges to fund these special programs.

[43] Rate impacts are similar in the Abundant Supply and High Gas futures, as shown in Appendix A (Detailed Tables). In the Tight Supply and Low Gas futures, Expanded Energy Efficiency reduces rates by approximately 0.4 ¢/kWh in 2017 primarily by avoiding REC scarcity prices associated with higher load growth and a 20% Class I requirement. In 2022, rates *increase* by 0.1 to 0.2 ¢/kWh because new combined-cycle plants are displaced, nullifying the price impact and failing to compensate for the increased program charges. However, the reduced quantity of consumption outweighs the rate impact, and customers still save $310 million and $199 million compare to the Base Case (net of $138 million participant out-of-pocket costs).

RPS Flexibility scenario would support approximately 6,100 more jobs than the Base Case and 600 more jobs than with Expanded Energy Efficiency alone.

Figure 31
Incremental Annual Costs and Savings of RPS Flexibility with Expanded Energy Efficiency (Relative to the Base Case)



Recommendations Regarding RPS

We have evaluated the costs and risks that Connecticut customers face in complying with the existing RPS Class I requirements. As an alternative, we have also examined a policy that enables greater flexibility to attain RPS targets, reflecting a higher priority on energy efficiency. This analysis finds that Expanded Energy Efficiency, when allowed to compete for up to a quarter of the Class I requirements, can achieve even more ambitious environmental goals, with lower costs and rates and more in-state jobs for Connecticut. Thus, DEEP recommends reforming the RPS requirements along these lines to help realize this opportunity. Future stakeholder discussions will have to develop the specific provisions. Future discussion should also consider allowing other resources, such as out-of-region large hydropower to help meet Class I requirements more flexibly. There are many important issues that would have to be addressed regarding transmission planning, potential contracting structures and how they might impact contracting parties.

C. New Cost-of-Service Generation Resource Scenario

The New Cost-of-Service Generation Resource Scenario examines the value to Connecticut customers of building and "owning" a plant before such a resource would have been developed by merchant developers. To analyze this scenario, we assume the development of a new efficient-scale 656 MW gas-fired combined-cycle plant in Connecticut in 2017, at an overnight cost (excluding interest during construction) of $929/kW (in 2012 dollars). Consistent with our assumptions for generic merchant entrants, we assume $17/kW-year fixed operations and

maintenance costs, but we depart from generic assumptions by using a relatively low 6.7% after-tax weighted-average cost of capital, reflecting the allocation of risk to customers. Customers would pay for the full capital cost plus fixed operating and maintenance costs, following a traditional regulated cost-of-service revenue requirements schedule over an assumed 30-year life of the plant, through the imposition of a non-bypassable charge. They would receive all of the plant's revenues, including any energy margins and capacity revenues.

This analysis does not evaluate a scenario in which capacity is needed but merchant generation is not forthcoming, and the states or ISO New England solicit capacity as a backstop for meeting reliability needs. Such a scenario was not evaluated because our resource adequacy analysis did not identify a need for new generation over the study horizon. The exceptions are in the "Tight Supply" and "Low Gas" futures, where new generation becomes needed in 2018 in New England, although not in Connecticut specifically. Future IRPs should assess whether those futures are being realized or new generation is needed for any other reason, and whether the market is likely to fail to meet that need.

Evaluation of New Cost-of-Service Generation Resource Scenario

Building new generation always entails assuming risk, but sponsoring a new generation facility well ahead of likely market needs inflates these risks and using a cost-of-service cost recovery model shifts risk onto customers. In addition to the typical risk that any particular plant might not earn enough in the markets to cover its development cost (including a return on investment), recent capacity market rule changes raise the real possibility that a proposed new resource will not qualify for *any* capacity payments during its early years in operation. This likelihood arises from the implementation of the Minimum Offer Price Rule (MOPR), which is a new feature being added to Forward Capacity Markets in order to prevent and mitigate the exercise of buyer market power, *i.e.*, artificially depressing the capacity price by flooding the market with uneconomic capacity.[44] The details regarding the rule and also the application of the rule to individual market offers have not yet been fully determined. Generally, new generation will have to offer into the forward capacity auction at a competitive (*i.e.*, cost-reflective) price, as if it did not have a state-sponsored contract. A resource being introduced before it would be economic on a competitive basis might not clear the market and thus might not get paid for capacity.

In the most stringent case, the new cost-of-service generation unit being examined here would not earn capacity revenues until at least 2023, at which time a new merchant unit also would be competitive. However, it is possible that the unit could clear the capacity market earlier if its lower financing costs are considered in determining its mitigated offer floor, or if it has low unit-specific construction costs. Instead of analyzing every possibility, we evaluated customer benefits under two divergent assumptions: 1) that the unit would receive no capacity revenue (*i.e.*, not clear in the auction based on a relatively high minimum offer price floor) until 2023; and 2) the most optimistic assumption that the minimum offer price floor for this unit somehow would be low enough that the unit would clear the auction and receive capacity revenues immediately upon commencing operation in 2017.

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[44] Federal Energy Regulatory Commission, "Order on Paper Hearing and Order on Rehearing," Issued April 13, 2011, 135 FERC ¶ 61,029, Docket No. ER10-787-000.

COST-OF-SERVICE GENERATION — THE BASICS

What is cost-of-service generation?

Most generation in New England is owned by independent power producers, who expect that revenues from wholesale markets including capacity and energy markets will exceed their operating costs and earn them a return on invested capital commensurate with the risks they take. Revenues based on future market prices can be highly variable (i.e., risky) and therefore investors demand relatively high returns. An alternative arrangement is possible, whereby a developer sells the power under a long-term contract with a state agency or utility, with the price of that power reflecting the all-in costs of building and operating the plant, net of all revenues received. The purchaser then recovers the power costs from customers. By guaranteeing a revenue stream that covers capital and net operating costs, the contract essentially shifts market risks and rewards to customers; revenue predictability reduces development risk and enables lower cost financing. These contracts mimic traditional "cost-of-service" regulation where utilities build power plants based on assurances that prudently-incurred costs (including reasonable payments to debt and equity) will be recovered in regulated rates.

How does cost-of-service generation fit into wholesale and retail markets?

Cost-of-service contracts enable the introduction of specific resources into the wholesale power market that private developers otherwise might not provide. These resources may be sought for reliability enhancements (capacity value or quick-start reserve capability); to meet fuel diversity or risk hedging objectives; or to foster particular technologies (solar, fuel cells). In restructured retail markets such as Connecticut, contractual terms and rate recovery details have to recognize that utilities do not own generation or have captive load to serve. The costs of such long-term contracts are typically recovered through non-bypassable charges that appear on all customer bills, regardless of their choice of retail energy supplier. Using non-bypassable charges spreads the costs across all customers and avoids the situation where cost recovery falls on specific suppliers who customers might drop because the charges (especially in the initial years of cost recovery) are above-market compared to other suppliers.

Does Connecticut have any cost of service generation or similar arrangements?

There are several examples of cost-of-service generation and other similar arrangements in Connecticut. Over the past few years, the state has sponsored the development of 506 MW of combustion turbine projects to help meet quick-start reserve requirements in Connecticut, through cost-of-service agreements. In other cases, the state has sponsored or required the use of long-term contracts coupled with non-bypassable customer surcharges — although none has used the cost-of-service model discussed here. For example, capacity from the Kleen project (a 620 MW combined cycle plant that began operating in 2011) is procured under a long-term contract, and long-term contracts support the development of specific in-state renewable projects under the Project 150 program.

For simplicity, Figure 32 shows the annual costs and direct benefits to customers only for the Base future with the more stringent Minimum Offer Price Rule capacity revenue assumption. The figure shows that regulated revenue requirements are initially much higher than the energy margins the unit would receive, while capacity revenues are unavailable until 2023. When the capacity revenues appear in 2023, overall market revenues exceed the assumed cost-of-service revenue requirements paid by the customer-owners, for two reasons: (1) capacity market revenues at that point are assumed to be determined by a merchant generator, which has higher financing costs due to higher rates paid to debt and equity holders and a shorter amortization period; and (2) the cost-of-service revenue requirements have declined with depreciation. However, the net benefits after 2023 do not outweigh the initial net costs in present value terms until 2035, as shown in the left half of Figure 33.

The overall value to customers appears more positive if energy price reduction benefits are included. Building an efficient combined-cycle plant in advance of the time of need reduces energy prices by $1.6 to $2.1/MWh between 2017 and 2022, until the capacity would have presumably been built anyway in 2023. Including the resulting $49–66 million of annual benefits suggests a more positive proposition for customers. On a cumulative NPV basis, it is still more costly than doing nothing until 2022, as shown by the dotted curve in Figure 32.[45] These figures do not show the (slightly greater) value available if a lower minimum offer price is accepted and the unit clears earlier when capacity prices are still low. The results of this case and all others analyzed are shown in Appendix A (Detailed Tables).

The right half of Figure 32 shows the value of waiting to build the unit in 2020, closer to the time when New England will need capacity (although not in Connecticut specifically). The net cost is considerably lower compared to building in 2017, with six fewer years until breakeven on an NPV basis. Although there are also fewer years of energy price reductions between the time the plant is built and when a similar plant might have been built otherwise, the overall profile is still more favorable than building in 2017. In fact, including energy price reduction benefits (the dotted line) shows that the unit might break even on a cumulative NPV basis almost immediately upon operation in 2020.

Regarding emissions, building an efficient gas-fired plant in Connecticut would reduce New England emissions of NOx, SO_2, and CO_2. However, with the additional local generation, Connecticut's in-state NOx emissions would increase by several percent for the summer and annually, with a slight reduction in NOx emissions on High Energy Demand Days as the new plant displaces some less efficient, higher-emitting generation. The emissions savings could be greater if somehow the new generation plant could be part of a package agreement to close a high-emitting existing generator that otherwise would not retire.

Developing a 656 MW combined-cycle plant would create 2,700 jobs during the two-year construction period, followed by 100 ongoing jobs over the life of the plant. All jobs estimates include direct, indirect and induced effects of the project on in-state employment.

Recommendations Regarding New Cost-of-Service Generation

Our analysis of resource adequacy needs indicates that new generation is not needed in New England until 2022 or later, and not needed specifically in Connecticut until much later. The economics of building cost-of-service generation ahead of need suggests some potential benefits, although nothing strongly positive. Given these findings, it makes sense to wait until closer to the time of need. Sponsoring new generation should be reconsidered in the next IRP in two years, considering updated information on market conditions at that time.

[45] Cumulative NPV is defined as the sum of all prior year's cash flows, with each year's cash flows discounted to a 2017 value, and then expressed in 2012 real dollars.

Figure 32
Annual Costs and Revenues of a 656 MW, $929/kW Cost-of-Service Combined-Cycle Plant
(2012 $Mil)

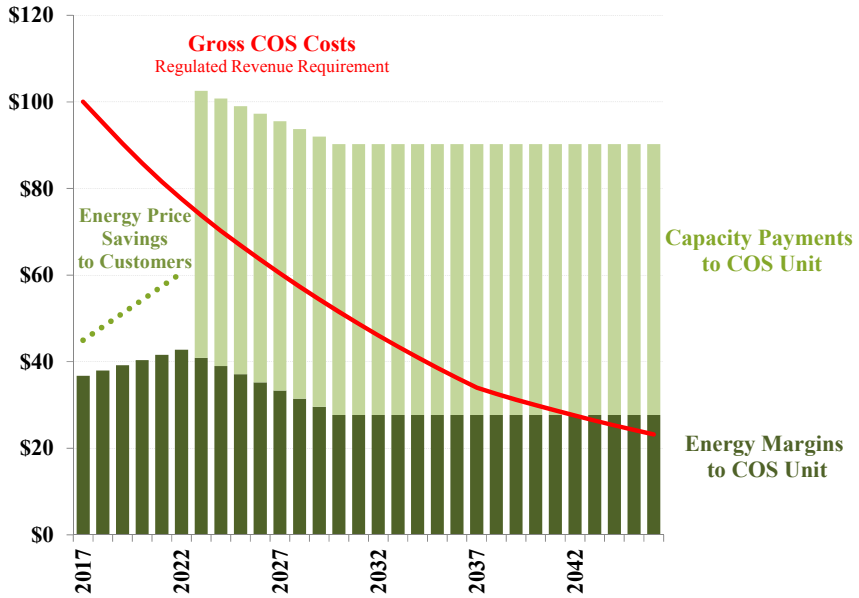
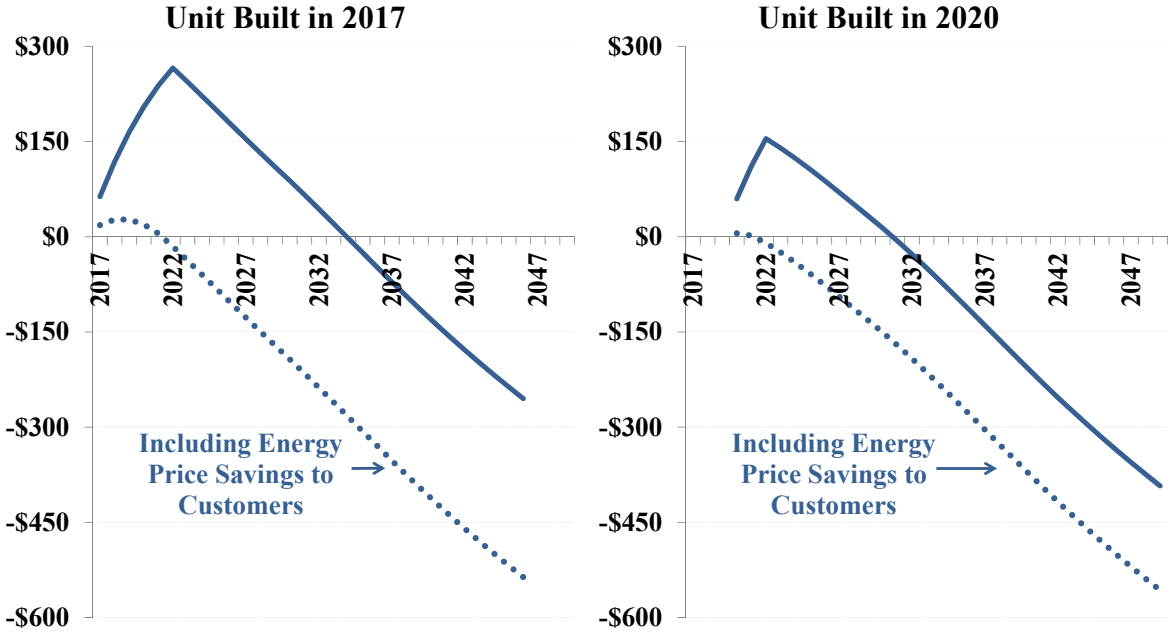


Figure 33
Cumulative NPV of the Costs of a COS Plant (2012 $Mil)



D. Transmission

Section 90 of PA 11-80 requires consideration of Non-Transmission Alternatives (NTAs). However, there are no transmission enhancements to the Base Case being considered in this IRP, and hence no NTAs were evaluated. Appendix G (Transmission Planning) does discuss the identification and evaluation of NTAs generally. As discussed there, ISO New England is currently developing an NTA process, and the State of Connecticut should be engaged in that development. This will be especially important over the next year when the ISO will conduct a reliability needs analysis including consideration of NTAs for central Connecticut and Hartford.

Appendix G also presents identified transmission reliability needs and ongoing studies in Connecticut, particularly in southwest Connecticut and central Connecticut. It also summarizes emerging issues affecting transmission planning.

E. Emerging Technologies

This IRP assesses emerging technologies that may provide attractive energy resource options in the coming decade and beyond, even if they are not yet developed enough to play a major role in the current market. Five technologies of interest to stakeholders in Connecticut's resource planning process are: plug-in electric vehicles (PEVs), advanced metering infrastructure (AMI), energy storage, advanced waste-to-energy, and geothermal energy. For each technology, we identified current trends, its potential to play a role in Connecticut's portfolio of energy resource options in the coming decade and beyond, and state-level activities that could help enable further adoption. Findings and recommendations are explained in Appendix H (Emerging Technology) and summarized below.

Plug-in Electric Vehicles (PEVs). Connecticut's Electric Vehicle Infrastructure Council and the Electric Distribution Companies collectively are preparing the state for rapid and seamless integration of PEVs into the market. In 2011, the Electric Power Research Institute (EPRI) developed projections for Connecticut, which estimate that the new vehicle market penetration of PEVs may reach 7% by 2020 and 16% by 2030 under a medium market penetration scenario. Based on these current trends, the impacts on the generation system and peak demand should be manageable for Connecticut's Electric Distribution Companies, especially if the charging load can be managed with time-varying rates enabled by user-friendly charging technology. However, coincident charging may create problems for local distribution systems, especially if the PEVs cluster in certain locations. For that reason, it is important for Connecticut to implement a proactive approach to monitor where the PEVs are appearing, and to address near-term localized impacts through focused system upgrades. Pilot programs can provide insight into customer charging profiles and whether and how they change their charging patterns in response to time-based rates. In addition, the State should consider working with the private sector to develop charging infrastructure.

Advanced Metering Infrastructure (AMI). AMI deployments are projected to ramp up across the United States over the coming decade, with half of all households expected to be equipped with a smart meter by as early as 2015. In Connecticut, market penetration of AMI is likely to happen at a more gradual rate. The United Illuminating Company has recently upgraded its remote

meter reading and billing capability and is deploying some advanced meters to its customer base cost effectively. The Public Utility Regulatory Authority deferred approving Connecticut Light & Power's AMI proposal due largely to uncertainty around the technology and its benefits. As such, the impact of AMI in Connecticut is expected to be modest over the next ten years. Possible state policy options for addressing AMI-related concerns and accelerating deployment — if desired — include further research into the benefits of AMI, programs for educating and protecting customers from financial and other risks, and providing clarity around appropriate cost recovery mechanisms.

Energy Storage. While certain forms of energy storage (such as pumped hydro) have existed in the United States for nearly a century, growing concern over renewables integration has led to an increasing interest in emerging bulk and distributed storage technologies. Currently, these new technologies are typically too costly to be economically competitive with other resources, except in limited applications. However, a significant amount of federal funding has been made available to advance the state of the technology and reduce costs. Whether this will significantly change the economics over the coming decade remains uncertain. Aside from financial incentives, state level activities to promote adoption could include modifications to the regulatory framework, utility planning processes, and market rules to more fully recognize the multi-dimensional benefits that energy storage provides.

Advanced Waste-to-Energy (AWE). Connecticut is the nation's leader in converting trash to energy through the traditional incineration process, and recent studies have suggested that further development of this resource in the state is not needed. However, there is interest among policymakers in emerging forms of AWE, such as anaerobic digestion, that could potentially achieve similar benefits with less environmental impact. As of yet, these projects are challenging in terms of commercial viability and therefore likely to proceed on a quite limited basis. Future state activities to promote development of the technology could focus on small-scale demonstration projects or other related research. For example, Connecticut's Clean Energy Finance and Investment Authority (CEFIA) is establishing a pilot program to test the use of anaerobic digestion on organic waste to produce electricity and heat. As specified by state legislation (P.A. 11-80, Section 103(b)), the pilot program will last three years and will support five pilots through loans, grants, or power purchase agreements.

Geothermal Energy. Although there is more than 3 GW of geothermal capacity in the United States, with another 800 MW scheduled to come online in the next few years, all of this capacity is located in the Western U.S. Studies have found that geothermal potential in Connecticut (and all of New England) is quite poor. Activities to promote geothermal development in Connecticut would need to focus on developing innovative drilling, power conversion, and reservoir technologies that are more effective and available at much lower costs than they are today. Such research already is happening to a limited degree in Connecticut through DOE grants.

Micro-grids. While the State, to date, has taken a gradual regulatory approach to the deployment of smartgrid technology, the two storms of 2011 revealed a vulnerability in the state's current electricity system that must be addressed in planning for the state's electric future. The ability to ensure the operation of critical infrastructure during an emergency with a strategic deployment of clean distributed resources that can be isolated from the larger grid in the case of outages would require the use of smart-grid technologies. While recognizing the financial, regulatory, and

operational challenges of using distributed generation (DG) resources within micro-grids to increase the resiliency of our electric infrastructure, the potential opportunity to significantly alleviate the pain, disruption, and economic loss caused by prolonged power outages warrants an analysis to evaluate and develop a targeted deployment strategy for smartgrids. To that end, DEEP will continue to investigate the deployment and funding of smartgrid technology to support micro-grids as a part of a larger overall strategy on resiliency.

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LATHAM & WATKINS LLP

MEMORANDUM
January 31, 2012

PRIVILEGED AND CONFIDENTIAL ATTORNEY-CLIENT PRIVILEGE DRAFT

To: Reed Hundt and Ken Berlin, Coalition for Green Capital
From: Latham & Watkins LLP
File no: 503152-0000
Subject: Overview of statutory authority and potential opportunities for the Connecticut Clean Energy Finance and Investment Authority (CEFIA)

In 2011, the State of Connecticut enacted the nation's first Green Bank in the form of the Clean Energy Finance and Investment Authority (CEFIA). Public Act 11-80[1] streamlines Connecticut's energy programs under a consolidated Department of Energy and Environmental Protection and provides CEFIA with both the authority and the mandate to pursue innovative financing measures to promote deployment of clean energy projects.

During the negotiations that resulted in the drafting, legislative approval and enactment of PA 11-80, members of the Connecticut legislature made it clear that they supported the creation of CEFIA as provided in PA 11-80 because they believed it would change the way that Connecticut funds clean energy projects. The legislature envisioned PA 11-80 as establishing an entity that would largely replace the emphasis on grant type programs with programs that provide low cost financing support, including loans and guarantees, to encourage greater deployment of renewable and energy efficiency projects. The legislature expects CEFIA to attract private capital investment to combine with public funds to financially support deployment of clean energy projects, and to develop new mechanisms that would enable it to further leverage limited public funds using substantial private capital investment.

This advisory memorandum[2] examines CEFIA's authority under PA 11-80 and briefly outlines financing opportunities that could be pursued by CEFIA in accordance with its statutory authority and obligations. Part I summarizes CEFIA's authority and obligations under

[1] Public Act 11-80, An Act Concerning the Establishment of the Department of Energy and Environmental Protection and Planning for Connecticut's Energy Future (PA 11-80), §99, codified at Conn. Gen. Stat. §16-245n.

[2] This advisory memorandum was prepared at the request of and for the Coalition for Green Capital. This memorandum is not a legal opinion, and should not be interpreted or relied upon as such.

PA 11-80, including specific procedural requirements with which CEFIA is expected to comply before it may engage in financing activities. Part II summarizes four categories of financing activities in which CEFIA could engage in accordance with its authority under PA 11-80, including a list of examples of potential programs and specific activities which could be undertaken by CEFIA. Because CEFIA enjoys broad statutory authority under PA 11-80, the list of potential financing activities is near limitless; as such the activities presented are intended only as examples of the types of activities CEFIA could pursue. Part III outlines a proposed Energy Efficiency Lending Trust, one potential financing structure that illustrates how the broad and flexible authority provided to CEFIA under PA 11-80 possibly could be exercised to provide significant benefits to the public. Finally, Part IV concludes this advisory memorandum by attempting to address some of the immediate issues which PA 11-80 requires the CEFIA Board to address, and provides suggestive guidance regarding the Board's consideration of these issues.

I. CEFIA'S STATUTORY AUTHORITY

A. Scope

PA 11-80 expressly provides CEFIA with broad statutory authority to foster a clean energy economy in Connecticut and move the state to the forefront of energy efficiency and renewable energy financing.[3] CEFIA is charged by law with developing separate programs to finance clean energy investment in small projects and larger commercial projects; support financing and other expenditures that promote investment in clean energy; and stimulate demand for clean energy within the state.[4] Pursuant to PA 11-80, CEFIA enjoys broad and flexible authority to establish programs; finance and support financing, expenditures and investments; own property; issue bonds; refinance existing obligations and other activities to spur the development of clean energy in Connecticut.[5] While PA 11-80 contains a number of specific procedural requirements for CEFIA and the Clean Energy Fund, it contains very few substantive limitations on how CEFIA conducts its activities as long as such activities are consistent with (i) CEFIA's statutory purpose, (ii) resolutions adopted by the CEFIA Board relating to CEFIA's purpose, and (iii) a comprehensive plan adopted by the CEFIA Board to govern its activities, including those of the Clean Energy Fund. These requirements are detailed below. The CEFIA statute contains a number of specifically authorized funding sources for CEFIA (described in detail in Part III), while noting that CEFIA is not limited to these funding sources alone. Also worth noting is that there are no statutory limitations on financial participation in or relating to any Special Purpose Entities (SPE) established and/ or provided financing support (e.g., direct participation, guarantees) by CEFIA.

B. Structure

CEFIA is deemed to be a "quasi-public agency for purposes of chapters 5, 10 and 12 [of the Connecticut General Statutes] and within Connecticut Innovations, Incorporated for

[3] In addition to CEFIA's other activities, it also manages the Clean Energy Fund. See Conn. Gen. Stat. §16-245n(c).

[4] See Conn. Gen. Stat. §16-245n(d)(1).

[5] Id.

administrative purposes only."[6] PA 11-80 also authorizes CEFIA to seek to qualify as a Community Development Financial Institution under Section 4702 of the United States Code.[7]

C. Procedural Requirements

1. Comprehensive Plan

PA 11-80 directs CEFIA to "support financing or other expenditures that promote investment in clean energy sources in accordance with a comprehensive plan developed by [CEFIA],"[8] making such a comprehensive plan a precondition to CEFIA's financing activities. PA 11-80 calls for the comprehensive plan to identify strategies "to foster the growth, development and commercialization of clean energy sources and related enterprises."[9]

In addition to requiring CEFIA to develop a comprehensive plan, PA 11-80 also directs the Clean Energy Fund, a successor to the former Renewable Energy Investment Fund, to carry out its activities are in accordance with a comprehensive plan developed by the Clean Energy Fund.[10] As this requirement existed prior to PA 11-80, the current activities of the Clean Energy Fund would need to be consistent with the plan developed by the former Renewable Energy Investment Fund until amended.

While the statute is ambiguous, a fair reading is that CEFIA may use the comprehensive plan required under PA 11-80 to govern all of its activities, including financing provided by the Clean Energy Fund.

2. Other Procedural Requirements

The CEFIA Board must also take three additional specific procedural steps prior to undertaking the activities authorized and mandated by PA 11-80. First, the Board must adopt a resolution establishing CEFIA.[11] Second, the Board must adopt a resolution providing for CEFIA's purposes (consistent with the purposes found in the statute).[12] Finally, "[b]efore making any loan, loan guarantee, or such other form of financing support or risk management for a clean energy project, [CEFIA] shall develop standards to govern the administration of the

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[6] Id. Chapters 5, 10 and 12 of the Connecticut General Statutes relate to bonds, codes of ethics, and quasi-public agencies, respectively.

[7] Conn. Gen. Stat. §16-245n(d)(2)(A). If approved by the U.S. Department of the Treasury as a Community Development Finance Institution, CEFIA or a CEFIA subsidiary would be treated as a qualified community development entity for purposes of Section 45D and Section 1400N(m) of the Internal Revenue Code.

[8] Conn. Gen. Stat. §16-245n(d)(1)(B).

[9] Id.

[10] Conn. Gen. Stat. §16-245n(c).

[11] Conn. Gen. Stat. §16-245n(d)(1).

[12] Id.

authority through rules, policies and procedures that specify borrower eligibility, terms and conditions of support, and other relevant criteria, standards, or procedures."[13]

In addition, because CEFIA is deemed to be a quasi-public agency under chapters 5, 10 and 12 of the Connecticut General Statutes, it arguably is subject to the procedural requirements imposed on quasi-public agencies as defined under chapter 12.[14] For example, under chapter 12, prior to adopting a proposed procedure, a quasi-public agency shall give at least thirty (30) days notice of its intended action by publishing its proposal in the Connecticut Law Journal.[15] The notice shall include the following:

(1) either a statement of the terms of the substance of the proposed procedure or a description sufficiently detailed so as to apprise persons likely to be affected of the issues and subjects involved in the proposed procedure;

(2) a statement of the purposes for which the procedure is proposed; and

(3) when, where and how interested persons may present their views on the proposed procedure.[16]

In addition, a two-thirds vote of the full membership of the board of a quasi-public agency is required to adopt its proposed procedure.[17]

D. Other Statutory Requirements

In addition to the procedural requirements detailed above, CEFIA is also required to provide information regarding rates and terms and conditions for public inspection and subject to private audits;[18] submit an annual report to the Connecticut Department of Energy and Environmental Protection, with copies to the Connecticut General Assembly, on programs and activities undertaken by CEFIA;[19] and review annual statements setting forth all sources and uses of funds from entities receiving financing.[20] Finally, PA 11-80 requires establishment of a number of specific pilot programs to be administered by CEFIA, including establishing a three-year pilot program by March 1, 2012 with one or more standardized grant amounts, loan

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[13] Conn. Gen. Stat. §16-245n(d)(2)(B).

[14] CEFIA is not expressly listed in chapter 5, §1-120(1), which includes a list of those entities defined as quasi-public agencies, including, among others, Connecticut Innovations, Incorporated.

[15] Conn. Gen. Stat. §1-121(a).

[16] Id.

[17] Id.

[18] Conn. Gen. Stat. §16-245n(d)(2)(F).

[19] Conn. Gen. Stat. §16-245n(f)(1).

[20] Conn. Gen. Stat. §16-245n(f)(3). Under the statute, residential projects for buildings with one to four dwelling units are exempt from any annual auditing requirements, though they may be required to grant their utility companies' permission to release their usage data to CEFIA.

amounts and power purchase agreements to promote development of up to 50 MW of new combined heat and power projects that are each below 2 MW;[21] establishing a three-year pilot program to support using organic waste from farms with on-site anaerobic digestion facilities to generate electricity and heat;[22] structuring and implementing a residential solar investment program to create at least 30 MW of new residential solar photovoltaic installations by December 31, 2022;[23] providing performance-based incentives and performance-based buydowns for the purchase or lease of qualifying residential solar photovoltaic systems;[24] maintaining a publicly accessible schedule of incentives and solar capacity;[25] making provisions for comprehensive training, accreditation and certification programs to create a permanent Connecticut-based solar workforce;[26] and establishing a "condominium renewable energy grant program" to provide grants to residential condominium associations and owners for purchasing clean energy sources.[27] Nothing in PA 11-80 mandates precisely how CEFIA shall provide financing support to these pilot projects directly; rather, CEFIA appears to have considerable statutory flexibility to tailor the finance-related aspects of its pilot programs to complement its broader goal of achieving greater private sector financing support for clean energy deployment (*e.g.*, combining limited performance-based buydowns with lower cost debt financing, providing performance-based incentives in the form of lower cost debt financing, etc.).

E. Sources of funding for CEFIA and its activities

PA 11-80 provides CEFIA with a number of specifically authorized funding sources, while expressly providing that CEFIA is not limited to these funding sources alone. Specifically authorized funding sources include (i) funds repurposed from existing statutorily-created clean energy programs, subject to approval by the Connecticut General Assembly and the requirement that such funds be used for expenses of financing, grants and loans;[28] (ii) any federal funds that can be used for the activities of the Clean Energy Fund; (iii) charitable gifts, grants, and contributions and loans from individuals, corporations, university endowments and philanthropic foundations; (iv) earnings and interest derived from CEFIA's activities; (v) to the extent that CEFIA or a CEFIA subsidiary qualifies as a Community Development Financing Institution under Section 4702 of the United States Code, funding from the Community Development Financing Institution Fund administered by the United States Department of

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[21] PA 11-80, §103(a).

[22] PA 11-80, §103(b).

[23] PA 11-80, §106(a).

[24] PA 11-80, §106(b).

[25] PA 11-80, §106(e).

[26] PA 11-80, §106(g).

[27] PA 11-80, §111.

[28] While the statutory language contains some ambiguity regarding what sorts of fund repurposing requires additional legislative approval, the best reading of this language (and the reading that best reflects the intent of the General Assembly in enacting PA 11-80), is that CEFIA has sufficient statutory authority to repurpose funds as between programs and activities already supported by the Clean Energy Fund or otherwise managed by CEFIA. The statute merely protects other funds that subsequent to the enactment of PA 11-80 remained within another statutorily-created clean energy program from being repurposed into the Clean Energy Fund without additional legislative approval.

Treasury, as well as loans from and investments by depository institutions seeking to comply with their obligations under the United States Community Reinvestment Act of 1977; and (vi) contracts entered into by CEFIA with private sources to raise capital, subject to limitations on the average rate of return set by the CEFIA Board.[29]

II. CATEGORIES OF FINANCING ACTIVITIES AUTHORIZED UNDER PA 11-80

A. Direct lending by CEFIA, including establishment of a revolving loan fund

The first category of financing available to CEFIA is to continue providing direct loans to end users in Connecticut, including the establishment of a revolving loan fund.[30] CEFIA currently uses this type of structure for the Connecticut Solar Lease Program, a direct lending program that does not utilize outside debt capital and instead relies on the Clean Energy Fund's existing public funding sources as the source of lending capital.

In addition to the Connecticut Solar Lease Program, other examples of direct lending programs which could be undertaken by CEFIA include the following:

- Direct lending to renewable energy projects and residential and commercial retrofit programs, including specialized commercial projects such as those in the municipal and state governments, universities, schools, and hospitals (MUSH) markets.

- For each of the above, this lending can be done either directly using existing funding sources administered by CEFIA or through auction financing.

- Similarly, for each of the above, loans can be made either directly or to other institutions, including energy distribution companies doing the retrofits or project developers responsible for renewable energy installations.

- Repayment of these loans could be made directly or through an on-bill repayment mechanism. Use of on-bill financing, however, would need regulatory approval and may extend the timeframe for these projects.

- Provide direct up-front financing in connection with a Property-Assessed Clean Energy (PACE) program for either commercial or residential projects, with loans repaid through the property taxes under the program. Note that commercial PACE would require the enactment of legislation being crafted by DEEP.

Assuming that direct loans are prudently made by CEFIA, direct lending presumably will guarantee results for the funding available, as well as enabling CEFIA to gain experience in making such loans and providing CEFIA with the opportunity to learn from the market and other lending partners. However, absent additional leverage, the limited capital available to CEFIA

[29] Conn. Gen. Stat. §16-245n(d)(2)(C).

[30] While not addressed in this advisory memorandum, grants also would fall into the general category of offering direct financial assistance to end-users.

from its existing public funding sources will likely constrain near-term wide-scale deployment of clean energy resources and the attendant near or medium-term development of a clean energy economy in Connecticut. These funding constraints can be overcome by seeking to attract private investment in CEFIA directly, as authorized by PA 11-80, as well as by attracting private investment in one of more CEFIA-related SPEs created for that purpose.

B. Participation in a direct lending deal with one or more outside lenders

Perhaps the most straight-forward of leveraging CEFIA's limited capital from public funding sources would be to partner with one or more outside private lenders in providing direct financing to end-users. This sort of financing would have many of the characteristics of the direct lending opportunities described above, but instead of CEFIA being responsible for the full amount being financed, the loan(s) would have multiple participants including CEFIA and one or more outside private lenders.

In addition to the results that direct lending can provide in terms of financing for end-users, loan participation offers at least three additional significant advantages for CEFIA. First, the involvement of outside lenders provides leveraging opportunities for CEFIA that simply do not exist when CEFIA is responsible for providing the full loan amount. Even instances where outside lenders limit their investment to 50% of the total, with CEFIA providing the other 50%, allow CEFIA to double the funding available for its direct lending programs. Second, participation by outside lenders allows CEFIA to "piggy back" on the diligence performed by these lenders. Because these lenders are making a significant investment of their own, CEFIA can rely to some extent on their expertise in making the loan, ensuring all such loans are carefully vetted in accordance with traditional banking standards. Finally, CEFIA can also use the outside lender as the loan administrator, saving CEFIA from having to perform loan processing functions for which its lending partner may be substantially better placed to perform.

Each of the direct lending programs described above in Section A could also be undertaken in partnership with one or more outside lenders.

C. Facilitate pooling and securitization of project loans

In addition to direct lending, PA 11-80 provides sufficient flexibility for CEFIA to create funding structures to pool and securitize project loans to end-users, allowing for the involvement of substantial amounts of outside investment capital. Any such securitization, including any issuance of bonds to underwrite the pooled costs of clean energy projects, would require the formation of a bankruptcy-remote SPE in the form of a trust. The trust could then participate in direct lending or further leverage the investment capital through participation with other lenders. CEFIA's involvement in such financing, therefore, would be the development of the funding structure and the creation of the trust mechanism and any other entities necessary for the funding structure's operation. CEFIA could also offer credit enhancements to reduce the cost of capital and make the trust more attractive to outside investors. An example of such a structure focusing on financing energy efficiency projects is found in Part III below.

While more complicated than direct lending, this type of financing structure is not new in Connecticut. A similar structure to that proposed below (including loan loss reserve support) is currently being used for an energy efficiency financing program administered by the Connecticut

Energy Efficiency Fund (which is not currently under CEFIA), though there are some factors which limit the impact of the CEEF program, including its scale, its income eligibility restrictions and its reliance on debt capital provided by utilities (and repaid at the utilities weighted cost of capital).

The primary advantages of this type of financing structure are its ability to raise potentially significant amounts of capital in the markets for rated debt and the fact that an existing financial institution would be responsible for actual program administration, minimizing CEFIA's responsibility to actually run the day-to-day mechanics of the program. In addition, because this structure relies either exclusively or virtually exclusively on outside capital, CEFIA's limited capital sourced from public funds can be used for other purposes.

D. Provide credit enhancements to reduce the cost of capital

The final category of financing options open to CEFIA is to provide a range of credit enhancements, including loan loss reserve funds and loan guarantees. These credit enhancements can be used to lower the cost of capital for projects fully financed using outside capital; direct lending projects in which CEFIA is participating with outside lenders; and pooling and securitization arrangements in which the credit enhancements reduce the risk profile of the investment products being offered in the markets for rated debt.

III. THE ENERGY EFFICIENCY LENDING TRUST

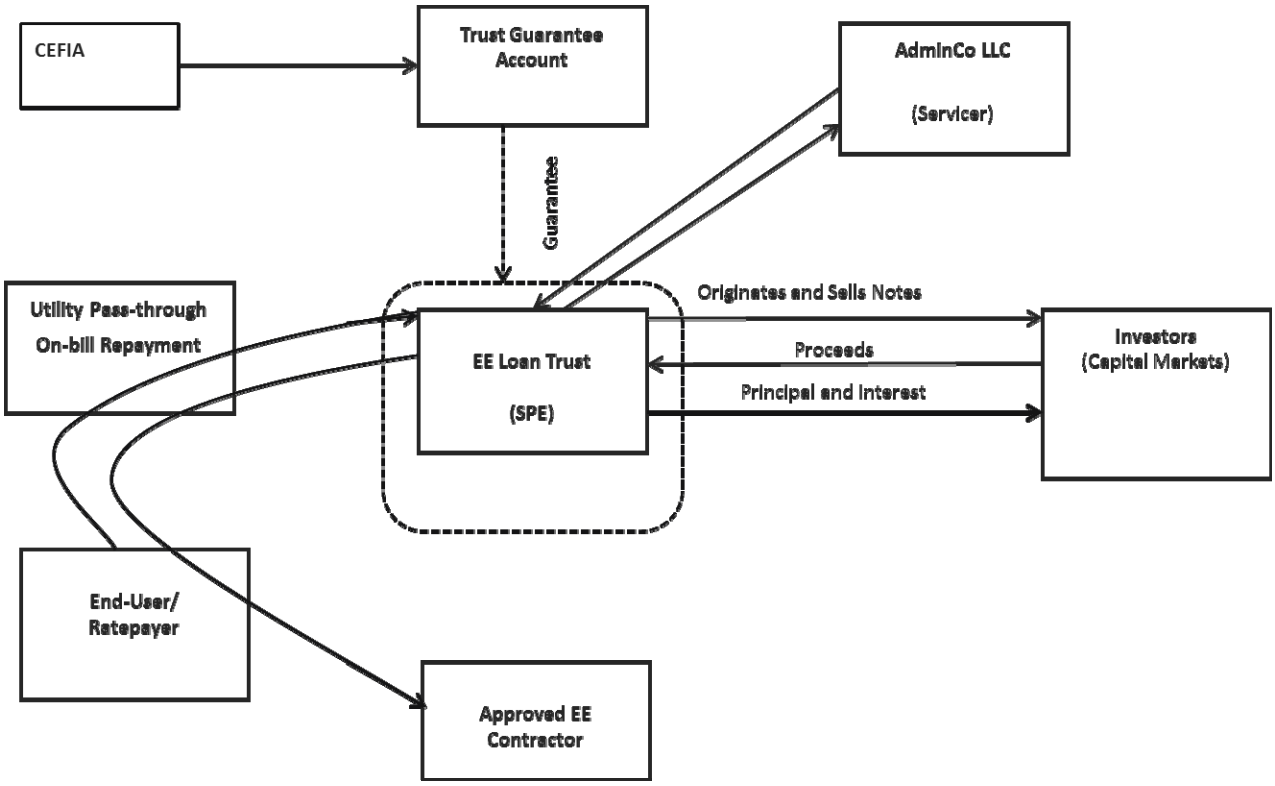
The potential promise of pursuing a path based on CEFIA's inherent flexibility is most easily illustrated with energy efficiency financing examples. Energy efficiency is widely recognized as the lowest cost option for providing energy services over the long term when compared with other resources, yet deploying energy efficiency measures at scale has proven to be a so-far insurmountable challenge because of, among other things, large up-front costs and limited capital resources available to the consumer or the public financing entity. Many of the key barriers to large-scale deployment of energy efficiency can be overcome by CEFIA if it takes advantage of its flexibility to develop public-private partnership financing vehicles that induce significant participation by private capital investors in providing 100 percent up-front loans for energy efficiency projects. Such vehicles should enable CEFIA to supplant existing financing programs that have little or no private capital participation on the debt side, such as direct loans and grants/rebates and interest rate buy-downs. Such public-private partnership vehicles also should enable CEFIA to succeed in its mission without having to develop significant staffing and a large internal infrastructure to engage banking-type functions.

At least initially, CEFIA will likely need to partner with other financial institutions in order to scale up quickly and best use its resources by tapping the capital and expertise of others in the private sector. CEFIA's comprehensive plan and lending standards should allow and encourage delegation of those standards to commercially reasonable practices, as practiced by partners with solid financing histories and experience.

One potential model (outlined in Chart 1), with which we assume CEFIA already has some familiarity, would have CEFIA use some of its limited capital resources to provide the credit enhancement, such as a loan loss reserve, necessary to support the securitization of large numbers efficiency loans to end-users pooled together through a special purpose trust (e.g., a

master trust cycling through individual loans) that issues bonds sold to private investors. This investment vehicle should be particularly attractive to private investors, would lessen any risk borne by CEFIA (giving it greater leverage), and should result in a lower cost to borrowers, if the loans underlying the trust can be repaid through utility bills (as appears to be contemplated under Connecticut law),[31] as the unmitigated risk of default might be determined by a rating agency to be at or below the default rate for utility bills payments. At the same time, the trust and its loans would be serviced by a private financial institution avoiding the need for CEFIA to develop internal infrastructure and expertise to perform loan servicing, traditional back office banking-type functions, or loan trust administration services (e.g., communications with trust investment participants). As noted above, the trust could combine its pooling and securitization activities with the other categories of financing activities (direct lending, loan participation with other lenders, and the creation of credit enhancements); in this way the trust serves as a different and complementary means of accomplishing the same goals as CEFIA making these loans and loan guarantees directly.

Chart 1.



[31] See Public Act No. 07-242 of 2007.

IV. IMMEDIATE ISSUES FOR CONSIDERATION BY THE CEFIA BOARD

A. Standards and Rules to guide CEFIA's activities

As mentioned above, "[b]efore making any loan, loan guarantee, or such other form of financing support or risk management for a clean energy project, [CEFIA] shall develop standards to govern the administration of the authority through rules, policies and procedures that specify borrower eligibility, terms and conditions of support, and other relevant criteria, standards, or procedures."[32] However, other than the procedural requirement that these standards be in place prior to the extension of financing assistance, the statute contains few specific requirements concerning the substance of these standards, providing significant flexibility to the CEFIA Board to develop standards that fit with the specific purposes and activities identified by the Board. The fact that these standards must be in place prior to any financing activities, however, makes the development of such standards a top priority for the organization. One approach which CEFIA might pursue would be to adopt a broad standard of commercially reasonable practices, and delegate the defining of such practices to partners with which CEFIA participates in lending projects.

B. An initial plan of action: demonstrating CEFIA's ability to successfully execute a limited number of financing tasks

Rather than pursuing the broad range of financing opportunities authorized under PA 11-80, CEFIA may want to consider focusing initially on developing the various pilot programs required under PA 11-80, as well as undertaking specific financing activities for which it can demonstrate near-term positive results. Specifically, direct lending through the existing Connecticut Solar Lease Program will allow CEFIA to develop internal expertise and gain insight from such direct market participation, especially in partnership with lead borrowers with solid financing histories and experience. In addition, CEFIA may want to consider working with one or more financial institutions to develop the Energy Efficiency Lending Trust illustrated in this advisory memorandum, including its loan loss reserve mechanism supported directly by CEFIA.

Together, these two types of financing activities could demonstrate CEFIA's capacity to develop and administer (or oversee the administration of) direct lending, pooling and securitization, and credit enhancement programs, offering a range of financing support for renewable energy and energy efficiency deployment in Connecticut.

C. Maximizing lending activity performed or supported by CEFIA

CEFIA should consider the development and adoption of principles to govern CEFIA's programs in CEFIA's comprehensive plan that will provide it with the operational flexibility to pursue both the pilot programs required under PA 11-80 but also the financing activities described above. Specifically, CEFIA should consider adopting principles that commit it to maximizing its leverage through loan participation programs, pooling and securitization arrangements, and the development of credit enhancement programs. These will allow for

[32] Conn. Gen. Stat. §16-245n(d)(2)(B).

CEFIA to fully leverage its limited resources for maximum impact, while also limiting its exposure to potential losses in direct lending arrangements for which CEFIA provides the full loan amount. These strategies are designed to fulfill the promise of the nation's first Green Bank and foster a clean energy economy in Connecticut.

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CLEAN ENERGY
FINANCE AND INVESTMENT AUTHORITY

Memo

To: Board of Directors

From: Dale Hedman / Rick Ross

Date: February 14, 2012

Re: For Discussion Purposes Only - Anaerobic Digestion and Combined Heat and Power Pilot Programs Under Section 103 of Public Act 11-80

BACKGROUND
Pursuant to Section 103 of P.A. 11-80 (see Appendix I), CEFIA is required to establish two (2) new three-year pilot programs through the use of either loans, grants or power purchase agreements.

- **Combined Heat and Power** – the first program is to promote the development of up to 50 megawatts (MW) of new combined heat and power projects in Connecticut that are 2 MW and below in capacity. CEFIA may provide a per kilowatt (kW) incentive of up to three hundred-fifty dollars.

- **Anaerobic Digestion** – the second pilot program will promote the development of up to five (5) new on-site anaerobic digestion (AD) facilities to generate electricity and heat using organic waste, on or before March 12, 2012. Each project under the AD pilot program may be no larger than 1.5MW.

Per the statute, CEFIA shall allocate four million dollars annually from the Clean Energy Fund provided that two million dollars shall be allocated for CHP and two million dollars shall be allocated for anaerobic digestion projects. As prescribed in Section 103 of P.A. 11-80, on or before January 1, 2016, CEFIA will report to the joint standing committee of the General Assembly having cognizance of matters relating to energy regarding the status of the programs and whether such programs should continue.

CEFIA is proposing the following format for these programs subject to discussion, review and approval of the Deployment Committee:

- **Reverse Auction** – projects will compete against one another by using one of the three cost mechanisms identified below:

    1. Grant - cost per kW basis up to a maximum amount per kW, as specified in Section 103, for each qualifying technology listed below

        - Combined Heat & Power (CHP) - up to $350/kW

- Anaerobic Digestion (AD) – up to $450/kW

2. Loan – fifteen (15) year fixed loan through one of CEFIA's financing partners - CEFIA to arrange for either a low interest loan (buy-down) or loan guaranty. If this option is selected the proposal will need to specify the interest rate that will be required by the system owner/developer to finance the project over the 15-year term.

3. Power Purchase Agreement (Performance Based Incentive (PBI)) – proposals shall specify the cost per kWh required over a fifteen (15) year period, based on the predicted generation, up to the maximum amounts listed below for each qualifying technology. CEFIA will pay the customer/developer, for the system generation (kWh) at the agreed upon rate, on a quarterly basis throughout the term of the PPA.

    - Combined Heat & Power (CHP) – TBD ($/kWh)

    - Anaerobic Digestion (AD) – TBD ($/kWH)

- **RFP Issuance** - a competitive RFP will be issued, accepting project proposals from owners/developers, for each of the identified pilot programs on an annual basis. The first release scheduled to occur on March 1, 2012. Subsequent releases will be on the same date each year unless the day happens to fall on a weekend or holiday, where it will then be pushed to the following Monday.

- **Project Evaluation Criteria** - the applications meeting the minimum requirements will be evaluated by CEFIA and third party evaluators for funding based on the following evaluation criteria:

    - Project Economics 70%, considering incentive type in order of preference:
        1. Unsubsidized Loan
        2. Loan Loss Reserve
        3. Subsidized Loan - Interest Rate Buy-Down (buy-down cost is less than other alternatives)
        4. PPA (in the form of a Performance Based Incentive (PBI))
        5. Direct Subsidy (grant)
    - Deployment of the Technology 10%
    - Probability of Project Completion and Project Feasibility 10%
    - Public and Unique Ratepayer Benefits 10%

APPENDIX I

Sec. 103. (*Effective July 1, 2011*) (a) The Clean Energy Finance and Investment Authority shall on or before March 1, 2012, establish a three-year pilot program to promote the development of new combined heat and power projects in Connecticut that are below two megawatts in capacity size. The program established pursuant to this section shall not exceed fifty megawatts. The authority shall set one or more standardized grant amounts, loan amounts and power purchase agreements for such projects to limit the administrative burden of project approvals for the authority and the project proponent, including, but not limited to, a per kilowatt cost of up to three hundred fifty dollars. Such standardized provisions shall seek to minimize costs for the general class of ratepayers, ensuring that the project developer has a significant share of the financial burden and risk, while ensuring the development of projects that benefit Connecticut's economy, ratepayers, and environment. The authority may in its discretion decline to support a proposed project if the benefits of such project to Connecticut's ratepayers, economy and environment, including emissions reductions, are too meager to justify ratepayer or taxpayer investment.

(b) The Clean Energy Finance and Investment Authority shall establish a three-year pilot program to support through loans, grants or power purchase agreements sustainable practices and economic prosperity of Connecticut farms and other businesses by using organic waste with on-site anaerobic digestion facilities to generate electricity and heat. As part of the pilot program, the authority may approve no more than five projects, each of which shall have a maximum size of one thousand five hundred kilowatts at a cost of four hundred fifty dollars per kilowatt.

(c) On or before January 1, 2016, the authority shall report, in accordance with the provisions of section 11-4a of the general statutes, to the joint standing committee of the General Assembly having cognizance of matters relating to energy regarding the program established pursuant to this section and whether such program should continue.

(d) The Clean Energy Finance and Investment Authority shall allocate four million dollars annually from the Clean Energy Fund, provided two million dollars shall be allocated for combined heat and power projects and two million dollars shall be allocated for anaerobic digestion projects.