Challenges for Electric System Planning

Reasonable Alternatives to ISO-NE's Discounts for Uncertainty

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This paper is a report to the E4 Group on a few specific aspects of the overall planning process that ISO New England conducts on an annual basis. The views, opinions, and conclusions expressed in this paper are those of Synapse Energy Economics and do not necessarily reflect the views of any of the organizations that comprise the E4 Group.

CONTENTS

EXECUTIVE SUMMARY

From 2002 through June 2015 New England ratepayers spent approximately $7.5 billion on transmission additions and expansions. The most recent Regional System Plan Project List identifies planned additions of 210 projects with an estimated cost of $4.8 billion over the next 10 years in order to maintain continued reliable and economic operation of the system.[1] The Regional System Planning Process at ISO New England (ISO-NE) evaluates reliability needs for the region based upon a needs assessment planning process. The needs assessment is based upon various planning assumptions including load levels, generation dispatch scenarios, inter-region transfer limits, and the retirement or development of generation resources. This report focuses on the specific issue of ISO-NE's assumptions relating to the forecasting of solar photovoltaic (PV) and energy efficiency and their effect on load forecasts. The regional long-term load forecast is a critical element in determining transmission expansion. The system is evaluated against this forecast in order to determine where and when transmission upgrades may be required to ensure reliability. ISO-NE applies numerous discounts to both its energy efficiency and distributed generation forecasts to address perceived uncertainties about future state policies, tax credits and other incentives, electricity costs, and alternative resource costs. While the forecast of the regional net peak and annual energy reflects the additions of PV and energy efficiency, the uncertainty assumptions result in PV and energy efficiency forecasts that substantially understate the impact of these resources. Even when industry trends and ISO-NE data show that the steep discounts are not warranted, the ISO continues to apply them. This leads to forecasts that overstate future electric system loads. As a result, ratepayers are being asked to pay for more transmission upgrades than are needed.

This paper highlights significant discrepancies between current data and trends regarding contributions of energy efficiency and PV resources to reductions in load and ISO-NE's forecasts regarding the future contributions of these resources. Based upon analysis of actual trends in implementation of energy efficiency and PV shown by the data, the paper provides a basis for more accurate and reliable forecasts. The purpose of the paper is to highlight the impact of overly conservative "uncertainty" assumptions on system planning and provide ISO- NE and stakeholders a basis for further discussion.

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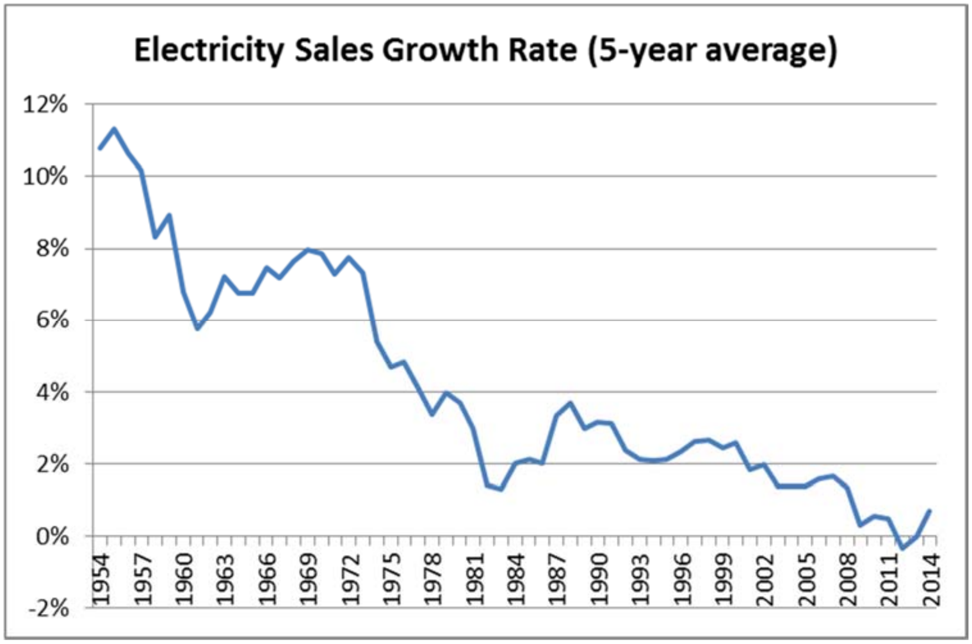
[1] ISO-NE. 2015. *June 2015 RSP Project List*. Available at: http://www.iso-ne.com/static-assets/documents/2015/06/final_rsp15_project_list_presentation_june_2015.pdf.

1. INTRODUCTION AND BACKGROUND

1.1. Introduction

Over the last several decades, the linkage between general economic growth and increasing electricity consumption from the regional bulk power grid has eroded. In some regions it has virtually disappeared due to substantial amounts of self-supplied energy provided by distributed generation and energy efficiency. New England and New York have seen electricity growth curves flatten, or even decline in some seasons, despite several years of overall economic growth. Other regions of the United States have also experienced much slower growth in annual energy consumption and peak demand. There are exceptions: areas with the most robust recent economic growth (for example, oil and gas fracking areas) are also experiencing strong growth in electricity consumption.

Figure 1. Diminishing growth in national electricity sales

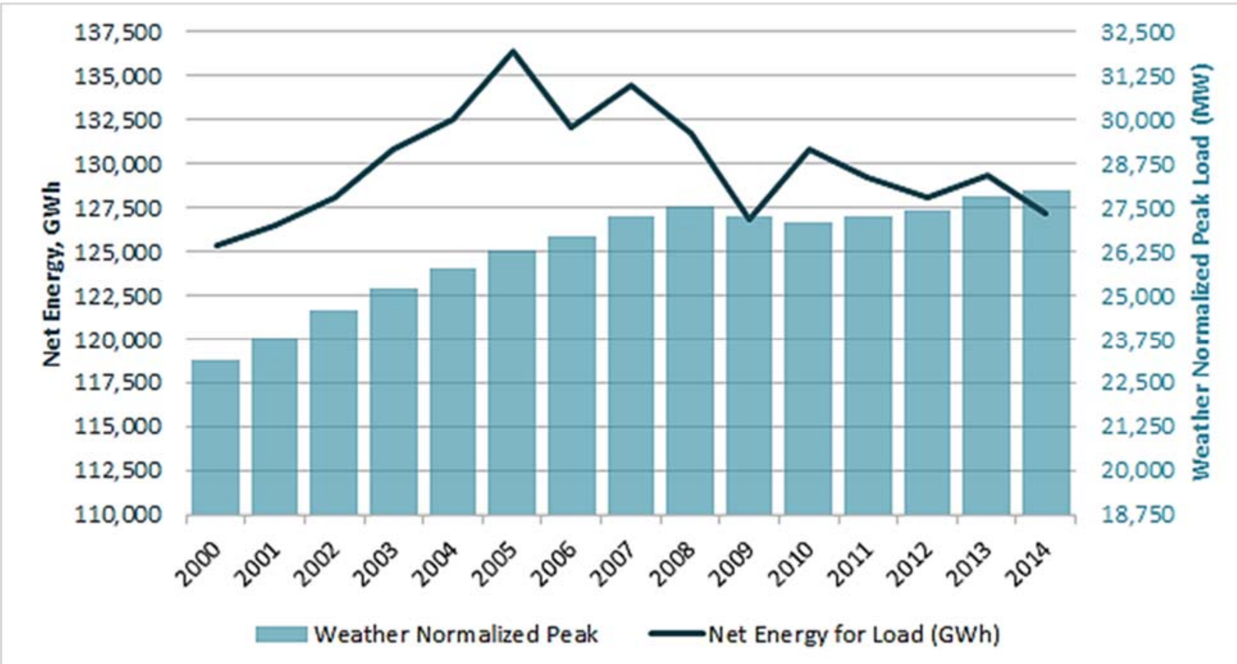


Source: Synapse Energy Economics, April 2015.

Until recently, the entire history of electric power development had demonstrated a strong linkage between many econometric factors and increases in annual electric consumption and peak loads. In other words, when the economy grew, the United States used more electricity. Figure 1 shows the rate of increase in annual electricity sales since the middle of the last century, a time of general prosperity and substantial economic growth. However, there has been a steady decline and the growth rate dropped below 2 percent at the end of the 20th century. In the 21st century, declining growth has continued on a national average, but with variations across regions. The 2008 recession sent the national average below zero, and we have not experienced the rebound in electricity sales that typically follows such recessions.

New England has experienced a flattening or declining trend of annual energy consumption and very small increases in summer peak loads. Figure 2 shows the trends in both categories: the solid line shows declining annual energy consumption (directly correlated to the electric sales in Figure 1, above) and the bars show the barely increasing peak loads.[2]

Figure 2. New England energy and peak load history



Source: Synapse Energy Economic, April 2015, developed from ISO-NE CELT reports.

In this paper, we review the ISO-NE forecast for future energy consumption and peak loads as developed through the Planning Advisory Committee process. Over the last decade, due to stakeholder requests, ISO-NE has added separate forecasts of future energy efficiency and solar photovoltaic (PV) resources. ISO-NE uses these to adjust the long-term forecasts for evaluating the ability of the New England regional electric grid to reliably serve the needs of electricity consumers.

In developing those separate forecasts, ISO-NE has made numerous assumptions about the cost-effectiveness, development, deployment, and performance of energy efficiency and solar resources, as well as state policies designed to support and encourage the development of these resources. Stakeholders participating in the development of the forecasts have described some of those

[2] The peak loads we refer to throughout this report are weather-normalized peak loads. From a planning perspective, weather-normalized peak loads provide a consistency to forecasts and a way to compare them from year to year under defined weather conditions. For example, a cool summer day with a peak load consumption of 25,000 MW may represent a higher weather-normalized load than a hot summer day with a peak load of 25,300 MW.

assumptions as overly conservative.[3] ISO-NE defends its assumptions as appropriate due to the uncertainty about future energy efficiency and distributed generation programs that could substantially impact its forecasts.

Synapse reviewed some of the disputed assumptions used by ISO-NE and explored how slightly different assumptions would affect those long-term forecasts. We then applied adjusted energy efficiency and PV forecast values to the ISO's 2015 growth forecasts. The results showed a steadily declining use of grid energy as well as declining peak loads. In this paper, we describe these results and also briefly discuss three potential factors that could accelerate these trends of declining use of grid energy.

1.2. Background

If system planning cannot provide reasonably accurate forecasts of future needs, resource solutions involving enhancements to transmission facilities and development of new power supply will likely be misapplied, and possibly squandered, to the detriment of reliable, cost-effective service to consumers.[4] In our current situation of declining energy consumption from the grid and flat peak load growth, adding traditional generation resources or building new transmission facilities may create stranded costs. In other words, consumers may be stuck footing the bill for uneconomic infrastructure they do not need.[5] The grid may benefit more from small-sized resources that start quickly and can vary their electricity output in order to supplement less flexible resources (non-battery backed wind and solar as well as base load resources). Investments that help balance load and supply resources at the distribution level may be more important than upgrades to the ISO-dispatched bulk power system.

In order to make decisions about where and what kind of facilities to develop across New England, a broad group of stakeholders must reach some general consensus about future needs. The annual planning process currently conducted by ISO-NE faces significant challenges today and in the near future to adequately address our region's needs.

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[3] The energy efficiency and PV forecasts are developed through two separate working groups managed by the ISO-NE System Planning Department. The history of the forecasts, including annual stakeholder comments and ISO-NE responses to those comments, are available on the EE Forecast Working Group and DG Forecast Working Group web pages at http://www.iso-ne.com/committees/planning.

[4] We acknowledge that forecasts will never precisely predict actual future consumption or peak loads. We examine the ISO's forecasts in regard to consistent bias or inaccuracy that can potentially be addressed through better understanding of recent data and trends.

[5] The consequences of excessive load forecasts are borne out in the case of the Maine Power Reliability Project proposed by Central Maine Power (CMP) Company in 2008. CMP used load forecasts for the 10-year period ending 2017 to justify the project. The high stress, 90/10 load forecast for 2017 in 2006 was 34,970 MW. The most recent comparable load forecast in the 2014 Regional System Plan shows peak loads of 34,195 MW by 2023, and as noted, we believe these are themselves too high. Had CMP used more reasonable load forecasts in evaluating the need for the $1.5 billion transmission upgrade, it is doubtful the project would have been built, saving all New England electricity consumers more than a billion dollars.

1.3. Topics Reviewed

In this report, we review elements of load forecasting that are essential threshold requirements for good system planning. Before ISO-NE can test the robustness and resiliency of the New England grid and all its components, it must first establish the annual energy consumption and peak load levels that the system will need to deliver. Not all aspects of load forecasting are reviewed in this paper.

In Section 2 we focus on the following specific topics:

- Assumptions about economic growth impacts on annual energy consumption and peak loads
- Assumptions about the growth of energy efficiency resources that affect the quantities of energy efficiency resources in the forecast
- Assumptions about the growth of solar PV resources that affect the quantities of distributed generation resources in the forecast

In Section 3 we modify the energy efficiency and distributed generation forecasts and then apply them to the current ISO-NE growth forecasts to show the significant difference between the ISO's assumptions and our modified assumptions. We also discuss how "uncertainty" about future trends can affect forecasts.

2. CURRENT DATA TRENDS IN NEW ENGLAND

2.1. Economic Growth and Recessions

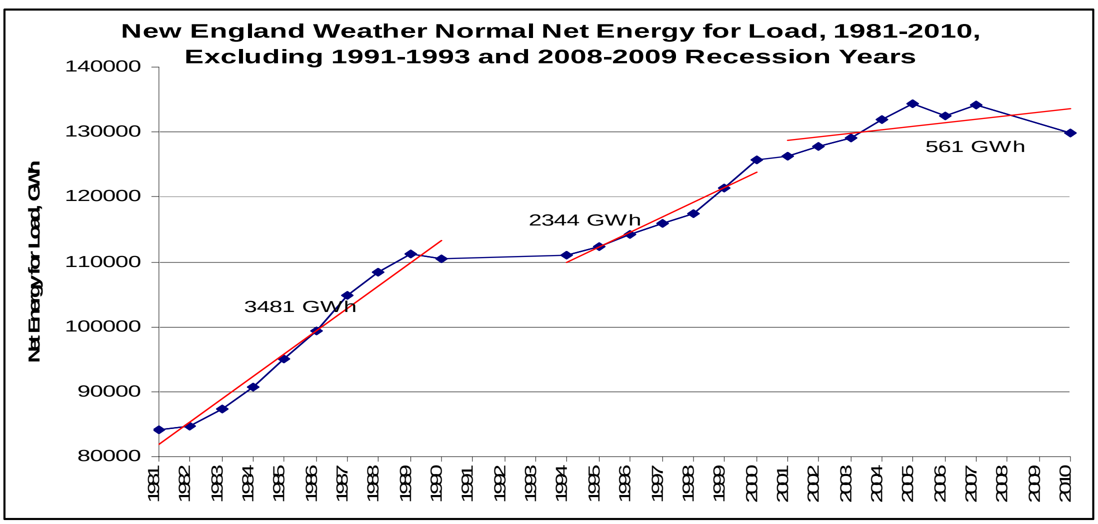
ISO-NE continues to use economic growth trends in its forecasting process despite strong evidence that indicators of economic growth are no longer accurate predictors of annual increases in energy consumption and, from a reliability perspective, peak load growth.[6] At the start of this century, there was a good linkage in New England between summer air-conditioning loads and an economic metric: personal income growth. Better than other metrics such as regional gross domestic product, household income, or home sales, personal income growth closely tracked with summer peak load growth driven by air-conditioning load. The linkage seemed reasonable: growth in personal income might be used to purchase more window units or convert window units to centralized air conditioning for the whole house, or to move to new homes with air conditioning. This improvement in summer comfort for individuals in their residences may also have spurred commercial establishments to install air conditioning.

[6] *Where has Electricity Demand Gone in PJM and What are the Implications?* Paul Sotkiewicz, PJM Chief Economist, 2014 EIA Energy Conference. Available at: http://www.eia.gov/conference/2014/pdf/presentations/sotkiewicz.pdf.

However, despite the economic growth since the 2008 recession, there has not been a corresponding increase in electricity growth.[7] Part of the explanation may be that personal income has lagged for the vast majority of consumers, other than high-income consumers.[8] Those high-income consumers that have experienced growth in personal income since 2008 are likely to already own air-conditioned homes. An additional explanation may be that low cost air conditioners have helped create a saturated market and the current turn-over in air conditioners is replacing older, less efficient units with new, higher efficiency units. Other contributing factors to this low- or no-growth trend are general energy efficiency programs and solar PV installations, both of which reduce energy consumption from the grid.

ISO-NE also neglects to incorporate future recession events into its planning process. Business cycles are well-established phenomena that occur regularly, albeit unpredictably. Whenever there is a period of economic expansion (growth), there is a period of economic contraction (recession). Electricity growth, historically, has closely paralleled these economic cycles and some try to attribute the recent trends in lower energy consumption to the recession of 2008-2009. However, Figure 3 shows that when the two most recent recessions (1991-93 and 2008-09) are removed from the data, the decline in the growth of electric energy consumption is still significant. The graph shows that from 1981 through 2010 a 10-year average annual increase of 3,481 GWh drops to 561 GWh; a reduction from 3 percent annual growth to less than 0.5 percent between 1981 and 2010.

Figure 3. Reduced annual consumption adjusted for recession years



Source: Synapse Energy Economics, 2011 analysis from ISO-NE CELT data.

[7] We are cautious suggesting a complete break in the link. Growing population (evident in the United States overall) will require more housing, more goods, and more transportation. Regional differences can be significant in terms of existing facilities and equipment for both production and consumption. The pace of new distributed generation and expanded energy efficiency programs may vary significantly across the country. However, we are confident that the near unanimous approach by the six New England states to encourage efficiency and diversity of resources will continue.

[8] Discussion and Figures 1 and 2 from Center on Budget and Policy Priorities. Available at: http://www.cbpp.org/research/poverty-and-inequality/a-guide-to-statistics-on-historical-trends-in-income-inequality.

In its forecasts, ISO-NE assumes that future recessions never occur. This assumption is defended as an appropriate conservatism because ISO-NE does not know when a recession will occur in the future. In Section 3 we discuss how uncertainty adjustments need to be applied in a balanced way to avoid compounding forecast errors as the ISO currently does.

2.2. Energy Efficiency Forecast Applied to Load Forecast

ISO-NE develops its energy efficiency forecast, initially, by reviewing verified historical savings (energy and capacity) for individual energy efficiency programs in each state and dividing them by the program dollars spent to get a "production cost" per MWh of reduced demand. The MWh for each type of program are converted to MW of peak demand based on each program's performance. For example, a commercial lighting program would have a larger peak load reduction on a summer afternoon than a residential lighting program because the residential lighting is likely to be off until evening, and these values can vary by state within the region because of geography and program design. As with the MWh, the MW of peak load reduction have a production cost too. This provides ISO-NE with a state-specific cost for acquiring energy efficiency measures in terms of both annual energy (MWh) and peak load reduction (MW).[9] By knowing or estimating future budgets, ISO-NE can make a reasonable prediction of future energy and capacity savings for each state. If there is a state-specific change in energy efficiency funding, or a significant change in the energy efficiency measures that are provided, those changes can be immediately reflected in the annual estimates.

Table 1. ISO-NE 2015 Energy Efficiency Forecast (summer peak savings)

MW Savings	ME	NH	VT	CT	RI	MA	ISO-NE
2019	15	10	15	52	22	131	**246**
2020	15	9	15	49	20	123	**231**
2021	14	9	14	47	19	115	**218**
2022	13	9	14	44	18	108	**205**
2023	13	8	13	42	17	101	**193**
2024	12	8	13	39	15	94	**181**
Total 2019-24	83	52	84	272	111	671	**1,274**

Source: Synapse Energy Economics from the ISO-NE 2015 Energy Efficiency Forecast.

[9] The production cost values used by ISO-NE are an average of the prior three years of production cost data for both MWh and MW. Details on the ISO-NE EE forecast methodology are in an annual ISO report. Available at: http://www.iso-ne.com/static-assets/documents/2015/05/eef-report-2019-2024.pdf.

The downward trend over the long term is due to specific assumptions made by ISO-NE. We look at three particular assumptions that are questionable and subject to alternate interpretations. They are:

- a budget uncertainty factor with two elements;
- annual escalation of constant dollar production costs by 5 percent; and
- annual inflation adjustment of 2.5 percent added to production costs.

Budget uncertainty

ISO-NE may apply a budget uncertainty adjustment in two ways. First, there may be an adjustment due to potential changes in state policy that could make future budgets less predictable. The second adjustment is for program administrators who are unable to spend their full budget in a year, usually due to ramping issues for specific programs.

In the 2015 Energy Efficiency Forecast, ISO-NE makes no adjustment for uncertainty due to changing state policies, but it does apply a 10 percent uncertainty factor (reduction) to the annual budgets of Maine, Massachusetts, and Rhode Island. ISO-NE explains that the reason for this reduction is that all three states did not expend their full budgets in 2014 and the ISO assumes the underspending will continue.[10]

Production costs escalate 5 percent annually

ISO-NE maintains that each year the average pre-inflation cost of implementing an energy efficiency measure increases as less cost-effective measures are installed. The ISO assumes that low-cost energy efficiency measures become saturated (few left to do) and installers must turn to less attractive, but still cost-effective, measures. Neither the data in New England nor national data on energy efficiency costs support such an across-the-board assumption.

There are documented offsets to annual costs that may balance out the installation of slightly more costly measures. They include economies of scale that may apply to specific energy efficiency programs. One example of this would be an appliance rebate program that also recycles the old appliance; as the program expands from 200 to 500 and then to 900 appliances over three years, the per-unit costs may drop significantly. There may also be volume discounts that start to apply to large-scale lighting programs that initially install thousands, then tens of thousands of lighting fixtures. And there may be improvements to coordination with trade allies to promote and deliver the energy efficiency programs that result in annual production cost reductions rather than increases.

There are also technological improvements to the energy efficiency measures themselves that may lower the installed cost of savings. Improvements in appliance technology (motors, insulation, controllers, lighting, etc.) have led to steady reductions in the energy needed for the appliance to

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[10] ISO-NE EE Forecast Working Group presentation, slide 14, Available at: http://www.iso-ne.com/static-assets/documents/2015/04/iso_ne_final_2015_ee_forecast_2019_2024.pdf.

perform the service, while the costs of the appliances have remained stable. In addition, the use of new products and technologies in energy efficiency programs can produce annual reductions in costs as manufacturing processes are improved. This has been especially true in lighting programs as new lamp technologies and products have become widespread and production costs have fallen.

Changes in program design can also counteract the ISO's assumptions. In recent years some program administrators have moved their incentive payments "upstream" so that they are paid to new building contractors directly rather than to the end-use customer. These arrangements with industry experts have dramatically dropped the overall costs of certain measures.

Annual inflation adjustments of 2.5 percent

ISO-NE applies an annual inflation rate adjustment to the cost side of the energy efficiency programs; it is added to the production cost in addition to the initial 5 percent annual adjustment. ISO-NE assumes that annual program budgets are fixed. For states that have periodic renewals, ISO-NE assumes that appropriations to fund the energy efficiency programs will be constant with no increases for inflation. Since the standard for program activity in most New England states is "all cost-effective energy efficiency", the ISO's one-sided treatment of inflation (only on the production cost side) seems questionable. The point ISO-NE is making is that it believes inflation will make the overall cost of energy efficiency measures 2.5 percent more expensive each year and that program budgets will not increase; therefore, fewer energy efficiency measures will be installed.

It is interesting to note that ISO-NE treats each of its three adjustments as separate and independent of each other. The ISO does not see the inconsistency of assuming that annual program budgets will not be fully expended (as the 2015 forecast does for Massachusetts, Rhode Island, and Maine) and then also assuming that a cumulative annual 7.5 percent increase in production costs for those same states will exhaust the budget. From a logic perspective, ISO-NE cannot make both assumptions for the same state: namely, it should not assume the state cannot spend its full budget and simultaneously assume the state will run out of budget to implement programs.

Forecasted versus cleared energy efficiency resources

The ISO-NE energy efficiency forecasts show annual MW savings roughly consistent with the quantities of qualified capacity that clear the annual auction for the Forward Capacity Market (FCM). Table 2, below, shows the annual forecast quantities and the annual FCM-qualified energy efficiency capacity for the same years. The table shows the consistent downward bias of the ISO-NE energy efficiency forecasts over time (energy efficiency resources continually decline each year of the forecast, see Table 1 on page 7). The quantities of energy efficiency resources that clear and take on capacity supply obligations in the annual auctions are on an increasing trend, not a declining trend. This is a major flaw in the forecast methodology that ISO-NE has neither raised in the stakeholder process nor, to our knowledge, tried to address.

Table 2. Forecasted energy efficiency versus FCM cleared energy efficiency

ISO-NE MW	2015	2016	2017	2018
2012 forecast	249	233	218	205
2013 forecast		231	218	204
2014 initial			245	230
2014 forecast				239
FCM Cleared	**246**	**243**	**320**	**276**

Source: Synapse Energy Economics from ISO-NE EEFWG and FCM data.

The discrepancy between forecasted energy efficiency and installed energy efficiency quantities is actually larger than the amounts shown in the table. That is because the energy efficiency resources that clear in the auctions are a subset of a larger quantity of energy efficiency resources that are qualified by ISO-NE to participate in the auction. Energy efficiency program administrators often clear slightly lower amounts than the total qualified amount as a way to protect against under-achievement of their anticipated measure installation rates. Remember, the energy efficiency program administrators are estimating the quantity of energy efficiency measure they will install four years into the future when they submit their qualification packages. There are also changes to the cleared amounts that reflect decisions to pro-rate the quantity of cleared megawatts (this occurred during the first seven auctions that had floor prices with mandatory pro-ration based on either MW or price) or to de-list quantities of energy efficiency resources.[11] For planning purposes, ISO-NE uses the larger set of qualified energy efficiency resources when it makes reductions to its forecasted peak loads and annual energy consumption.[12] This means that the gap between forecasted quantities and installed quantities (quantities that reduce loads) is even greater than the gap in Table 2, above.

In Section 3 we adjust the ISO-NE energy efficiency forecast to better represent the actual trends in energy efficiency implementation shown by the data, rather than the overly conservative assumptions applied by ISO-NE.

2.3. Distributed Generation Forecast Applied to Load Forecast

The first ISO-NE forecast for distributed generation resources focused on PV resources due to the recent rapid increase in installations throughout New England. Distributed generation resources such as combined heat and power installations, other self-generation choices, and storage are not considered prevalent enough to warrant collecting data on locations and size.

[11] ISO-NE. 2014. *2014 Regional System Plan.* Table 4-4, p. 59. Available at: http://www.iso-ne.com/static-assets/documents/2014/11/rsp14_110614_final_read_only.docx.

[12] The ISO describes the difference between qualified and cleared energy efficiency resources in a presentation to the EE Forecast Working Group from April 2014 (slides 34-37). It is available at http://www.iso-ne.com/static-assets/documents/committees/comm_wkgrps/othr/enrgy_effncy_frcst/2014frcst/iso_ne_final_2014_ee_forecast_2018_2023.pdf.

In spring 2014, ISO-NE developed a methodology to estimate future PV installations from current data trends and state policies. For spring 2015, ISO-NE produced its first PV forecast for use in its planning processes. Five New England states have announced specific PV installation goals by a certain future date.[13] For its forecast, ISO-NE includes those nominal state goals but then discounts them starting with a 5 percent discount for 2015, increasing to 25 percent by 2019 and holding steady thereafter. Table 3, below, shows the discount factors used in 2014 and the changed (lower) discounts for 2015.

Table 3. ISO-NE discounts to state policy goals

	Thru 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
2014	0%	5%	10%	35%	40%	45%	50%	50%	50%	50%	50%
2015	0%	5%	5%	15%	20%	25%	25%	25%	25%	25%	25%

Source: DGFWG, Final 2015 PV Forecast, April 14, 2015.

ISO-NE applies an additional discount to years that are beyond a specific state policy. The ISO starts with the nominal quantity of PV in the last year of the policy and then discounts that amount by 50 percent for all future years in the forecast. The 50 percent adjustment is a change from the 2014 methodology when the adjustment was 75 percent of the last policy year amount.

ISO-NE defends the two types of discounting as a conservative approach for a new resource type that is dependent on public policy mandates for successful achievement of the PV targets. Nonetheless, the discounting creates a substantial reduction to the estimates of future PV installations. For example, if Massachusetts policy goals ended in 2020 and the nominal quantity was 100 MW for that last policy year, ISO-NE would forecast a 25 percent reduction to the 2020 goal (75 MW instead of 100 MW) and then a 50 percent reduction for 2021 and future years (50 MW instead of 100 MW). [14]

Table 4 shows that the ISO is forecasting that PV solar resources will be diminishing in future years and that new installations will become insignificant after 10 years. Such a forecast is contrary to numerous other studies that show an escalation of PV installations over time as PV module costs continue to decline and battery storage becomes more cost-effective. It is also contrary to the stated purpose behind state policies that provide discounts and tax breaks for PV installation: the policy is intended as a bridge to a future time when PV is cost-effective for small users (residential and commercial customers). There are numerous reports that anticipate that over a 10-year horizon, PV installations will become the norm for all new buildings and the installation rate on existing structures will escalate.[15]

[13] Maine is the one state that has not set a specific goal.

[14] Details on the ISO-NE PV forecast methodology are in an ISO presentation to the DGFWG on April 14, 2015. Available at: http://www.iso-ne.com/static-assets/documents/2015/05/final_2015_pv_forecast.pdf

[15] One of the more recent reports was from the Rocky Mountain institute, *The Economics of Load Defection, April 2015.* We discuss the RMI report in Section 3.3, below. Synapse Energy Economics has also done studies for clients that look at future scenarios with substantial quantities of cost-effective PV solar that are available on our website www.synapse-energy.com.

Table 4. ISO-NE 2015 PV Forecast

	Thru 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
CT	119	71	90	46	43	40	40	27	27	27	27	**557**
MA	667	197	230	51	48	45	45	30	30	30	30	**1,405**
ME	10	2	2	2	2	2	2	2	2	2	2	**29**
NH	13	4	4	4	4	3	3	2	2	2	2	**44**
RI	18	10	20	27	31	29	21	7	5	5	5	**179**
VT	82	40	40	22	14	6	6	6	6	6	4	**235**
Regional - Annual MW	**909**	**324**	**387**	**152**	**142**	**126**	**118**	**75**	**73**	**73**	**71**	**2,449**
Regional - Cumulative MW	**909**	**1,233**	**1,620**	**1,772**	**1,914**	**2,040**	**2,158**	**2,233**	**2,306**	**2,378**	**2,449**	**2,449**

Source: DGFWG, Final 2015 PV Forecast, April 14, 2015.

In Section 3 we adjusted the ISO-NE distributed generation forecast to better represent the likely trend of PV installations in future years.

3. Revisions to ISO-NE Forecasts

The uncertainty assumptions that ISO-NE applies to the energy efficiency and PV forecasts have the effect of diminishing the annual quantities of energy efficiency and distributed generation resources over time. The absence of any uncertainty assumptions applied to the econometric forecasts of energy growth has the effect of expanding the estimated annual quantities of both electricity consumed and the peak loads over time. The compound effect of these assumptions creates over-stated system needs of a substantial amount. To determine roughly how large the over-stated needs are, we adjusted some of the uncertainty assumptions about the energy efficiency and distributed generation forecasts, created revised forecasts for energy efficiency and distributed generation, and then applied those revised forecasts to the ISO-NE published forecast of future peak loads and annual energy consumption from the grid.

3.1. Steady State Energy Efficiency and Distributed Generation Reductions

To determine the impact of ISO-NE's assumptions on the energy efficiency and distributed generation forecasts, we made a different set of assumptions for each forecast and applied those values to the ISO-NE 2015 Capacity, Energy, Loads, and Transmission (CELT) forecast (the same forecast analyzed in Section 2).

For the energy efficiency forecast, we held program budgets constant for inflation, reduced the production cost escalator, and assumed consistent MWh to MW conversion. These three adjustments produced the increases seen in Table 5. We do not find ISO-NE's reasoning persuasive that program budgets will never increase due to general inflation; the impact of this change is to slightly increase the energy and capacity made available from the program measures. The reduction in production cost from an annual increase of 5 percent to 1 percent better reflects the uncertainty regarding the direction of productions costs; they could be decreasing (due to program delivery efficiency and volume discounting) or increasing (due to materials costs and diminishing cost-effectiveness). The consistent MWh to MW conversion makes no assumption about whether future measures will be more or less correlated with peak loads. Table 5, below, can be compared with the ISO-NE 2015 Energy Efficiency Forecast, Table 1 on page 7.

Table 5. Adjusted 2015 energy efficiency forecast

MW Savings	ME	NH	VT	CT	RI	MA	ISO-NE
Synapse revised forecast							
2019	23	14	23	74	30	183	**347**
2020	22	14	23	74	30	181	**344**
2021	22	14	22	73	30	179	**340**
2022	22	14	22	72	29	177	**337**
2023	22	14	22	71	29	176	**333**
2024	22	14	22	71	29	174	**330**
Total 2019-24	132	84	134	435	177	1,069	**2,031**

Source: Synapse Energy Economics, May 2015.

For the PV forecast, we adopted the full quantity of PV installations necessary to meet state policy goals and we then held the last year value of the policy goal constant through the rest of the forecast years.[16] The trend over the last few years has been to increase state targets for PV and other forms of distributed generation, not reduce those targets. The ISO-NE approach of constantly reducing annual PV installations implies that new PV installations will approach zero in future years. We find that the continuing decline in PV module costs and the improvements in battery technology will support a robust solar industry at the residential and small commercial level in the long term. Some analyses show the horizon of grid parity is as few as 10 years away, with or without a continuation of state policies to promote behind-the-meter solar PV. Table 6 shows how we applied our revised assumptions to the ISO-NE PV forecast. The data in Table 6 can be compared to the ISO-NE 2015 PV Forecast, Table 4 on page 12.

[16] For Maine the PV value is based on the historical install rate (2 MW per year) of PV systems through 2014 and then held constant for all future years.

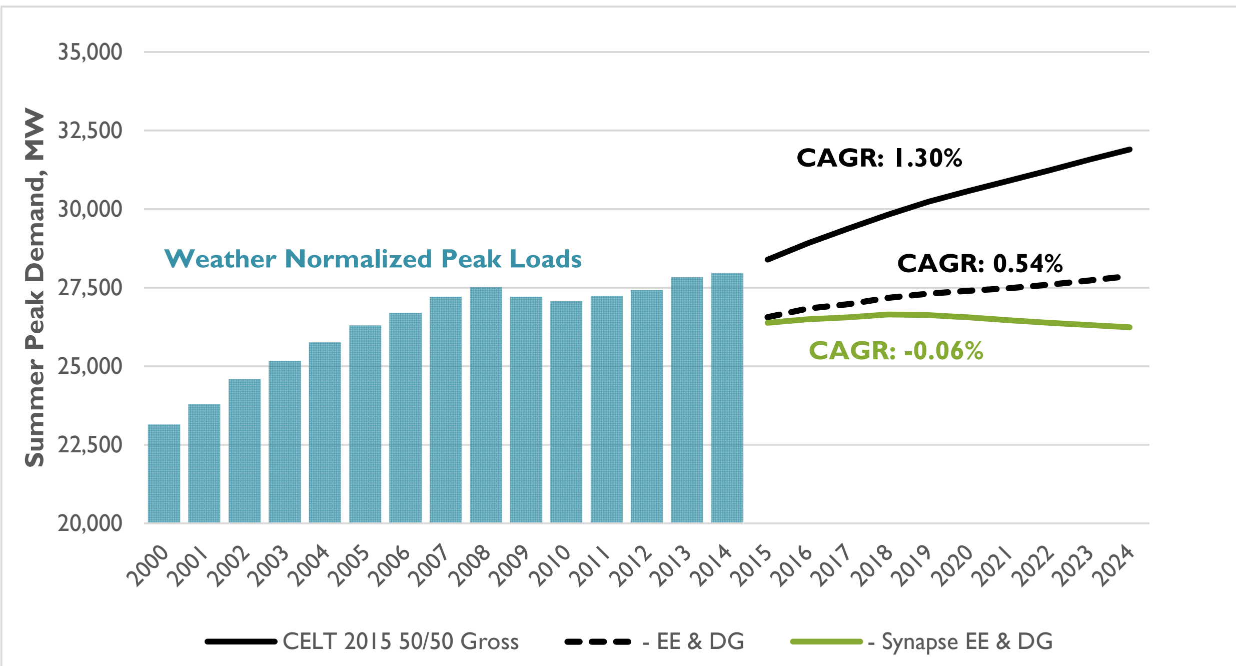
Table 6. Adjusted 2015 PV forecast

	Thru 2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	Total
CT	119	75	95	54	54	54	54	54	54	54	54	**719**
MA	667	207	242	60	61	61	61	61	61	61	61	**1,600**
ME	10	2	2	2	2	2	2	2	2	2	2	**33**
NH	13	5	5	4	5	5	5	3	3	3	3	**52**
RI	18	10	21	32	39	39	27	27	27	27	27	**297**
VT	82	43	43	43	43	43	43	43	43	43	43	**507**
Annual MW	**909**	**342**	**407**	**196**	**202**	**202**	**191**	**190**	**190**	**190**	**190**	**3,208**
Cumulative MW	**909**	**1,250**	**1,658**	**1,853**	**2,056**	**2,258**	**2,449**	**2,639**	**2,829**	**3,019**	**3,208**	**3,208**

Source: Synapse Energy Economics, May 2015.

The combined impact of our adjusted energy efficiency and distributed generation forecasts to the ISO-NE 2015 Peak Load Forecast is shown in Figure 4, below.

Figure 4. Synapse adjusted 2015 peak load forecast



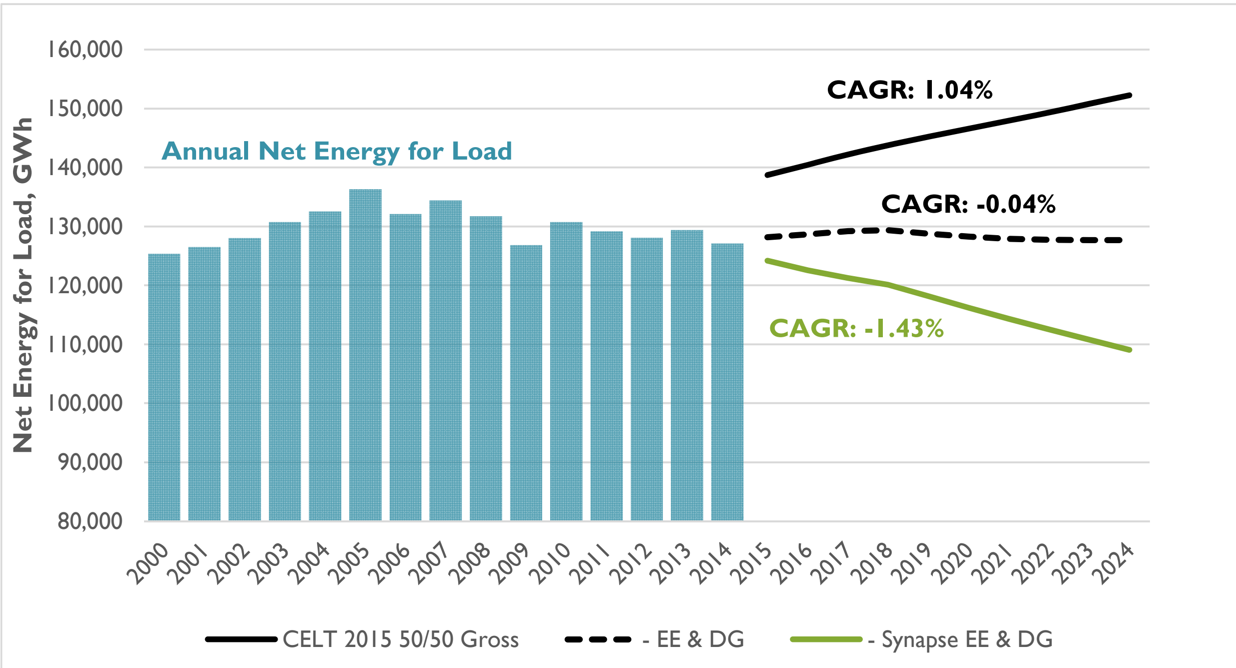
Source: Synapse Energy Economics, May 2015.

The solid dark line at the top is the ISO Forecast without adjustments of energy efficiency and PV resources. The dashed line in the center is the ISO Forecast after reductions for the ISO forecasts of energy efficiency and PV resources. The lighter line on the bottom is the ISO Forecast adjusted by Synapse reductions for energy efficiency and PV resources.[17] For each line, we have indicated the compound average growth rate (CAGR) that determines the slope of the line.

[17] All reductions for PV resources (ISO Forecast and Synapse Adjusted Forecast) are based on using 40% of nameplate PV values as the effective load carrying capability (ELCC) of PV installations. The 40% ELCC was adopted by ISO New England for the 2015 DG Forecast based on stakeholder comments and ISO data.

Figure 5 shows the combined effect of our adjusted energy efficiency and distributed generation forecasts for annual net energy consumption. We compare the CAGR of our adjusted forecast (lower light line) with the CAGR for the ISO Forecast (dark solid line) and the ISO Forecast reduced by their estimates of energy efficiency and distributed generation resources (dashed line).

Figure 5. Synapse adjusted 2015 net energy for load forecast



Source: Synapse Energy Economics, May 2015.

One way to compare the ISO-NE CELT forecast (net of energy efficiency and distributed generation) with the modified assumptions forecast is by percentage difference in MW and MWh. Table 7 shows a percentage comparison over the 10-year forecast period.

Table 7. 2015 Forecast percentage change for MW and GWh

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Peak Demand, MW										
CELT 2015 50/50 Net	26,565	26,834	26,977	27,177	27,310	27,400	27,487	27,599	27,733	27,875
- Synapse EE & DG	26,381	26,490	26,558	26,651	26,628	26,553	26,462	26,379	26,310	26,239
- Synapse EE & DG	-1%	-1%	-2%	-2%	-2%	-3%	-4%	-4%	-5%	-6%
Net Energy for Load, GWh										
CELT 2015 50/50 Net	128,174	128,645	129,208	129,346	128,786	128,283	127,910	127,720	127,668	127,699
- Synapse EE & DG	124,182	122,587	121,271	120,132	118,185	116,234	114,334	112,530	110,796	109,083
- Synapse EE & DG	-3%	-5%	-6%	-7%	-8%	-9%	-11%	-12%	-13%	-15%

Source: Synapse Energy Economics, June 2015, from CELT 2015 and modified assumptions for energy efficiency and distributed generation.

3.2. Addressing Uncertainty

ISO-NE discounts energy efficiency and PV forecast due to “uncertainty” about future quantities of these resources. The impact of that discounting is to reduce the annual contributions of these resources at a steadily declining rate until there are no annual additions of any energy efficiency or PV resources.

ISO-NE makes no adjustments for uncertainty for economic-based forecasts such as the annual growth rates for peak loads or energy consumption from the grid. There is no attempt to address uncertainty related to future economic recessions despite their persistent occurrence over the last several decades. Economic recessions slow growth in both peak loads and annual energy consumption and sometimes (as with the 1991 and 2008 recessions) turn growth negative for a year or two. Fifty years ago, robust economic growth and associated increases in electricity consumption made the impacts of recessions insignificant. Today, however, impacts on ten-year forecasts from recessions (reductions to those forecasts) persist beyond the ten-year forecast horizon. Applying a discount to the load forecasts to address this longer-term impact may be appropriate.

The compound effect of applying uncertainty to forecasts that reduce consumption from the wholesale power grid and not applying uncertainty to forecasts that increase consumption is to make ISO-NE forecasts less useful in discussions about planning for future conditions. The ISO continues to assume that there will be system load growth in the future when all current data shows that systems loads are starting to decrease and the trend for those annual decreases is accelerating. This mistaken assumption permeates ISO-NE thinking at all levels. In a recent discussion paper on the interaction between energy and capacity markets, the ISO describes the important role of the Planning Department in determining the annual Installed Capacity Requirement and goes on to state that “[t]he ICR increases as the region’s demand for electricity increases over time.” The assumption of annual growth for grid services is repeated in the section where ISO-NE describes the renewable exemption to the offer review trigger price. [18]

Stakeholders in the region at all levels need to have confidence that ISO-NE can perform its planning function in a manner that is responsive to demonstrated changes in resource development and policy-driven objectives. Using “uncertainty” as the rationale for making substantial reductions to policy goals cannot be sustained when the data shows the uncertainty reductions to be unwarranted.

In the coming years, there will be decisions made about the retirement of existing resources, the best locations for new resources to ensure system reliability, and the integration of distributed energy resources based on current public policies and evolving economic efficiencies. Targeting infrastructure expenditures for needed cost-effective enhancements to the grid is obvious. Less obvious, but equally important, is to avoid investments in new supply resources and expanded transmission facilities that can become stranded. Resource developers and state siting regulators need to consider the wastefulness of investing in large assets with 30 to 40 year economic lives that are likely to become unnecessary in a

[18] ISO New England. 2015. “Discussion paper on New England’s capacity markets and a renewable energy future.” Pages 4 and 10.

short period of time. Investments in small scale and distributed resources, particularly those that can respond quickly to changes in system conditions (as loads and generation fluctuate), may be better suited to address the declining need for grid-delivered electricity.

3.3. Uncertainty that could Accelerate Declining Loads

There are several factors that could accelerate the current trends of declining peak load growth and annual energy consumption. While we have not done an in-depth analysis of these factors, we want to mention them for consideration as uncertainties in future planning studies. They include:

- The expansion of energy efficiency programs as a strategy for compliance with the EPA's proposed Clean Power Plan Rule. Energy efficiency is one of the building blocks that the EPA specifically identified as a potential way to comply with its proposed rule. Although the New England states may be able to meet most of the target emissions levels required by the rule with the existing Regional Greenhouse Gas Initiative (RGGI) program, the gaps (if any) may be addressed most cost-effectively through expansion of existing state energy efficiency programs. Expanding energy efficiency programs to meet Clean Power Plan requirements will have the effect of further reducing annual energy consumption and peak loads below the levels in our adjusted ISO-NE forecast.

- The addition of battery storage systems as a cost-effective component of PV installations may lead to a much faster adoption rate for PV systems than currently anticipated. The economics of PV and battery installations are improving to the point that they will likely become the first choice for new homes and businesses without any state or federal incentive programs. Batteries may also increase the adoption of other distributed technologies such as combined heat and power, wind, and thermal conversions to electricity.

- The development and purchase of electric vehicles, including plug-in hybrids, has the potential to increase energy consumption from the grid, but may also provide opportunities to better manage power flows on the grid. In some respects, electric vehicles are batteries. They can be charged during low-cost, non-peak hours and then discharge their energy to provide transportation and electricity services during high-cost hours.

The impact of battery technology, particularly on deployment of PV resources, is described in a recent paper from the Rocky Mountain Institute (RMI). The paper describes four case studies that extrapolate current electricity costs and future costs of PV with battery systems to develop a timeline of reduced electricity sales. The four study areas are in Hawaii, Texas, Kentucky, and New York. The case study on Westchester, NY is a reasonable proxy for much of New England in terms of electricity consumption, electricity costs, and solar radiation. That study showed a 20 percent reduction in residential electricity sales (displaced by PV) for 2024 and a 50 percent reduction in sales for 2030. The case study showed similar reductions for commercial customers. The sales reductions are based on the crossing of two trend lines: increasing electricity costs over time and declining costs for PV plus battery resources. The results vary from economic today (Hawaii) to economic in future years based on local electricity costs and the geographic location (sunshine). The study assumes no net metering for the PV plus battery resources, but notes that net metering policies can accelerate the trends.[19]

4. Conclusions

The New England region needs to consider the best way to adapt the traditional planning processes to address known and anticipated changes in electricity production and consumption. Our review of ISO New England load forecasts show significant discrepancies with current data and trends regarding the contributions of energy efficiency and PV resources. The ISO's forecasts significantly understate future contributions from these resources due to some poorly supported assumptions regarding current trends. The combination of understated contributions with an underlying growth forecast that is uncorrected for periodic recessions produces exaggerated forecasts of future energy consumption and peak loads.

The potential harm from these forecasts is to suggest there are needs when there may actually be none. Resource developers and state officials will focus on the wrong investments (solutions) in the wrong locations based on the ISO's over-stated forecasts. This misdirection regarding resource needs will intensify if the declines in grid-delivered energy and peak loads accelerate from today's rates. Adding thousands of megawatts of new grid-based resources to a New England electric system that uses less energy from the grid each year is an impending train wreck. To help mitigate the severity of the transition to a more distributed New England electric system, we need to start with improved forecasts from ISO New England that address current and impending changes. This will provide stakeholders in the region a better starting point for making future investments and perhaps avoid situations such as the over-building that appears to have occurred with the Maine Power Reliability Project and possibly other transmission upgrade projects in the region.

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[19] Rocky Mountain Institute. 2015. *The Economics of Load Defection.* Executive Summary.