APPENDIX C

ENERGY EFFICIENCY

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INTRODUCTION

This appendix provides background on the existing energy efficiency activities in Connecticut and includes a description of this IRP's Base Case Energy Efficiency ("Base Case EE") and Expanded Energy Efficiency ("Expanded EE") scenarios. Alternative policy approaches to achieving the savings identified in the Expanded EE scenario are also discussed.

BACKGROUND

Connecticut has a successful history of implementing energy efficiency. In 2007, Public Act 07-242, *An Act Concerning Electricity and Energy*, portrayed energy efficiency as the centerpiece of a statewide energy policy and directed the State to implement "all-cost effective energy efficiency." More recently, Connecticut's landmark energy reform bill, Public Act No. (PA) 11-80, made significant changes to Connecticut's energy conservation policy and structure, representing a fundamentally new approach to achieving energy efficiency. PA 11-80 allows Connecticut to align its energy efficiency goals with national goals and objectives and to work toward positioning Connecticut as a leader in the nation for energy efficiency. Specifically, the Act calls for aggressive efficiency targets for weatherization of residential buildings and state-owned or –leased buildings, and addresses the leveraging of existing funds to provide low-cost energy efficiency financing and the utilization of savings-based and performance-contracting initiatives. Part of the implementation of PA 11-80 will involve the Electric Distribution Companies' (EDCs) continued annual submission of a Conservation and Load Management (C&LM) Plan to DEEP and PURA, in accordance with Connecticut General Statutes §16-245m and §16-32f. This plan is developed with the advice and assistance of the Energy Efficiency Board (EEB) and its consultants. In addition to planning energy efficiency programs for a one-year budget cycle, the 2012 C&LM plan also reports that in 2010, the EDCs delivered average energy efficiency (EE) savings of approximately 50 MW in peak load reduction and 400 GWh of energy per year.

BASE CASE EE SCENARIO

Description of Base Case Programs

The Base Case Energy Efficiency (Base Case EE) scenario for Connecticut reflects "business-as-usual" EE, with continuation of the EDCs' program structures and designs currently deployed in Connecticut within state approved program budgets. Base Case EE represents what is achievable through the existing funding structures:

- 0.3 ¢/kWh charge on customer bills provided for in the CT General Statute §16-245m;
- Revenues received from ISO-NE for EE capacity entered into ISO-NE's Forward Capacity Market;
- Revenues resulting from the sale of Class III Renewable Energy Credits (RECs) provided for under Docket No. 05-07-19RE01 and PA 07-242; and
- Revenues from the Regional Greenhouse Gas Initiative (RGGI).

The Base Case EE plans primarily include continuation and extension of the EDCs' current programs. The Base funding is estimated at approximately $101 million in the EDCs 2012 C&LM plans. The EDCs' 2012 C&LM plans include the following residential programs:[1]

1. *Home Energy Solutions (HES)*: The HES Program began in 2006 as a residential duct sealing pilot. Since that time, it has grown to a multi-million dollar retrofit program with 26 vendors delivering "core services" to customers throughout Connecticut. In 2011, the limited income program (HES Income Eligible, or HES-IE) was merged under the existing HES umbrella, allowing the Electric Distribution Companies to market a single program to all eligible customers. In the HES program, an authorized contractor performs an energy assessment, makes on-the-spot improvements, and depending on the customer's eligibility, provides exclusive money saving rebates on appliances, HVAC (heating, ventilation, and air conditioning) systems and insulation. A fee is collected from the customer at the time of the service for the non-limited income portion of HES.

2. *Retail Product Programs*: This program consists mainly of offering customers discounted compact fluorescent light bulbs (CFL). Although many residential customers are transitioning to the CFLs naturally over time, a 2009 survey administered by the Energy Efficiency Fund revealed that the CFL saturation was only 23% in Connecticut. The Energy Independence and Security Act ("EISA") of 2007 may phase out certain standard-use incandescent bulbs beginning in 2012, but it is not expected that CFLs will replace all traditional incandescent bulbs. Some manufacturers have already produced EISA-compliant halogen products, which are more efficient than incandescent bulbs but are substantially less efficient than CFLs. For that reason, the EDCs will continue CFL programs beyond the EISA deadline. In 2011, the EDCs began to offer upstream incentives for light-emitting diodes (LEDs) for a small number of retailers. In 2012, the EDCs plan to increase the number of LEDs under negotiated cooperative promotions to educate customers on the benefits and availability of LEDs at numerous retailer outlets across the State.

3. *Residential New Construction Program*: This program will phase in new ENERGY STAR version 3.0 requirements. The new requirements include additional thermal enclosure systems, thermal bridging criteria and water management systems, and HVAC design and testing requirements. The CT Zero Energy Initiative will continue and become an integral part of the program through the addition of a new incentive track called "Low Load Homes."

The EDCs' 2012 C&LM plans include the following commercial and industrial (C&I) programs:[2]

1. *Energy Conscious Blueprint/Lost Opportunity Program*: This program serves the new construction and equipment-replacement markets. The term "lost opportunity" refers to

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[1] 2012 C&LM Plan (link below):

http://www.dpuc.state.ct.us/DEEPEnergy.nsf/c6c6d525f7cdd1168525797d0047c5bf/2fa1f8d01cfc0cc785257981007276d4/$FILE/2012%20CLM%20Electric%20and%20Gas%20Plan%20FINAL.pdf

[2] *Ibid.*

the situation where energy savings opportunities beyond those implied by the existing codes and standards would be lost without intervention. To address this sub-optimal level of energy efficiency enhancements, the Energy Conscious Blueprint offers comprehensive programs for new construction.

2. *Energy Opportunities Program*: This program is based on implementing a comprehensive initiative that encourages program participants and contractors to look beyond the "low-hanging fruit" to achieve deeper savings in existing commercial, industrial, and municipal facilities. The program offers incentives, financing, and other resources to replace existing, inefficient equipment with energy-saving options. They are mainly focused on higher performance lighting technologies and targeted efforts to eliminate older fluorescent lighting technologies from customer facilities.

3. *Small Business Energy Advantage (SBEA) Program*: This program provides cost-effective, turnkey energy efficiency services for small business customers. These services typically include energy assessments and installation of measures, and are provided by a network of approved contractors. The Electric Distribution Companies pay incentives for relevant energy efficiency measures within cost-effectiveness constraints and offer an interest-free financing option to credit-qualifying customers for the balance. The financed contract amount appears as a line item on the customer's electric bill.

4. *Business and Sustainability Challenge*: This program is designed to capture energy savings through information-based behavioral change and capital investments by customers. It will use various forms of energy use feedback mechanisms such as energy dashboard tools to show the end-user how much energy they have used compared to another point in time. With this knowledge, customers are expected to make more informed decisions on how to maintain equipment and system performance on an ongoing basis.

Base Case Savings and Budgets

The Base Case EE programs are expected to yield roughly 200 GWh of annual savings per year (0.6% of the gross CT load in 2012) in the 2012 and 2022 time frames. As a result of continuous implementation of the Base Case EE programs over the study period, the cumulative annual energy savings (starting in 2012) are expected to reach 2,277 GWh in 2022. These energy efficiency programs are also expected to yield approximately 30 MW of annual capacity savings, with cumulative annual capacity savings reaching 309 MW in 2022. These cumulative annual savings result from adding new measures to the program mix every year. It is estimated that the annual program cost of implementing the Base Case EE programs is approximately $101 million per year. Figure 1 presents the Base Case EE Program savings and budget.

Figure 1

Summary of Base Case EE Program Savings and Costs

		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
New Energy Savings	*(GWh)*	235	224	218	213	209	205	201	195	194	192	190
Cumulative Annual Energy Savings	*(GWh)*	235	459	678	891	1,101	1,305	1,506	1,701	1,895	2,087	2,277
New Capacity Savings	*(MW)*	30	29	29	29	28	28	28	27	27	27	27
Cumulative Annual Capacity Savings	*(MW)*	30	60	89	117	145	173	201	228	255	282	309
Annual Budget	*($Mil)*	101	99	99	99	99	99	99	100	100	100	100

This IRP does not quantify the benefits of the Base Case EE scenario. It only quantifies the incremental costs and benefits of the Expanded EE scenario relative to the Base Case.

Relationship to ISO New England's Load Forecasts

We reviewed how ISO New England's 2011 peak and energy forecast methodology accounts for past and future impacts of EE programs. As a result of our methodology review, we decided to use the ISO's energy and peak forecasts *net of passive demand resources cleared through* the forward capacity auction for the 2014/15 delivery year (FCA5) without additional adjustments for potential future energy efficiency. The details of our methodology review are discussed in Appendix B (Resource Adequacy).

This approach recognizes that ISO's "gross" forecast already partially accounts for the effects of future energy efficiency on the future load growth rate. As explained in Appendix B (Resource Adequacy), the load forecast is based on regression analysis, with much of the historical regression data reflecting metered loads net of energy efficiency. Thus, to the extent that historical efficiency programs tempered historical growth rates, these tempered growth rates are partially projected forward, implicitly assuming similar programs will continue to improve the energy efficiency of the economy. Deducting *all* future energy efficiency would partially double-count the effects of energy efficiency and thus understate future metered load. This IRP therefore does not count all future energy efficiency against ISO-NE's load forecast. Whereas we fully deduct energy efficiency cleared through 2014/15 and beyond, we do not further increase the deduction for additional energy efficiency that might be implemented after 2014/15. This approach is reasonable given the incomplete data on how historical energy efficiency tempered electricity growth rates (and hence the forward-looking rate that is essentially extrapolated from the past) and incomplete data on future energy efficiency throughout New England. This approach would likely achieve approximately the right effect of energy efficiency in the long-run, and any errors are likely to be within the larger errors inherent in load forecasting during these economically uncertain times.

Recognizing the uncertainties in future load levels, this IRP includes an analysis of alternative futures in which, among other factors, the load is higher (in the "Tight Supply" future) or lower (in the "Abundant Supply" future). In addition, even if there were a slight bias in the load forecast, it would not substantially affect the evaluation and benefits of the Expanded EE Resource scenario within each Future. The Expanded EE Scenario is defined precisely relative to the Base Case, such that each incremental unit of program savings beyond the EE Base Case reduces the load forecast by one unit.

EXPANDED EE RESOURCE SCENARIO

The Expanded EE scenario is based on the 2010 *Potential Study* sponsored by the Connecticut Energy Efficiency Board (EEB) and conducted by KEMA Consulting, with input from the EEB members and the Electric Distribution Companies. The *Potential Study* estimates the cumulative annual savings that could be achieved after ten years of implementation, as compared to a baseline in which customers will install only measures with minimum energy efficiency ratings.

The *Potential Study* employs a bottom-up approach in which hundreds of measures from different sectors are evaluated for their energy efficiency savings potential. A full list of the energy efficiency measures and programs and their contributions to the Program Achievable Potential savings, and hence to this IRP's Expanded EE scenario savings, can be found in the *Potential Study* Appendices.

The study starts with developing a *technical potential* based on a detailed bottom-up analysis of hundreds of individual measures in each sector. The technical potential represents the savings that would result if all customers adopted the most efficient measures regardless of their cost. After the technical potential is calculated, the study calculates an *Initial Economic Potential* that includes only those measures with lifetime benefits exceeding costs. Each measure's cost includes not only the incremental cost of equipment, but also the installation cost, except for retrofits that would have similarly occurred in the baseline (but with less efficient equipment). Benefits are based on the "Avoided Cost Study" by Synapse in 2007. Avoided costs include avoided energy and capacity costs, avoided transmission and distribution costs, energy and capacity DRIPE (demand response induced price effect), renewable energy credits (RECs) and avoided environmental externalities.[3]

The Initial Economic Potential is then adjusted upward by 10% to reflect the impact of emerging technologies and cost reductions over the study period, yielding a *Total Economic Potential*. Next, the *Total Achievable Potential* is calculated by reducing the Total Economic Potential by 15% to account for barriers to customer adoption. It is important to note that these four potential measures include energy savings from all sources including the EDC programs, building codes, standards (the light bulb standard), and naturally occurring savings.

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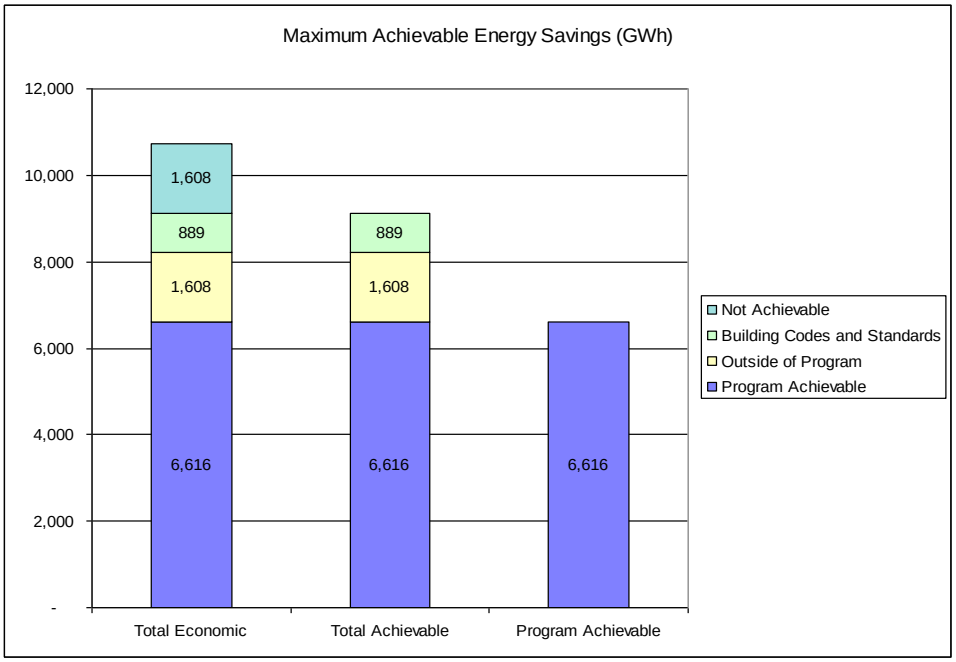
[3] After the first draft of this IRP was submitted, KEMA was asked to perform an analysis on the 2010 *Potential Study* to test the robustness of the cost-effective potential, considering changes in assumed avoided costs. They ran two different sensitivity analyses using different avoided costs to evaluate the cost effectiveness of each technically potential measure. The first sensitivity analysis used updated avoided costs that included avoided energy, capacity, transmission and distribution, renewable energy credits, DRIPE and CO_2 externality costs. The DRIPE and avoided externality costs were taken from Synapse's most recent 2011 Avoided Cost Study; avoided transmission and distribution costs were based on the EDCs' avoided T&D cost studies; and the avoided energy and capacity costs were taken from the 2012 IRP Base Case and Synapse's 2011 Avoided Cost Study. Although the updated avoided energy costs were lower than in the 2007 Avoided Cost Study, the avoided externalities, RECs, and DRIPE were higher, resulting in fairly similar total avoided costs and no significant change to the "Initial Economic Potential" described above. The second sensitivity analysis used the same avoided costs as the first sensitivity except that the DRIPE and CO_2 externality costs were assumed to be half as large. The result of this analysis showed that the updated cost-effective potential was slightly less (8% less energy savings and 17% less capacity savings) than the original potential.

Finally, the *Program Achievable Potential* is calculated by subtracting the savings due to codes and standards, and naturally occurring savings from the Total Achievable Potential, leaving only those savings that can be achieved by the EDC programs. Codes-related savings are estimated as 35% of all cost-effective new construction savings potential occurring on the Total Achievable Potential. Standards-related savings are consistent with the imminent federal lighting standards and account for 50% of economic compact fluorescent light bulb (CFL) savings occurring on the Total Achievable Potential. Finally, the naturally occurring savings refer to those savings that materialize due to market forces and free-rider savings (outside-of-program) and represent 15% of the Total Economic Potential. Figure 2 presents the relationship between the Total Economic, Total Achievable, and Program Achievable Potential.[4]

Figure 2
Relationship between Program Achievable and Total Economic Potential



In this IRP, the Expanded EE resource scenario is based on the full Program Achievable Potential of 6,616 GWh, or 600 GWh/year over 11 years (1.8% of the gross CT load in 2012).

The other alternative considered was to define the Expanded EE Scenario based on the Accelerated Funding Scenario from the Potential Study, which employs expanded program funding to achieve most of the Program Achievable Potential savings (5,910 GWh out of 6,616 GWh). This IRP defines the Expanded EE scenario based on the Program Achievable Potential because that is a fuller measure of the maximum achievable potential that can be achieved over the entire study horizon. It is a fuller measure of the potential compared to the Accelerated Funding Scenario because: (i) it is not constrained by funding availability, and (ii) it is not subject to the limitations of stock turnover and the absence of emerging technologies. Unit costs for achieving the Expanded EE scenario savings are assumed to be equal to those from the

[4] Reproduced from "Connecticut Electric Residential, Commercial, and Industrial Energy Efficiency Potential Study," April (2010), Figure 5-15. "Outside of Program" refers to naturally occurring savings.

Accelerated Funding Scenario, as the *Potential Study* did not quantify these costs for the Program Achievable Potential.

Figure 3 presents the resulting program savings and costs under the Expanded EE Scenario and compares them to the IRP Base Case Scenario savings and costs.

Figure 3
Summary of Expanded EE Program Savings and Costs

		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
SAVINGS FROM EACH YEAR'S NEW MEASURES												
Base Case	*(GWh)*	235	224	218	213	209	205	201	195	194	192	190
Expanded EE	*(GWh)*	601	601	601	601	601	601	601	601	601	601	601
Incremental	*(GWh)*	366	377	383	388	392	397	401	407	408	409	411
Base Case	*(MW)*	30	29	29	29	28	28	28	27	27	27	27
Expanded EE	*(MW)*	125	125	125	125	125	125	125	125	125	125	125
Incremental	*(MW)*	95	96	97	97	97	98	98	98	98	98	99
CUMULATIVE ANNUAL SAVINGS												
Base Case	*(GWh)*	235	459	678	891	1,101	1,305	1,506	1,701	1,895	2,087	2,277
Expanded EE	*(GWh)*	601	1,203	1,804	2,406	3,007	3,609	4,210	4,812	5,413	6,015	6,616
Incremental	***(GWh)***	**366**	**743**	**1,126**	**1,515**	**1,906**	**2,303**	**2,704**	**3,111**	**3,518**	**3,928**	**4,339**
Base Case	*(MW)*	30	60	89	117	145	173	201	228	255	282	309
Expanded EE	*(MW)*	125	251	376	502	627	753	878	1,004	1,129	1,255	1,380
Incremental	***(MW)***	**95**	**191**	**288**	**385**	**482**	**579**	**677**	**776**	**874**	**972**	**1,071**
ANNUAL BUDGET												
Base Case Budget	*($Mil)*	101	99	99	99	99	99	99	100	100	100	100
Expanded EE Budget	*($Mil)*	206	206	206	206	206	206	206	206	206	206	206
Incremental	*($Mil)*	105	107	107	107	106	106	106	106	106	106	106

It is instructive to compare these assumptions to the costs presented in recent C&LM Plans. Figure 4 below compares the resulting costs in the Expanded EE scenario to those in the 2012 CL&M plan's "Increased Savings Scenario," which achieves a similar level of annual savings. (Note: the unit costs are expressed as costs per-one-year-kWh saved to facilitate easier comparison among data sources. These costs appear approximately 12 times larger than the cost per lifetime-kWh saved, corresponding to the average measure life). As the figure shows, the unit costs are similar but slightly higher in the Expanded EE scenario[5] because the more aggressive savings go further up the cost curve. However, the unit cost increase is small because the Expanded EE scenario includes many additional measures in the C&I sector that have a lower monetary cost but considerable non-monetary cost barriers, such as encouraging energy efficient practices.

Figure 4 also compares the Expanded EE Scenario unit costs to those in the 2012 C&LM Plan's "Base Case," which basically represents the business-as-usual. This comparison highlights an important difference between the Expanded EE scenario and the C&LM Plan Base Case and Increased Savings Scenarios as we describe below.

[5] However, the cost per kW saved in the Expanded EE scenario, based on the *Potential Study*, is significantly lower than in the C&LM plan because some of the measures are more peak-focused.

Figure 4
Comparison of *Potential Study* Costs to the 2012 C&LM Plan

	2012 CL&M Plan				2010 Potential Study	
	Base Case		Increased Savings Scenario		Expanded EE	
Annual Savings (GWh)	**235**		**589**		**6,616**	
Costs	*($Mil)*	*($/1yr-kWh)*	*($Mil)*	*($/1yr-kWh)*	*($Mil)*	*($/1yr-kWh)*
Program Cost	$101	**$0.43**	$197	**$0.33**	$2,262	**$0.34**
Participant Cost	$54	**$0.23**	$167	**$0.28**	$2,118	**$0.32**
Total Cost	$155	**$0.66**	$364	**$0.62**	$4,380	**$0.66**

Notes:
1- All costs are expressed in 2012 dollars.
2- The program costs from both the 2010 *Potential Study* and the 2012 C&LM plan include all marketing and administrative costs.

The Expanded EE scenario is an ambitious scenario and a major step forward for an energy efficient future. Similar to all other ambitious initiatives, it will require substantial changes from the *status quo*. First of all, it will require shifting a substantial amount of the cost burden from program budgets to individual participants. While the C&LM Increased Savings case assumes "moderate leverage" to help the participants pay for measure costs with low-cost financing, the Expanded EE costs assumes even greater reliance on financing and other approaches to induce participants to pay a larger share of measure costs. Moreover, as discussed earlier, the Expanded EE scenario includes many additional measures in the C&I sector that have a lower monetary cost but considerable non-monetary cost barriers, such as encouraging energy efficient practices. If these efforts do not materialize and the program costs under Expanded EE remain as high as those in the first year of the Base Case ($0.43 1-yr kWh), the retail rate impacts of the Expanded EE program would be approximately 0.2 cents/kWh higher than currently assumed.

It should also be noted that the 2012 C&LM Base Case unit costs shown in Figure 4 are not representative of the remaining ten years in the IRP Base Case. Although the annual costs remain generally constant, the annual incremental savings gradually decline in the Base Case, as shown in Figure 3. This is mostly because the incremental savings attributable to the CFL-related programs decrease as the penetration of the CFLs increases over time. Thus, the Base Case unit program costs reported in Figure 4 are lower than the average unit program cost of $0.48 per 1-yr kWh saved over the entire 11 years in the IRP Base Case.

If the Expanded EE Scenario costs improvements are not attained and remain as high as in the Base Case 11-year average, at $0.48 per 1-yr kWh saved, the Expanded EE Scenario would require 0.3 cents/kWh more customer rate support than if the assumed cost improvements were attained.

Alternatively, if the full Expanded EE annual program budget ($206 million) were available and the costs per 1-yr kWh saved were the same as the Base Case 11-year average, the savings would be less than in the Expanded EE scenario: 428 GWh annual incremental energy savings (1.3% of the gross CT load in 2012) and 58 MW annual incremental capacity savings, compared to the 601 GWh and 125 MW shown in Figure 3 for the Expanded EE scenario. These annual savings would imply 4,708 GWh and 638 MW cumulative savings in 2022 (compared to 6,616 GWh and 1,380 MW in the Expanded EE scenario). Nevertheless, this lower level of capacity savings would not necessitate replacement capacity over this time period (since there are no local or regional resource adequacy needs even in the Base Case).

As mentioned above, Figure 4 expresses the unit costs from the *Potential Study* in $ per one year kWh saved. Expressing the costs in "$ per one year kWh" rather than "$ per lifetime savings" allows a more direct cost comparison between the *Potential Study* and 2012 C&LM Plan, as the Potential Study did not report the lifetime savings for the Program Achievable Potential. However, we still inferred the lifetime savings from the Potential Study by using the detailed measure data and calculated *Potential Study* costs in "$ per lifetime savings" as $0.028/life-time kWh, $0.026/life-time kWh, and $0.054/life-time kWh respectively for program, participant, and total costs. For C&LP, the Base Case costs in $ per lifetime savings are $0.043, $0.021, and $0.060 and for UI, they are $0.047, $0.027, and $0.060 respectively for program, participant, and total costs.

Future Refinements to Expanded EE Scenarios

This IRP defines the Expanded EE Scenario based on the Program Achievable Potential quantified in the Potential Study. To guide future adjustments to the long-term trajectory of energy efficiency, it would be prudent to conduct an updated potential study. Updates could include: using updated avoided costs; for each measure, gathering and applying Connecticut-specific market data to inform market size, penetration curves, costs, and achievability; identifying specific non-cost barriers and practical ways to overcome those barriers, where applicable.

POLICY APPROACHES TO REALIZING EXPANDED EE SAVINGS

Connecticut's 2007 Public Act 07-242, *An Act Concerning Electricity and Energy*, directed the State to implement "all cost-effective energy efficiency." As discussed in the main report, the analytical results of this IRP strongly support achieving all cost-effective energy efficiency. In addition to reducing total energy costs, greater energy efficiency could help reduce customer rates (especially if new energy efficiency were allowed to help meet a more flexible RPS Class I requirement, as discussed in the IRP main report). Then the question becomes what are the best policy approaches to effectively and efficiently capture the full potential? The most immediate answer is to expand the scope of the EDC programs, which may need to be partly supported by increased customer charges unless the program costs can be funded through new mechanisms such as increasing Class III requirements. In addition, there are other possible innovative approaches that may help achieve the Expanded EE savings, with less reliance on the EDC incentives. These approaches are also aimed at addressing non-monetary barriers through targeted programs, codes, standards, and information provision. Below, we discuss some of these approaches.

Expand Innovative Financing

Customer financing can help to achieve the Expanded EE savings with less reliance on incentives. Connecticut recently established an organization called the Clean Energy Finance and Investment Authority (CEFIA) that functions as a "Green Bank" aimed at providing low-cost financing for clean energy and energy efficiency projects. In this role, CEFIA will leverage public and private funds to drive investment and accelerate clean energy deployment across Connecticut,[6] by granting low interest loans to clean energy projects and energy efficiency projects.

CEFIA's activities build on existing programs. Most recently, the EDCs introduced a new residential loan program that offers subsidized, low interest rate loans to residential customers who make qualified energy efficiency improvements to their homes. This program is also one of the first nationally that offers on-bill repayment provisions. Connecticut's financing programs for the residential, commercial, and industrial sectors include the following:

1. The Energy Conservation Loan (ECL) Program and Multifamily Energy Conservation Loan (MEL) Program after financing at below-market rates to single family and multifamily residential property owners for energy efficiency investments;

2. The HES On-Bill Financing Loan Program offers subsidized, low-interest rate, unsecured loans with on-bill repayment which are provided either through utility or Energy Efficiency Fund;

3. The Small Business Energy Advantage (SBEA) and Municipal Program offers zero percent, on-bill loan repayment to small businesses and municipal customers;

4. The Small Commercial and Industrial Loan Program offers reduced interest loans through a third party financing entity; and

5. The C&I Loan Program offers low-interest subsidized financing for energy efficiency projects costing more than $1,000,000.

Utility and state loan programs are particularly important because commercial banks often show little interest in offering energy efficiency financing to small customers. Typically, commercial banks grant loans only to energy service companies (ESCOs), who manage the projects for large commercial and industrial customers. Unlike commercial banks, credit unions have demonstrated increasing interest in giving loans to small commercial and residential customers for their energy efficiency projects.[7]

With the American Reinvestment and Recovery Act (ARRA) and other stimulus initiatives, such as the Small Business Jobs Act, state and local energy authorities gained new tools to finance energy efficiency efforts. A good example is the "Qualified Energy Conservation Bond" (QECB), which allows state governments to issue bonds to finance energy efficiency projects with the federal government covering a portion of the interest.

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6 http://www.ctcleanenergy.com/CEFIA_2_Page_Brochure.pdf

7 Joel Frehling, "Energy Efficiency Finance 101: Understanding the Marketplace," *ACEEE*, August 2011.

In most states, state housing agencies have emerged as the biggest supporters of energy efficiency projects. Many agencies link low-income housing tax credit incentives to energy efficiency projects and even provide bonus incentives for projects that agree to follow Enterprise Community Partner's Green Communities guidelines.[8] Similarly, state development finance authorities have started to fund energy projects. These agencies can issue bonds and use the proceeds to finance commercial projects. As the bonds include the "moral backing" of the state, the agencies are able to borrow with lower interest rates than the projects are able to do on their own. For example, most recently, the Illinois Finance Authority has been given statutory authority to issue up to $3 billion in "moral obligation" loan guarantees and bonds for the development of energy efficiency and other clean energy project developments in the state.[9]

Accelerate Market Transformation

"Market transformation" refers to the strategic process of intervening in a market to create lasting change in standard practices by removing identified barriers or exploiting opportunities to accelerate the adoption of all cost-effective energy efficiency.[10] Market transformation can be implemented through different channels: (i) interventions that directly address identified market barriers; (ii) competitive market forces, private capital, and information sharing that drive energy efficiency gains; and (iii) collaborations between government, private sector, consumers, and other stakeholders that influence market structure and functioning.[11]

Market transformation is aimed at changing the "business-as-usual" practices to a higher state of energy efficiency. Market transformation can be accelerated through codes and standards and by social marketing strategies. The expectation is that market transformation will result in more market-based implementation of energy efficiency services and products. This is also a clear objective in the Companies' 2012 C&LM plan: "Efforts in 2012 will include an increased emphasis on programs and initiatives that promote sustainable energy management as a core consumer and business value. Ultimately, as the green market grows, programs should move from a primary dependency on public benefit charges to a more self-sustaining industry that can be supplemented, or leveraged, through Energy Efficiency Fund resources."

Induce Behavioral Change through Information

Behavioral change induced by information is one of the ways market transformation operates. As more and more customers become informed about efficient energy practices and their financial and societal benefits, more customers are expected to invest in better measures and practices without relying on incentive mechanisms. However, most customers do not have easy access to detailed information about how to save on energy costs effectively. The most direct way to address this market failure is to find innovative ways to provide information to customers.

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8 *Ibid.*

9 *Ibid.*

10 http://www.aceee.org/topics/market-transformation

11 Sabrina Birner and Eric Martinot, "Market Transformation for Energy Efficiency Products: Lessons from Programs in Developing Countries," *Energy Policy*.

Over the past few years, several private companies started to offer "behavior-based programs," mostly for residential customers. These behavior-based programs have been gaining traction with utilities and commissions recently and are mostly known for their "home energy reports." In these monthly or quarterly reports, customers are provided personalized information on energy usage in their homes; comparison to similar households in the neighborhood; and quick tips that can quickly yield energy savings. Increased awareness of energy usage and knowledge about specific energy saving opportunities enable users to act in their own financial interest. Empirical studies report that participants achieve annual energy savings in the range of one to three percent.[12] More recently, a new study found that these impacts may persist over time; however more evidence is needed to be able to conclusively claim that the impacts persist over time.[13]

Mandating additional energy efficiency information labels on manufactured products is another way of addressing the market failure in information provision. If these labels provide clear, helpful, and standardized information about the efficiency of products, customers can make on-the-spot comparisons and make more informed purchase decisions. As customers start making purchase decisions not only based on price and quality of the products, but also on the energy efficiency rating of the products, the expectation is that the inefficient products will be driven out of the market. The ultimate goal is to make manufacturers compete on the energy efficiency of their products, in addition to other attributes such as quality and price.

Finally, public outreach campaigns, curriculums in elementary, secondary and high schools, collaborations with universities and technical schools, and advertising campaigns involving local celebrities also help address the information problem and incentivize more efficient behavior.

Introduce More Aggressive Codes and Standards

An effective way of accelerating the market transformation is to introduce more aggressive codes and standards. Current codes and standards mostly dictate baseline measures that have sub-optimal levels of energy efficiency. Moreover, most building codes are not necessarily strictly enforced. Some improvement is possible through more rigorous enforcement.

However, existing codes generally address only new construction, which covers a small fraction of the building stock. Potentially much more savings could be achieved if codes were imposed on existing buildings upon change of ownership. Such codes would have to be set carefully in order not to impose prohibitively high costs on sellers of buildings that are difficult to retrofit.

A complementary policy approach would be to mandate old and new building owners to disclose energy usage and efficiency statistics of their buildings. These statistics can be standardized and may include utility bills, building envelope characteristics, and other measures that indicate the energy efficiency level of a building. It is expected that this kind of disclosure will incentivize building owners to make efficiency investments, as buyers develop an interest in higher efficiency residences and office spaces.

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[12] See for more information, *The Brattle Group*, "Measurement and Verification Principles for Behavior-Based Efficiency Programs," May 2011, prepared for OPOWER.

[13] Hunt Allcott, "Social Norms and Energy Conservation," *Journal of Public Economics*, 2011.

Explore Efficiency-Inducing Rate Structures

Rate designs can provide incentives to use energy efficiently. One such rate design, dynamic pricing, is receiving widespread consideration, especially as more and more utilities pursue investments in advanced metering infrastructure (AMI). Although dynamic pricing rates are very effective in reducing peak load, they are not likely to have a sizable impact on overall energy consumption as the higher critical peak rates are only in effect during a small number of hours. There is another type of rate design, inclining block rates, which can be effective in promoting energy efficiency. Under such a rate design, the price of electricity (at least the transmission and distribution components) rises with increasing usage. However, rather than rising uniformly with each kWh of consumption, the rate rises when the consumption exceeds a certain threshold. Under such a rate structure, customers have incentive to use energy more efficiently and realize most of their energy consumption in the first and least expensive block of usage.

Inclining block rates have several advantages in combination with other initiatives. First, it is a low-cost option as it does not require smart meters, incentive or rebate payments, or significant administrative costs. Second, it improves the economics of other energy efficiency measures. It creates a faster payback for higher efficiency equipment installations and increases the value of in-home information display technologies. Finally, it is customer-friendly and can be deployed universally.[14] Faruqui (2008) reports that the amount of load response depends on the price elasticity of energy consumption and estimates short-run load overall energy savings in the range of 0.5 to 5.9% based on Monte Carlo simulations.[15]

However, there are also some challenges involved in implementing inclining block rates. First, inclining block rates do not necessarily directly correspond to the system costs which can lead to economically inefficient behavior. Second, managing customer bill impacts will be important under the inclining block rates structure. Those customers who respond to the lower pricing incentive in the first block would reduce their monthly usage and hence their monthly bills, but customers who do not respond to inclining block rates may end up with higher bills. Before implementing an inclining block rate structure, it is advisable to determine customer segments that can be adversely affected by these rates and potentially look for ways to mitigate those adverse impacts. Finally, there are concerns to the extent that inclining block rates may discourage the adoption of plug-in electric vehicles or efficient heat pumps, but it is possible to design alternative rates such as time-of-use rates or separate metering for such customers.

The steps that must be followed in designing an effective inclining block rate structure usually involve balancing the tradeoffs among conflicting objectives such as encouraging more efficient energy consumption, more accurately representing system marginal costs, promoting social objectives, protecting vulnerable customers, and ensuring bill stability.[16]

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[14] Ahmad Faruqui, "Inclining Toward Efficiency," Public Utilities Fortnightly, August 2008.

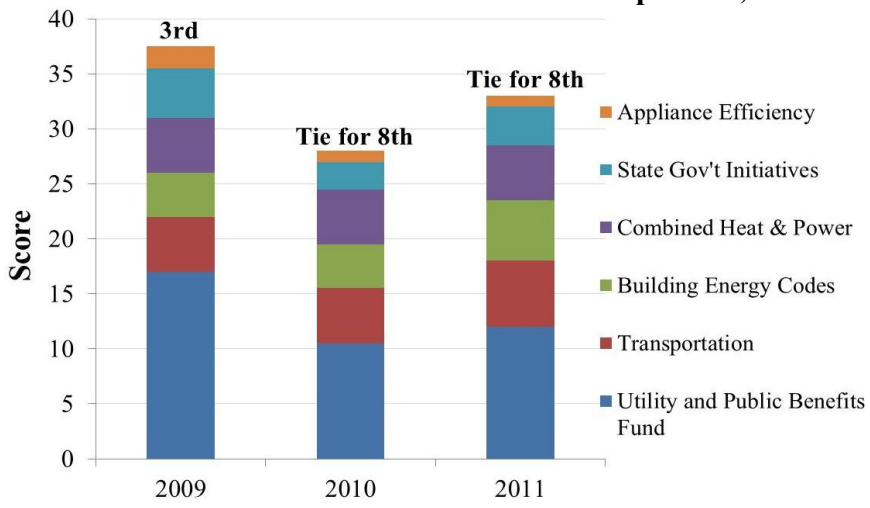
[15] *Ibid.*

[16] These steps are described in detail in Faruqui, *op. cit.*.

CONNECTICUT'S ENERGY EFFICIENCY RANKING

Connecticut's successful record in implementing energy efficiency 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. 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. From 2009 to 2010, Connecticut dropped 9.5 points in its total score, moving its ranking from 3rd to 8th. Figure 3 demonstrates the composition of Connecticut's total score for 2009-2011.

Figure 3
Connecticut's ACEEE State EE Scorecard Comparison, 2009-2011



The three categories with a net loss in performance from 2009 to 2010 are:

1. Utility and Public Benefits Fund Efficiency Programs and Policy Score (Maximum possible score is 20). It is made up of five sub-categories: (i) electricity program spending; (ii) electricity savings; (iii) gas program spending; (iv) EE targets; and (v) utility incentives/removal of disincentives. Connecticut fell in every sub-category except "gas program spending" in which it increased by 0.5 points. The total score dropped from 17 in 2009 to 10.5 in 2010.

2. State Government Initiatives Score (Maximum possible score is 7). It is made up of three sub-categories: (i) financial and information incentives; (ii) lead by example (an aggregate of building requirements and efficient fleets); (iii) RD&D. Connecticut fell in every sub-category. The total score dropped from 4.5 in 2009 to 2.5 in 2010.

3. Appliance Efficiency Score. The appliance efficiency score methodology changed between 2009 and 2010; however, the point structure remained constant (states could only receive a maximum of three points). Due to a methodology change from 2009-2010, it is difficult to draw a comparative conclusion for the appliance efficiency score.

Connecticut's EE score improved in all three categories from 2010-2011, with the exception of the Appliance Efficiency Score, which remained numerically constant. It is important to recognize that, although the ACEEE score is an important metric for progress in energy efficiency program implementation, it should be interpreted carefully as it is a relative metric. Improvement in a score may be due to other states falling behind, or reduction in a score may be due to other states improving more. Other metrics such as incremental year-over-year program savings, $/kWh cost of achieving energy savings, or whether the target savings are met may be more useful. As long as the state energy efficiency objectives are met, the changes in the ACEEE rankings may carry only secondary importance.