Synapse
Energy Economics, Inc.

Forecasting Distributed Generation Resources in New England:

Distributed Generation Must Be Properly Accounted for in Regional System Planning

Prepared for the E4 Group:

Conservation Law Foundation
ENE (Environment Northeast)
GridSolar LLC
Industrial Energy Consumer Group
Maine Public Advocate
Natural Resources Council of Maine

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The E4 Group consists of the following organizations who, through engagement in the review of the Maine Power Reliability Project, realized we had a common interest in advocating for changes in electric reliability planning and policy in New England:

The **Conservation Law Foundation** is a nonprofit, member-supported public interest advocacy organization dedicated to solving environmental problems that threaten the people, communities, and natural resources of New England.

ENE (Environment Northeast) is a regional nonprofit organization incorporated in Maine that researches and advocates innovative policies that tackle our environmental challenges while promoting sustainable economies.

GridSolar, LLC is a Maine company that utilizes “non-transmission” alternatives built around smart grid tools and new clean energy technologies to solve reliability concerns and provide new sources of clean, renewable energy – all at lower total costs and with less risk than major new transmission build-outs.

The **Industrial Energy Consumer Group** is a Maine-based incorporated association of large energy consumers. The IECG participates in state, regional and federal energy regulatory proceedings, litigation, and legislative matters pertaining to the cost and supply of energy.

The **Maine Public Advocate** is an agency of the State of Maine charged with representing the ratepayers of Maine’s regulated utilities.

The **Natural Resources Council of Maine** is a nonprofit membership organization protecting, restoring, and conserving Maine's environment, now and for future generations.

1. Executive Summary

In recent years, electric system planning in New England has focused almost exclusively on improvements to the bulk transmission system. Since 2002, New England ratepayers have spent approximately $5 billion on transmission additions and expansions. These investments have eliminated virtually all congestion on the New England system, yet the Independent System Operator's (ISO) Regional System Plan for 2012 (RSP12) calls for ratepayers to spend $6 billion more on additional transmission projects over the next several years.

The ISO determines the need for transmission expansion projects in conjunction with each of the transmission and distribution utilities. One of the cornerstones for these determinations is the regional long-term load forecast—a prediction of electricity usage around the region over the next ten years. The existing bulk power system is evaluated against this forecast in order to determine where and when transmission upgrades may be required to ensure reliable system operations into the future.

The ISO's forecast of future system needs incorporates a number of factors, including economic forecasts, weather data, generator retirements, load distribution changes, historical loads, forward capacity auction results, and Federal Appliance Efficiency Standards. However, the ISO forecast does not account for the region's significant and rapidly growing distributed generation (DG) resources, especially solar PV resources. This practice results in the ISO ignoring likely transmission and reliability benefits and overestimating electricity load—with ratepayers being asked to pay for larger, more expensive transmission upgrades than are needed.

In this report, we examine the ISO's current treatment of DG resources in system planning, and its projections of new DG resources in New England by 2021. We then identify (to the best of our ability, within the scope of this study) the existing DG resources in each New England state, and the policies driving the growth of these resources. Based on this research, we provide our own preliminary projection of DG resources by state for 2021, and compare these projections to the ISO's projections for the same year. We conclude with recommendations for the ISO to improve its treatment of DG resources in system planning.

Key Findings

The key findings of this study include the following:

- The ISO forecasts that approximately 800 MW of solar PV will be installed in New England by 2021. It has not yet presented any estimates of other types of DG.
- Our research shows that significantly more DG resources—mostly solar PV—are likely to be installed by 2021. Several states have already installed more DG than the ISO estimates will be installed by 2021, and the remaining states are planning to install significantly more DG than the ISO is predicting by 2021.

- Based upon our initial review of available information, Synapse estimates the potential for as much as 2,855 MW of installed capacity from new DG resources in New England by 2021.
- Yet ISO does not account for any DG resources in its base case analysis of system needs and has resisted requests to do so. For the purposes of transmission planning, the ISO currently forecasts that zero MW of new DG will be installed by 2021.
- While existing DG resources eventually lower ISO's load forecast by lowering the historical load values on which the forecast is based, it takes years for a DG resource to be fully recognized in this manner.
- If the impacts of DG continue to be ignored in the system planning process, then reliability benefits will be overlooked, load forecasts will be overestimated, and ratepayers will end up paying for bigger, more expensive transmission upgrades than are needed.

In response to requests to incorporate DG resources into its system forecasts, the ISO has noted that there is a great deal of uncertainty associated with the amount and the location of new DG resources installed over the next ten years. ISO also has noted that the impacts of some DG resources on the transmission system are not easy to anticipate due to their intermittent operating patterns. While these are valid points, they do not lead to the conclusion that these resources should be ignored altogether for forecasting purposes. Sound forecasting practices require that the ISO use the best data available (not only for DG resources, but for anything that might impact the forecast) in order to develop forecasts that represent the future as best as possible.

The estimates that we present in this report are preliminary and will improve with further research and better reporting protocols over time. In the development of these initial estimates, we have reviewed available databases, surveyed DG program staff at the major utilities and staff at the state energy agencies, and analyzed various public policies adopted by the states to promote DG resources.

The purpose of this report is to highlight the need for a comprehensive analysis of the impacts that these DG resources will have on the electric system and to provide the ISO and stakeholders with a useful foundation for such an analysis. We recommend that the ISO establish a DG Forecast Working Group in order to develop a DG forecast that can track existing installations and project future installations. This working group should be established this summer, so that it will be able to provide the ISO with meaningful estimates of new DG resources that can be included in the 2014 Regional System Plan.

2. Treatment of DG Resources in ISO Planning

Distributed generation (DG) resources are small-scale electric generators that are connected to the distribution system, often behind a customer's meter. [1] DG resources—like solar photovoltaics (PV), micro wind turbines, small hydroelectric systems, and combined heat and power (CHP) installations—reduce a customer's demand for energy from the bulk power system and can even produce small amounts of electricity that can be fed back to the power grid to serve other consumers.[2] Solar PV resources typically have a strong coincidence with system peak demands, when electricity prices are at their highest.

These types of DG resources reduce emissions and cooling water usage, can be built quickly and in close proximity to loads, can help defer expensive transmission investments, and can put downward pressure on wholesale energy prices.[3] According to the U.S. Department of Energy, DG resources have a number of potential benefits to overall system reliability, including:

- Reduced peak load levels that must be served by the electric grid,
- Ancillary services such as reactive power and voltage support, and
- Increased resiliency against terrorist attacks or catastrophic weather events.[4]

DG resources and their potential benefits to the system are currently being ignored by the ISO in its transmission planning processes. ISO has informed the NEPOOL stakeholders that DG resources are too small, too uncertain, and too difficult to model for the ISO to include them in planning. These are the same arguments that the ISO used with regard to energy efficiency when stakeholders began urging the ISO to include the impacts of energy efficiency in planning more than six years ago.

Background: Energy Efficiency in ISO Planning

Until recently, the ISO's forecast of future energy needs did not account for the long-term, load-reducing impacts of energy efficiency measures. In 2012, following many years of study and stakeholder prodding, the ISO developed a methodology that estimates the reduction in energy and demand that is anticipated over the next ten years

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[1] Our focus in this report is mainly on small-scale, interconnected DG, and primarily solar PV, since this is currently the most rapidly growing type of DG. We note, however, that there are also potentially hundreds of MWs of back-up or standby generation as well as existing CHP generators that would also be considered distributed generation resources. We do not include these resources in this report.

[2] Certain DG resources are installed and/or operated in a way that does not allow for the feedback of electricity to the grid. In these cases, the amount of capacity the DG resources are capable of providing is not their name-plate rating, but rather the interconnected load they are installed to serve.

[3] *See* ISO Presentation "Effects of Increased Penetration of PV in New England," April 10, 2013.

[4] "The Potential Benefits of Distributed Generation and Rate-Related Issues That May Impede Their Expansion." U.S. Department of Energy. February 2007.

from state-regulated energy efficiency programs, and began incorporating this estimate into its system planning process.

Since this practice was implemented, forecasted annual energy use in New England has become almost flat, and summer peak loads have been reduced significantly.[5] The energy efficiency forecast is also being used in system planning studies, and has already led to reduced costs for ratepayers from deferred and/or avoided transmission projects.[6]

The energy efficiency forecast helps assure the states that their substantial investments in energy efficiency measures are being recognized as providing benefits to the electric system. The new energy efficiency forecast also better aligns the ISO's assumptions about future load levels with the reality of reduced load growth across the region.

Just like energy efficiency, DG projects have real impacts on the system. And just like energy efficiency, the states are investing significantly in DG resources, especially solar PV, but the system benefits of these investments are not being fully realized. As it does for energy efficiency, the ISO should include a forecast of future DG installations in its system planning.

DG Data and Participation in Wholesale Markets

For some time, stakeholders have been encouraging the ISO to determine how the addition of hundreds of megawatts of policy-driven DG resources will impact system planning. Most DG resources do not participate in our wholesale markets, and individual DG projects are usually very small and therefore unlikely to have any noticeable impact on the system by themselves. Until recently, the ISO has paid very little attention to these resources. While it is likely that any electricity generator capable of producing greater than 5 MW would participate in the region's energy market, most DG resources are smaller than 5 MW, and the costs associated with qualifying for and participating in ISO markets do not make sense for such small resources. Furthermore, not all owners of small DG resources are registered in the NEPOOL GIS[7] system, preferring instead to simply count the generation against their own electric usage.

Utilities or project sponsors seeking to interconnect DG resources greater than 1 MW but less than 5 MW are required to submit a "Generator Notification Form for Units or Changes of Less Than 5 MW" to the ISO, although in our research we have learned that many of these resources are not being reported in compliance with this requirement. Any database the ISO has developed from these Generator Notification Forms should be treated as incomplete. Starting in April 2013, the ISO began requiring that all new DG

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[5] *See* ISO's Final 2013 Energy Efficiency Forecast: 2016-2022, Planning Advisory Committee, March 21, 2013.

[6] See ISO's Follow Up Analysis to the New Hampshire/Vermont Solutions Study, Planning Advisory Committee, March 15, 2012.

[7] The NEPOOL GIS tracks and reports each MWh of energy generated or conserved by certain qualified resources, including distributed generation, and issues certificates that can be used to satisfy renewable energy requirements.

resources interconnecting to the grid, regardless of size, be reported.[8] However, as with the current 1 to 5 MW requirement, there is not a mechanism to ensure compliance from the distribution utilities doing the interconnections.

Going forward, if DG resources are reported in compliance with this new notification requirement, the ISO should have a much more complete picture of what is being installed across New England. Today, however, unless a DG resource clears in the forward capacity market (FCM) and receives a capacity supply obligation (CSO), its impacts are only accounted for as a load reduction that becomes embedded in the historic load values used to develop ISO's 10-year load forecasts. This impact would take several years to be fully recognized. In RSP12, the ISO noted that only a very small fraction of the estimated installed PV participates in the ISO energy market.[9] FCM-committed PV resources are the only PV resources that the ISO currently includes in its base case planning studies.

3. ISO's Projection of DG Growth in New England

Solar PV is the fastest growing DG resource type in the region, with over 340 MW in service and nearly 1,000 MW of proposed projects in various utility interconnection queues with the potential for development. The ISO recently acknowledged the significant growth of solar PV installations in New England, and in RSP12, the ISO committed to "monitor" the development of these resources going forward.

Recognition of PV Growth in RSP12

In RSP12, the ISO predicts: "As the New England states reach hundreds of megawatts of installed solar capacity, solar PV will begin to have a measurable impact on the power system load and operation."[10]

The figure below is from RSP12, and shows a reliable proxy estimate of the rapid increase in energy generated from PV resources in New England over the past several years. Note that this estimate understates the actual energy contributions from PV resources.[11]

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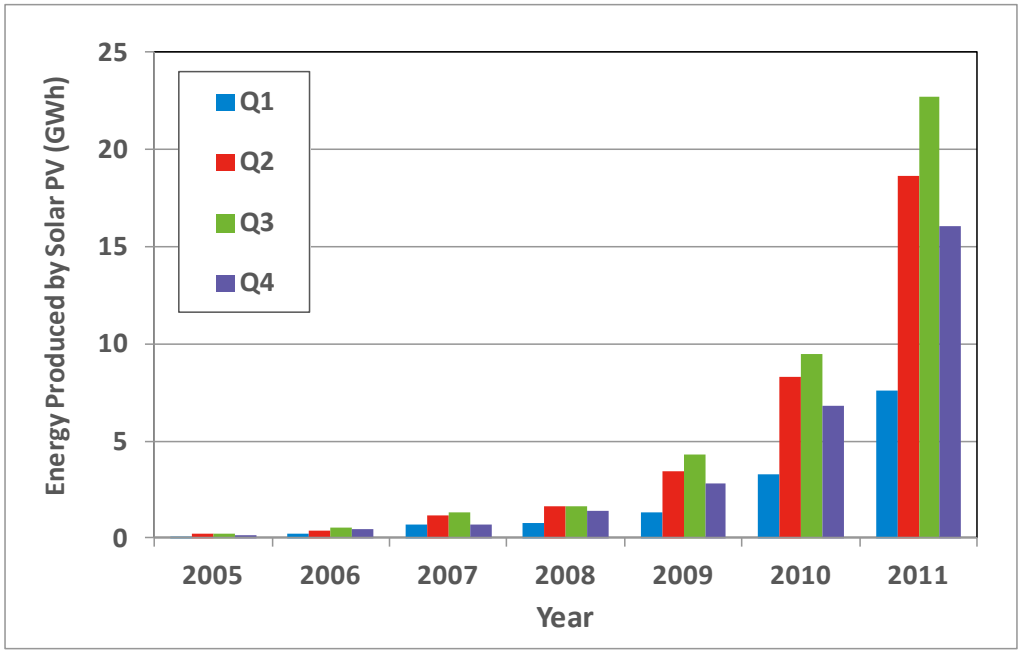
[8] Consent Agenda Item 5 (Revisions to Planning Procedure 5.1) as approved by the NEPOOL Participants Committee on April 5, 2013.

[9] 2012 Regional System Plan, p. 148.

[10] *See* Regional System Plan 2012 at 75.

[11] The Generation Information System (GIS) database may not include energy from all of the interconnected solar panels in New England and it does not include any contributions from unconnected (off-grid) solar systems.

Figure 1. Solar PV Energy Generated in New England from NEPOOL GIS data.



Source: ISO New England Regional System Plan 2012.

ISO's Projection of PV Growth

In presentations to the Planning Advisory Committee on May 16, 2012 and January 16, 2013, the ISO provided preliminary estimates of how much solar PV is currently installed in New England, and how much is anticipated over the next 10 years.[12] The following table presents the ISO's most recent estimates and its assumptions for solar PV growth in New England out to 2021.

While this is an improvement to ISO's past efforts, it still represents an incomplete picture of New England's DG resources. Our analysis shows that the growth in PV and other DG resources will actually exceed these ISO estimates by a great deal. (See section 4 of this report.)

Despite its own PV forecast (shown in Table 1, below), the ISO does not include any of these forecasted amounts of new DG resources in its base case analysis of system needs and has resisted requests to do so. The ISO assumes that zero MW of new DG will be installed in future years for the purposes of transmission planning.

[12] *See* ISO Presentation, "Update on Solar Photovoltaics and Other Distributed Generation," January 16, 2013.

Table 1. ISO's Preliminary Estimates of Regional PV by 2021.

State	Capacity Installed - end of 2011 (MW)	Total Estimated Installed PV by end of 2021 (MW)	Assumptions/Notes
Connecticut	31.1	300	Based on estimated growth of in-state PV resources summarized in CT's Draft Integrated Resource Plan, January 2012 (see Appendix D).
Massachusetts	74.6	430	Assumes Solar Carve-Out is achieved, and includes 30 MW of PV installed that is not counted towards carve-out.
Maine	1.1	5	Assumes statewide average annual growth rate is < 0.5 MW/yr.
New Hampshire	3.1	10	NH Class II RPS drives growth of approximately 25 MW in region; some is built in VT as part of VT SPEED and may also sell its RECs as part of NH Class II. Assumes statewide average annual growth is < 1 MW/yr.
Rhode Island	1.2	25	Assumes 24 MW of distributed generation contracts will be solar, and no growth in PV after 2014 contracts are satisfied.
Vermont	11.7	30	Assumes no growth in PV after goal of 2009 Standard Offer Program is satisfied. Does not consider future funding or RPS drivers for additional distributed generation that would include PV.
REGIONAL TOTAL	**122.8**	**800**	

Source: Adapted from presentations by ISO, May 16, 2012 and January 16, 2013.

DG resources continue to grow rapidly in New England and will have real impacts on key elements of system planning. While it is true that much uncertainty remains regarding the amount and impacts of DG resources in New England, this does not mean that ISO should assume these impacts to be "zero." Sound forecasting practices dictate that the ISO use the best data available regarding DG resources in order to estimate their likely impact on the system. Assuming that these resources will not exist is clearly not the best available data. If the ISO does not develop a method for recognizing the impacts of DG in its system planning process, then reliability benefits will be ignored, load forecasts will be overestimated, and ratepayers will end up paying for bigger, more expensive transmission upgrades than are needed.

4. Drivers of Current and Future DG Growth

In this section we develop a forecast for future DG installations in each New England state based on two factors: state policies and goals to achieve greater numbers of DG installations, and the recent record of actual installations.

Public policies, goals, and funding mechanisms adopted by the states—such as Renewable Portfolio Standards (RPS), net metering, green purchasing, feed-in tariffs, and standard offer programs—are driving the rapid development of DG in New England. Solar PV dominates this growth, spurred on as well by predicted declines in the costs of the system components and installation. Below, we highlight some of the policies in each of the New England states that have already led to significant installations of DG and are expected to continue to drive future development.

While there are many sources of information available, there is no single database or reporting requirement that adequately captures all of the DG that has been installed in New England to date. Each state has its own way of tracking DG interconnections, ranging from no tracking at all to comprehensive annual reports of all DG installations and pending applications. Finding, analyzing, and assuring the quality of this information is complicated and time consuming. Within the bounds of this study, we have done our best to present accurate and up-to-date estimates; however, we acknowledge that our numbers may include gaps, and that additional information may be available.

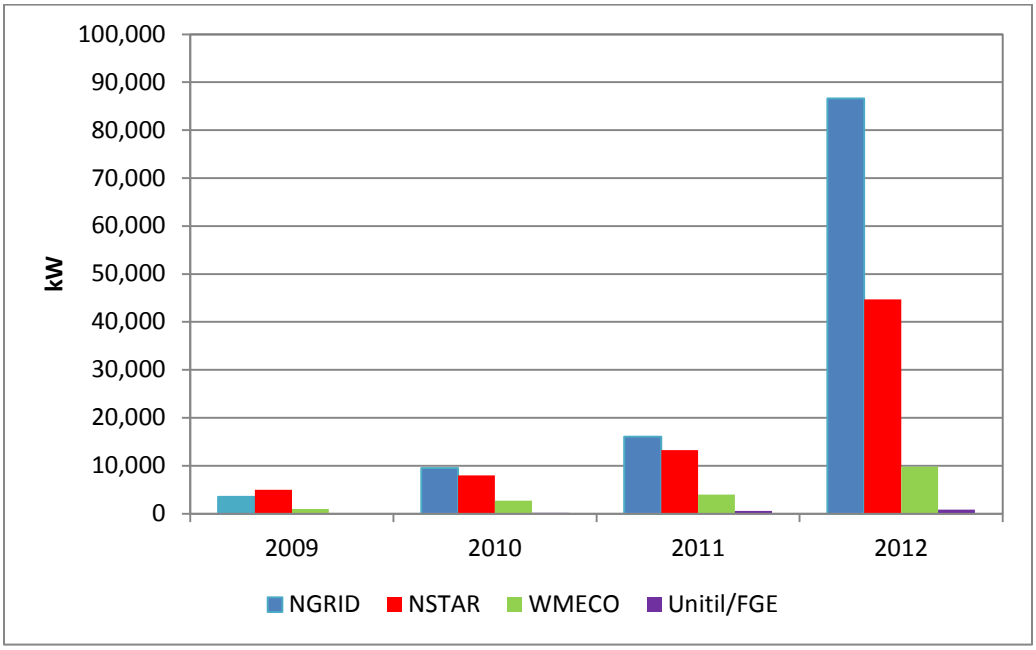
4.1 Massachusetts

Massachusetts is experiencing the fastest growth of DG in New England, and solar PV is leading the way. Policies in Massachusetts that are driving this growth include: the Green Communities Act, the state's Renewable Portfolio Standard, net metering, and other incentives such as grant programs.

The Green Communities Act

The Green Communities Act, which was signed by Governor Deval Patrick in 2008, set a goal of having 20 percent of the state's electricity needs served by clean energy by 2020, and established a grant program that provides technical assistance and incentives to support DG development in the state's municipalities. Governor Patrick also established an overall goal of installing 250 MW of solar PV in the state by 2017. Figure 2 illustrates the rapid increase in DG installations in Massachusetts since the state adopted the Green Communities Act.

Figure 2. DG Installations in Massachusetts by Utility, 2009-2012.



Source: MA DOER On-Site Generating Facilities Reports

Renewable Portfolio Standard (RPS)

The Massachusetts RPS requires that all retail electric suppliers provide a minimum percentage of electricity sales to customers from eligible renewable energy resources. The RPS includes a Class I Solar Carve-Out, which requires that a portion of the Class I RPS requirement be met with solar power. Each megawatt-hour (MWh) generated by a qualified PV resource is awarded one Solar Renewable Energy Credit (SREC), which can be sold to electric suppliers who need to comply with the RPS. The value of SRECs in Massachusetts depends on market factors, and is currently capped at the Alternative Compliance Payment amount of $550 per MWh.

The Solar Carve-Out program was designed to support 400 MW of solar PV by 2020. Once that cap is reached, no additional resources would be allowed to qualify for SRECs. However, because solar PV is growing so rapidly as a result of this and other programs, the state is currently expected to meet this goal by 2014. The Department of Energy Resources (DOER) is now working to revise the SREC program to ensure support for solar development beyond the 400 MW cap.

On May 1, 2013, Governor Patrick announced that—because his goal of installing 250 MW of solar PV by 2017 was met four years early—he has set a new goal of 1.6 GW of solar PV installations by 2020. This very aggressive target sends a strong signal to solar developers that the state is serious about continuing to support this type of DG resource. The Solar Energy Industries Association is encouraging the state to adopt the Governor's new goal as its new SREC cap, which would align Massachusetts with other leading solar states in the Northeast (like New Jersey and Maryland) in supporting solar development with a robust solar carve-out program.

Net Metering

The state's net metering rules allow owners of DG systems up to 2 MW in size to be compensated when they generate more electricity than they are using onsite. At the end of each billing cycle, if the customer has produced more electricity than he has used, he will receive a credit on his utility bill. The amount of the credit depends on the type of DG resource being net metered. Electricity generated by solar, wind, and agricultural DG projects is paid close-to-retail rates, whereas all other DG types eligible for net metering are paid wholesale rates for their excess generation.[13] Massachusetts also allows net metering customers to allocate their excess generation credits to other customers in their service territories, a practice known as "virtual net metering." This allows customers who cannot install DG systems on their property, such as renters, to benefit from net metering as well.

One unusual aspect of the Massachusetts net metering rule is that it requires only a minimal amount of onsite load be served by the DG system (such as that of the meter and the equipment itself). This has given rise to numerous applications for solar installations that are located in fields, which are interconnected to the distribution system with the express purpose of generating electricity to be sold to customers through virtual net metering.[14] The state currently caps total net metering assets at 3 percent of each utility's peak load for private customers and 3 percent for municipal customers. Currently, the total cap for net metered resources in Massachusetts is a little over 330 MW[15]. However, when the previous caps were close to being met, the state amended the caps to accommodate continued growth in net metered resources.

Other Incentives

Massachusetts has a number of other policies that promote solar PV and other forms of DG resources, including grant programs and numerous tax incentives. The Solarize MA and Commonwealth Solar II grant programs have helped fund over 20 MW of solar in Massachusetts so far.

Synapse Projection of DG Resources in Massachusetts

Table 2 shows the DG resources currently installed under several Massachusetts policies, and the amount of DG in utility queues.

While the ISO is currently anticipating only 430 MW of solar PV in Massachusetts by 2021, the huge number of projects in the utilities' interconnection queues, the Governor's new 1.6 GW target, the MA DOER's efforts to expand the SREC program, and the continued funding of programs such as Solarize MA and Commonwealth Solar II all suggest that the ISO is significantly underestimating how much solar PV will be installed in Massachusetts in the next several years.

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[13] Personal communication with staff at MA DPU.
[14] Personal communication with representative of National Grid.
[15] This total includes only the caps for National Grid, NStar, Western MA Electric Company, and Unitil.

Table 2. Distributed Generation Resources in Massachusetts[16]

	Number of Projects	Total Capacity Installed (MW)	Capacity in the Queue (MW)	Goal/Cap	Data As Of:
RPS - Solar Carve Out	4,963	215	n/a	400 MW	3/15/2013
Net Metering	n/a	167	412	330+ MW	5/1/2013
Solarize MA	219	1.2	n/a	-	4/1/2013
Commonwealth Solar	3,399	20	10	-	4/1/2013
Total PV Installed in MA	**n/a**	**250+**	**724**	**1,600 MW**	5/1/2013
Total DG Installed in MA	**n/a**	**350+**	**775**	**-**	5/1/2013

Note: Values are not additive.

Furthermore, the ISO has paid almost no attention to other DG resources—such as small wind and hydro systems, CHP, fuel cells, and farm methane projects—which continue to be developed around the state and the region. While these resources are not growing at the same rate as solar PV, they will nevertheless continue to add to the total number of DG resources being installed in Massachusetts. These resources must be tracked and their impacts represented in system planning.

We estimate Massachusetts will likely have at least 1.6 GW of solar PV installed by 2021 and will, at the very least, have the 100 MW of currently installed non-solar DG. As stated above, installations of non-solar DG resources are also anticipated to grow over the next ten years.

4.2 Connecticut

Public policies driving the development of DG resources in Connecticut include: the state's Renewable Portfolio Standard, Connecticut Public Act No. 11-80, net metering, the Residential Solar PV Program, and other incentives such as grant programs.

Renewable Portfolio Standard

Connecticut's RPS requires distribution companies to supply at least 27 percent of their retail load from eligible renewable resources by 2020. Companies must obtain at least 20 percent of their retail load from Class I resources, and 3 percent from either Class I or Class II resources by January 1, 2020; another 4 percent of their obligation was to come from Class III resources (CHP and EE) by 2010. Though most of the total renewable capacity for Connecticut's RPS requirements is coming from much larger projects, DG

[16] Sources for this table include: RPS Solar Carve-Out Qualified Renewable Generation Units report (March 13, 2013); Massachusetts Clean Energy Center's Commonwealth Solar Summary Report (April 1, 2013); MA DOER's On-Site Generating Facility Reports; and individual utilities' public reporting of their net metering activities.

systems such as solar PV, small wind and hydro, and fuel cells do qualify as Class I resources under the RPS.

Public Act No. 11-80

Connecticut Public Act No. 11-80 established a low- and a zero-emission renewable energy credit program (LREC and ZREC). The state's two utilities are required to solicit proposals for long-term (15-year) contracts with developers of behind-the-meter Class I generation projects, with a preference for technologies manufactured or developed in Connecticut. Under the solicitation, the companies are required to procure renewable energy credits from renewable energy resources that produce either low or zero emissions. The programs require utilities to spend a designated amount each year for these credits and prices are capped at $350/ZREC and $200/LREC. Overall, the programs mandate spending more than $1 billion on qualified renewable energy projects over the next 20 years. As costs continue to fall for DG technologies, more and more capacity will be installed through Connecticut's LREC and ZREC programs. The ZREC program is expected to drive significant solar PV development, while the LREC program will likely promote fuel cell projects, primarily.

Net Metering

Connecticut allows net metering of distributed generation resources up to 2 MW in size, with no cap on the total aggregate amount of net metering that can occur. Any electricity produced that is in excess of what is used at the site during a monthly billing period is carried forward as credits for one year. On March 31 of each year, the utility is required to reimburse customers for any remaining excess generation at the avoided cost of wholesale power. Connecticut municipalities can participate in virtual net metering, which allows towns to generate power via Class 1 renewables at a municipal host site and allocate the credits from any excess generation to as many as five additional beneficial accounts.

Residential Solar PV Program

The Residential Solar PV Program in Connecticut is anticipated to drive substantial investment in solar PV. The program provides rebates for small, customer-owned solar PV installations up to $11,500. Small third-party owned PV systems can also receive a performance-based incentive of $0.30/kWh for up to six years. The goal of the Residential Solar PV Program is to support 30 MW of residential PV by 2022.

Other Incentives

The state encourages other forms of DG resources through grant programs and various tax incentives, including the Combined Heat and Power and Anaerobic Digester Pilot Grant Programs, which aim to provide financial support for CHP and digester projects under 2 MW for up to 50 total MWs.

Synapse Projection of DG Resources in Connecticut

Information obtained from the state's largest utility, Connecticut Light & Power, suggests that, not including emergency backup generators, there are more than 330 MW of DG resources installed in CL&P territory (including 37 MW of solar PV), and close to 100 MW more in the queue awaiting approval to interconnect. The resources in the CL&P queue do not include many of the LREC and ZREC resources that have been accepted in the first round of those programs.[17] We expect interconnection requests will only grow as the programs mature.

While we have not been able to obtain updated information from United Illuminating (UI) as of the publishing of this report, information reported to the Energy Information Administration at the end of 2011 suggests that UI had close to 4 MW of DG participating in net metering in its service territory at that time.[18]

The state's RPS, LREC and ZREC programs, and other incentive programs will drive significant growth in DG resources, especially solar PV, in the state. Connecticut's 2012 Draft IRP estimated that nearly 400 MW of renewable resources will be developed in the state by 2022, and that most of these resources will be DG such as solar PV and fuel cell projects.[19] Considering there are already more than 400 MW of renewable DG resources installed or in the queue in CL&P's territory, this number is likely an underestimate.

We anticipate that, in addition to the 330+ MW in CL&P territory and the modest installations in UI territory, there will be hundreds of additional MWs installed under the new LREC and ZREC programs in Connecticut. A reasonable growth rate over the next seven years from the programs currently in place would suggest at least 700 MW of aggregate DG in the state by 2021.

4.3 Rhode Island

Public policies driving the development of DG resources in Rhode Island include: the DG Standard Contract Program, the state's Renewable Energy Standard, and net metering.

DG Standard Contract Program

In Rhode Island, growth in distributed generation is being driven mainly by the DG Standard Contract Program. In 2011, the legislature established a feed-in tariff for new distributed generation projects up to 5 MW. The law requires electric distribution companies to enter into 15-year standard contracts for an aggregate capacity of at least 40 MW by the end of 2014. The legislature established a distributed generation standard contract board, which sets fixed payment rates by generator capacity and type. The enrollment of resources for the program is taken in phases throughout the year. This is a

[17] Personal communication with representative from CL&P.
[18] EIA Form 861 requires an annual report on net-metering (Schedule 2D) and C&I distributed generation (Schedule 7) from all distributions utility companies.
[19] *See* 2012 Connecticut Final Integrated Resource Plan, Appendix D at D-13.

slower, more measured approach to promoting DG than has been taken in other New England states, but has already produced about 16 MW of DG—mostly solar PV—in Rhode Island. Once the goal of 40 MW of DG by 2014 is met, it is likely the state will push to expand the program beyond 2014.

Renewable Energy Standard

Rhode Island also has a Renewable Energy Standard requiring retail electric providers to supply 16 percent of their electricity sales from renewable resources by 2019. So far, 113 projects totaling more than 1,400 MW of renewable capacity have been approved by the Rhode Island Commission. Ten of these projects are small wind, hydro, or solar projects located in Rhode Island.[20] While much of the capacity driven by the state's RES is likely to come from larger, grid-connected renewables, DG resources will also grow as prices for these technologies continue to fall. Nevertheless, we expect only a small amount of DG to be driven by RES requirements by 2021.

Net Metering

Rhode Island allows net metering of DG resources 5 MW or less. Net metered systems must be "reasonably designed" not to provide more than 100 percent of the customer's load. Any excess generation that does not exceed 125 percent of the customer's consumption for that billing period is credited at the utility's avoided cost rate. The cap on net metered generation in Rhode Island is currently 3 percent of the utility's historical peak load, which is approximately 58 MW for National Grid, the state's largest utility. Rhode Island also allows virtual net metering.

Synapse Projection of DG Resources in Rhode Island

Our research indicates that Rhode Island will reach its 40 MW goal for its DG Standard Contract Program by 2014, and that the state will likely choose to expand that program to procure additional DG resources beyond 2014. If Rhode Island can procure 40 MW of DG in three and a half years, it can probably procure twice that much—another 80 MW—by 2021. It is also likely that the 58 MW net metering cap will be reached by 2021. Some net metering capacity may also be part of the DG Standard Contract Program; however, to date, none of the DG Standard Contract resources has requested to net meter.[21]

We estimate that Rhode Island will likely have at least 170 MW of DG resources online by 2021. This is significantly more than the 25 MW of PV that ISO has anticipated will be installed by 2021.

[20] *See* RI PUC Status Report on RES Applications, May 3, 2013.
[21] Personal communication with representative of National Grid.

4.4 Vermont

Vermont has two major programs driving DG in the state: the Sustainably Priced Energy Enterprise Development (SPEED) program and net metering.

The SPEED Program

The SPEED program was enacted by the Vermont legislature in 2005, and set a goal of achieving 20 percent of statewide retail electric sales from SPEED resources by 2017. SPEED resources are new renewable energy resources like solar PV, wind, farm methane, and qualified CHP resources. In 2009, the Vermont Energy Act was adopted, which included a feed in tariff, or standard offer program, designed to encourage the development of SPEED resources. The Act establishes default prices for the standard offer for different technologies. More than 19 MW of DG resources, mostly solar PV and farm methane, have been installed in Vermont as a result of the standard offer program, and over 120 MW were waiting in the program's queue as of February 2013. However, on March 1, 2013, the state changed its standard offer program to require a competitive RFP process to establish prices for SPEED resources. The projects in the queue were purged, and all resources seeking to participate in the SPEED program will now have to respond to the RFP.

Net Metering

Customers who install DG systems of 500 kW or less (2.2 MW for military projects and 20 kW for micro-CHP projects) can receive a net metering credit on their next bill for any excess generation they produce. At the end of the year, any unused excess is granted to the utility; however, virtual net metering (known as "group net metering" in Vermont) is permitted, allowing a group of customers to share the credits for excess generation from a net metered DG system. The cap on net metered resources in Vermont is currently 4 percent of either a utility's peak demand during 1996, or the peak demand during the most recent full calendar year—whichever is greater. This cap has been raised several times already to accommodate growing demand for net metering in the state.

In 2011, the state created a solar credit payment for all customers who have installed PV net metered systems. The solar credit payment increases the value of solar PV generation to customers up to $0.20 per kWh; once a payment amount is established, it will not fluctuate for at least two years. Utilities may also offer additional credits for other net metered DG resources.

Many customers have taken advantage of net metering in Vermont, with over 26 MW installed as of March 6, 2013; however, this still represents participation from fewer than one percent of all Vermont customers.

Synapse Projection of DG Resources in Vermont

Table 3 shows the total MWs of DG that have been procured under each of Vermont's key programs.

Table 3. Distributed Generation Resources in Vermont[22]

	Number of Projects	Total Capacity Installed (MW)	Capacity in the Queue (MW)	Goal/Cap	Data As Of:
SPEED	32	19.1	35.86*	127.5 MW by 2022	3/5/2013
Net Metering	2636	26.77	n/a	4% peak load	3/6/2013
Total		**45.87**	**35.86**		

**Approved/Under Construction*

The SPEED and net metering programs represent more than 80 MW of installed or approved DG projects in the state, including approximately 35 MW of solar PV installed—more than the 30 MW the ISO is anticipating by 2021. Another 35+ MW of DG (almost all solar PV) have already been approved and/or are under construction in the state right now. We expect the state will likely meet its SPEED goal of 127.5 MW of DG resources ahead of the 2022 target date, and that it will likely increase the goal when it is met. We also anticipate that customer participation in the net metering program will continue to increase, and that the caps will likely be met (and probably increased again) in the next 10 years. This could lead to more than 40 MW of net metered DG in Vermont.

With the success of Vermont's programs promoting DG and the continued growth anticipated in the future, we estimate that there could be at least 165 MW of DG resources installed in Vermont by 2021.

4.5 New Hampshire

New Hampshire's public policies supporting DG are not as aggressive as those in the states mentioned above, but the state is still realizing some growth in DG resources like solar, wind, and small hydro. Public policies driving the development of DG resources in New Hampshire include: the state's Renewable Portfolio Standard and net metering.

Renewable Portfolio Standard

New Hampshire's RPS requires the state's electricity providers—with the exception of municipal utilities—to acquire renewable energy certificates equivalent to 24.8 percent of their retail electricity sold by 2025. The RPS includes four distinct standards for different types of energy resources and requires at least 0.3 percent of the total be met with solar PV. Because the RPS allows all requirements to be met with credits purchased out of state, the RPS is not necessarily a strong driver of new solar or other DG resources in New Hampshire.

[22] Sources for this table include: Vermont Standard Offer Program Accepted Projects list; personal communication with Anne Margolis, Renewable Energy Development Manager at the State of Vermont, regarding net metering activities.

Net Metering

New Hampshire allows net metering for resources up to 1 MW in size. The rules separate customers into small generators (up to 100 kW) and large generators (greater than 100 kW and up to 1 MW). There is an aggregate statewide limit of 50 MW on net metering, with CHP projects limited to no more than 4 MW of that total. In New Hampshire, excess generation is carried forward as a credit on the customer's bill. At the end of the year, customers may elect to receive a payment for the carried-over excess generation at the utility's avoided cost rate. At the end of 2012, New Hampshire had over 5 MW of net metered DG resources, most of which (4.14 MW) are solar PV.[23]

New Hampshire's legislature is currently considering a bill to allow virtual (group) net metering of renewable DG resources in the state.[24] This would allow customers to receive net metering credits for a net metered system that is not located on their property. If this policy is adopted, it could encourage development of community-based or remote DG projects in the state.

Synapse Projection of DG Resources in New Hampshire

While there are not as many public policies driving DG development in New Hampshire, we conclude that the state will continue to experience some growth, especially if it chooses to allow virtual net metering. New Hampshire will likely have at least 50 MW of DG installed by 2021, in accordance with its cap on net metering.

4.6 Maine

Programs that help promote DG resources in Maine include: the state's Renewable Portfolio Standard, the Community-Based Renewable Energy Production Incentive pilot program, and net metering (called "net energy billing" in Maine).

Renewable Portfolio Standard

Maine allows its RPS requirements to be met with NEPOOL renewable energy certificates from the NEPOOL GIS system, and does not have a special carve-out for solar resources. Under the RPS, the state does have three goals for wind-energy development: (1) at least 2,000 MW of installed capacity by 2015; (2) at least 3,000 MW of installed capacity by 2020, of which there is a potential to produce 300 MW from facilities located in coastal waters or offshore; and (3) at least 8,000 MW of installed capacity by 2030, of which 5,000 MW should be from facilities in coastal waters or offshore.

[23] Personal communication with representative of PSNH; EIA Form 861 data.
[24] *See* SB98: http://www.gencourt.state.nh.us/legislation/2013/SB0098_SA.html

Community-Based Renewable Energy Production Incentive Program

Little if any of the RPS wind energy goals are likely to be met with DG resources under 1 MW. However, the RPS does provide an incentive for participation in the Community-Based Renewable Energy Production Incentive program, by offering a 1.5 credit multiplier for projects qualifying for this program. To be eligible, a generating facility must be 51 percent locally owned; use renewable energy resources (defined as solar, wind, hydro, certain biomass, fuel cells, and tidal); be no larger than 10 MW in generating capacity; and be located in the state. There is also a 10 MW carve out for small resources less than 100 kW.

Net Metering

Maine allows net metering for customers with systems 660 kW or less. Any excess generation is credited to the following month for up to 12 months, but at the end of a 12-month period, any remaining credit is granted to the utility with no compensation for the customer. Group net metering (also called virtual net metering) is allowed. Maine does not impose a cap on net metering, but it does require utilities to notify the PUC if the cumulative capacity of net-metered facilities reaches one percent of the utility's peak demand.[25]

Synapse Projection of DG Resources in Maine

Table 4 shows the DG resources installed under Maine's key programs.

Table 4. Distributed Generation Resources in Maine.[26]

	Number of Projects	Total Capacity Installed (MW)	Capacity in the Queue (MW)	Goal/Cap	Data As Of:
Community-Based Renewable Pilot	9	24.2	n/a	50 MW	2/1/2013
Net Energy Billing	1203	6.28	n/a	none	3/1/2013
Total	**1212**	**30.39**			

The ISO anticipates that Maine will experience very little growth in DG resources, and has estimated that by 2021 the state will have only around 5 MW of PV installed. While Maine's policies promoting DG resources are not as aggressive as we are seeing in most of the other New England states, according to Maine's two largest utilities, nearly 30 MWs of total DG have already been installed, including approximately 5 MW of solar PV.

[25] Based on ISO data in CELT 2013, Maine's peak load is approximately 2,065 MW, making one percent around 20 MW.

[26] Sources for this table include: ME PUC Community Based Renewable Energy Pilot Program Awarded Contracts; Chapter 313 2012 Utility Net Energy Billing Reports.

We anticipate that Maine will continue to experience modest growth in DG installations and—barring the adoption of new, more aggressive policies—could expect to see up to 70 MW by 2021.

5. Conclusions

Despite recent improvements in the ISO's efforts to determine the quantities of distributed generation resources in the region and to anticipate the growth of these resources into the future, our research shows that the ISO is significantly underestimating the current and potential DG in New England. Every New England state has already achieved, or is planning to achieve by 2021, significantly more DG resources than ISO's recent estimates. Table 5 shows a comparison of (a) what our research shows is currently installed, (b) what the ISO anticipates for solar PV resources in 2021, and (c) estimates that we have developed for potential DG resources, based on our research to date.

Table 5. Current and Projected DG Installations in New England.

State	Current DG Capacity Installed (MW)	ISO's Estimate of Installed PV by end of 2021 (MW)*	Synapse Estimate of Potential Installed DG by end of 2021 (MW)
Connecticut	400+	300	700+
Massachusetts	350+	430	1700+
Maine	30	5	70
New Hampshire	25	10	50
Rhode Island	29	25	170
Vermont	46	30	165
REGIONAL TOTAL	**980**	**800**	**2,855+**

* *Note that ISO's estimates are only for solar PV and do not include other types of DG.*

The New England states continue to invest significantly in DG resources. For example, Massachusetts has increased its solar PV target to 1,600 MW and continues to invest millions of dollars in programs promoting solar PV and other DG technologies in the state.[27] Connecticut's $1 billion LREC and ZREC programs are expected to stimulate tremendous growth in DG.[28] And Maine is authorized to spend up to $100,000 per year for its Community-Based Renewable Energy Production Incentive Program. With increasing solar PV targets in several states, and the continued investment in DG resources in general, the potential for as much as 2.8 GW of capacity from distributed generation in New England is very real.

[27] For instance, the state has allocated $40 million for the residential solar investment program and $6 million for the CHP Pilot Program.

[28] A CL&P representative suggested a doubling of total PV MW was likely in the first full year of the LREC/ZREC programs alone.

Of course the main problem is that ISO's system planning forecasts assume that there will be *zero* new distributed generation resources added to the system between now and 2021. Any resource that is of this magnitude and is capable of this kind of growth must be taken into account in electric system planning.[29] If these DG resources are not properly accounted for in the system planning process, then there will likely be overinvestment in the transmission and generation capacity in New England, and states that are making significant investments in DG resources will not be able to realize the full cost savings of those investments.

In order to provide better estimates for use in ISO system studies, we recommend that the ISO establish a DG Forecast Working Group in order to develop a DG forecast that can track existing installations and project future installations. This group should closely examine the issue of potential system impacts.

We recommend that the group focus initially on PV installations; however, the ISO should also develop a methodology for tracking and estimating all DG installations. Technologies other than PV are continually improving, and may experience similar rapid increases in installations as a result of technological advancements, cost reductions, and state policy support.

In addition to the recent revision to ISO's Planning Procedure 5-1, which will require notification for all new generating resources of any size, there are a number of resources from which the ISO can draw information about the quantity, size, and location of these DG resources. For example:

- The U.S. Energy Information Administration requires utilities to report annually installations of commercial and industrial DG projects less than 1 MW in size, as well as total net metering participation.[30]
- The National Renewable Energy Laboratory (NREL) tracks solar PV installations in each state.[31]
- Some state commissions require utilities to report DG interconnections or net metering activities. The Massachusetts DOER, for instance, requires utilities to report total DG installations and pending applications on an annual basis.[32] Vermont's SPEED Program information, including approved and pending projects, is available online,[33] and the Vermont PSD tracks net metering by size and technology type. The Maine PUC receives annual reports from Maine utilities summarizing their net energy billing activities for the year.

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[29] DG resources that participate in the ISO forward capacity market (FCM) are included in system planning studies. To date, however, the quantity of DG FCM resources has been very small, they impact only the first three years of the ten-year planning forecast, and they are not specifically tracked by the ISO.

[30] *See* EIA Form 861, Schedules 2D and 7.

[31] *See* NREL OpenPV Project, available at: https://openpv.nrel.gov/

[32] *See* On-Site Generating Facilities reports, available at: https://sites.google.com/site/massdgic/home/interconnection

[33] *See* Vermont SPEED Program website: www.vermontspeed.com

This information is available now for the ISO to gain a better understanding of DG resources. It is essential that the ISO stop ignoring the impacts DG resources have on system planning—both their benefits and their challenges. This report provides a reasonable estimate of what the future holds for these resources and makes one thing very clear: assuming that these resources do not exist is unacceptable.