Promoting Competitive Power Markets and Growing Zero-Emission Resources in New England

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Disclaimers

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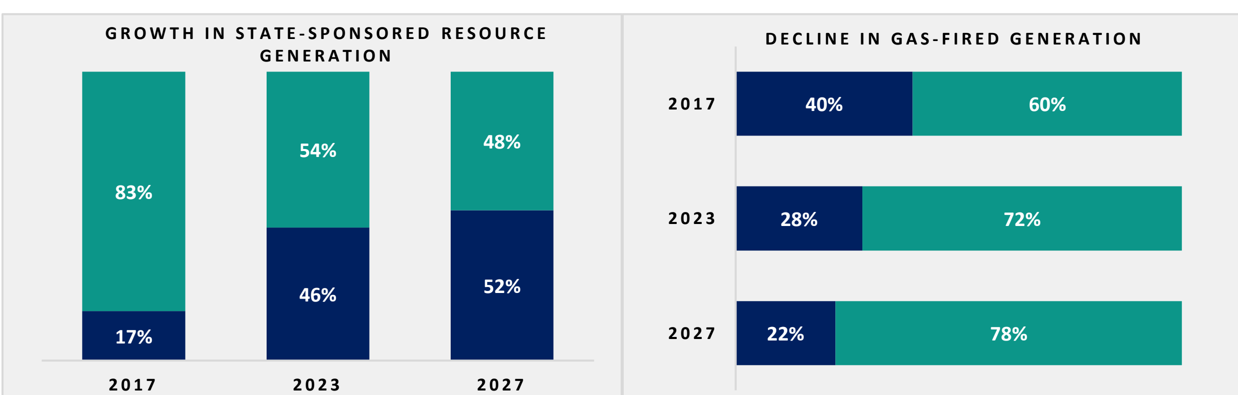
A. SUMMARY

New England has relied on wholesale and retail electric market competition to guide most electric capacity resource development in New England for nearly 20 years. Since that time the region's fleet of generation capacity resources has evolved to its current mixture where there is now an increased use of low emission natural gas-fired, renewable and energy efficiency resources operating alongside of existing hydroelectric and nuclear resources. By relying on New England's wholesale power markets, consumers have realized the benefits of this welcome evolution in power supply mixture while bearing only minimal cost of the risks taken by private investors to transform the power supply portfolio. As New England states take steps to fulfill their legislative mandates to promote low emission resources, the region is becoming more reliant on clean energy electric generation resources. It is critical to recognize the key roles that competitive power markets and existing generation resources play in New England today, and will still be needed to play in the future. Reliance on competitive markets will help minimize the costs of transitioning to a low carbon emission future while ensuring reliable electric system operations are maintained.

As this transition continues, state sponsored resource additions in New England are set to grow at a rapid pace (See Figure 1). The Renewable Portfolio Standards (RPS) in several states have been increased and new state led power procurement programs have been established that complement and exceed RPS requirements. Over the next ten years state sponsored resources are expected to become the largest single source of consumer electricity supply in New England by 2023, and to exceed 50% of the consumer electricity supply by 2027. This dramatic shift will necessarily cause generation provided from other sources to decrease. For example, Figure 1 illustrates how gas-fired generation production will decline substantially with increased production from new clean energy resources.

Figure 1: Estimated Growth in Clean-Energy Resources v. Decline in Gas-Fired Generation



Consequently, this growth in clean energy resources can be expected to substantially reduce energy market revenues for existing competitive market electric generation resources. This is consistent with ISO New England's own analysis showing the financial impacts existing resources face in the changing energy landscape.[1] Some of those existing resources will be expected to retire as they are displaced. There will, however, still be a need for other competitive power generation to provide electricity supplies and flexibility to maintain reliability of the grid for years to come. The expected revenue decline will occur right at the time early in the next decade where many existing units approach 20 years of continued operation and are likely to require significant investments to maintain reliable operations.

Moreover, other existing generation resources, including important clean energy resources like hydroelectric, nuclear and likely other existing RPS resources, are generally assumed by some policymakers to remain in operation indefinitely. However, these resources too will see declining energy market revenues. One need only look at the debate in Connecticut regarding the financial viability of Millstone nuclear station (and similar debates in other states in PJM and NYISO) to realize that a number of nuclear resource owners are experiencing an economic tipping point at which existing stations seriously consider retirement.

To accommodate a growing supply of clean energy resources New England's power markets must provide resource owners the opportunity to recover operating costs and future capital investments of the flexible resources that are needed to maintain reliability. It is important that the region recognize that the continued financial viability of many existing resources is necessary to achieve policy objectives. ISO New England is implementing its new Competitive Auctions with Sponsored Resources (CASPR) capacity auction framework to accommodate new clean energy capacity paired with retirements of existing resources, and seeks to advance a market-based proposal to address winter fuel security. Little attention has been given, however, to the impending impact of new clean energy procurements on energy markets. Failure to consider the market impacts of increased subsidized resource entry is likely to lead to the need for out-of-market payments to sustain existing resources. Such an outcome is the antithesis to relying on competitive markets and would be unnecessarily costly for the region's electricity consumers.

New England's wholesale electricity market design should ensure that resources that provide flexibility are compensated appropriately and that the costs necessary to maintain and enhance flexible resources can be expected to be recovered through ISO-NE's energy, ancillary services and capacity markets. Policymakers and stakeholders are urged to support the competitive power markets by developing sufficient market mechanisms to obtain the attributes desired from the New England power generation fleet.

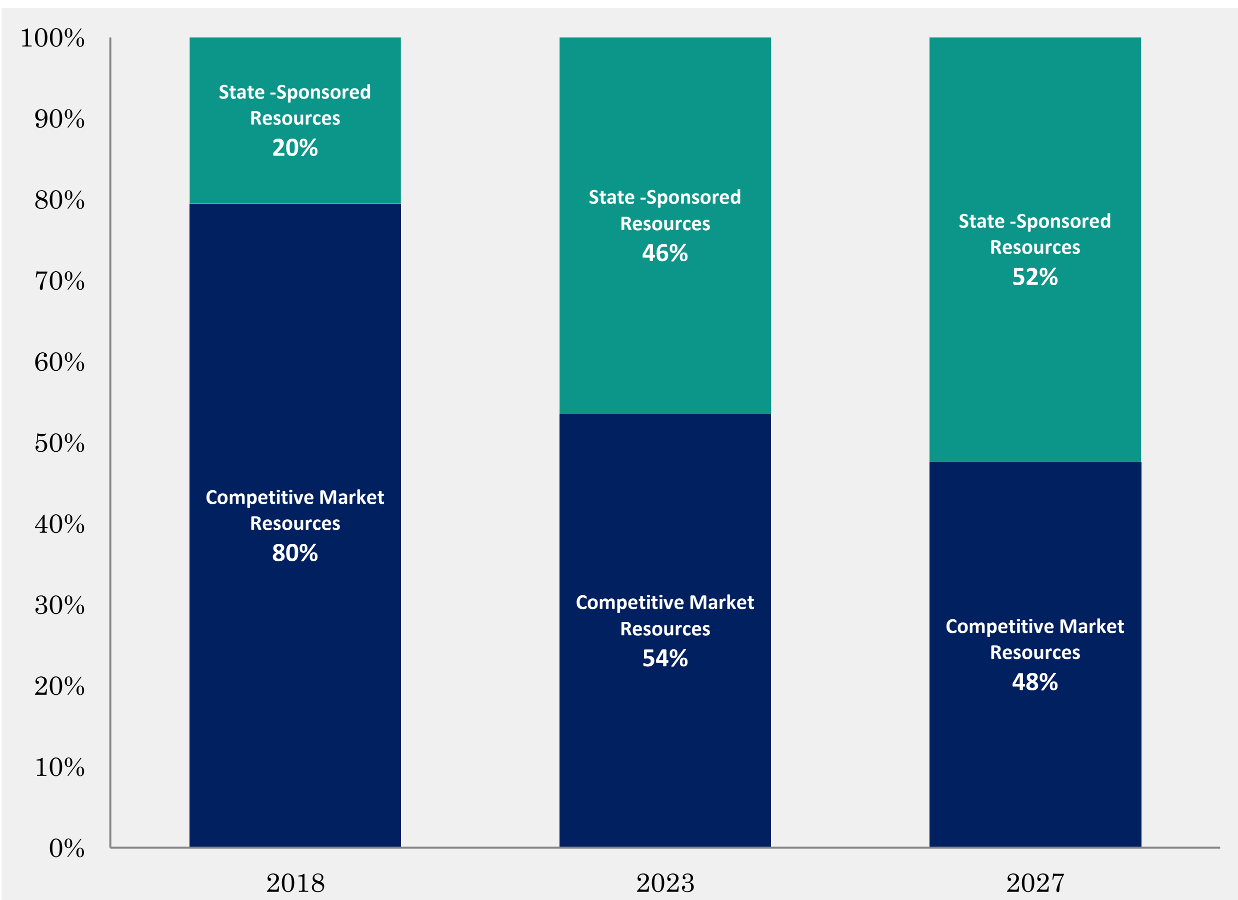
[1] ISO New England's 2016 NEPOOL Scenario Analyses (ISO NE 2017), Scenario 3 (Renewables Plus) at Figures 6-1, 6-2 and Tables 6-6, 6-7 and 6-11).

B. GROWTH IN CLEAN ENERGY RESOURCES IN NEW ENGLAND

1. *State Zero-Emission Resource Procurement Programs*

New England states are in the process of implementing programs intended to produce a large and rapid growth in zero-emission and renewable electric generation resources over the next ten years. As Figure 2 shows, based on current mandates and policies New England's clean energy resources will grow from meeting roughly 20% of New England's energy requirements today, to over 45% by 2023, and over 50% by 2027. This rapid growth rate in zero emission electric energy supply as a percentage of the New England region's total energy supply is matched only by the experience of California in the U.S.

Figure 2: State-Sponsored Resources v. Competitive Market Resources
(Estimated Energy Production, MWh)



There are several state policy programs working together to support the accelerated growth in clean energy resources and expected reduction in greenhouse gas emissions. Currently, there are long-term resource procurements underway in Massachusetts, Connecticut and Rhode Island. These procurements alone will meet more than 25% of New England's projected electric energy consumption by 2023, and will continue to add additional new resources in subsequent years.

Massachusetts utilities recently completed and filed for approval with state regulators 20-year power supply contracts for the future supply of 9.5 TWh per year of hydro-electric power (~1,100 MW) and approximately 3.5 TWh of off-shore wind powered (800 MW) energy (the first half of off-shore wind procurements authorized by 2016 legislation). These two contracts alone equal almost 11% of New England's projected annual electric energy consumption in 2023.

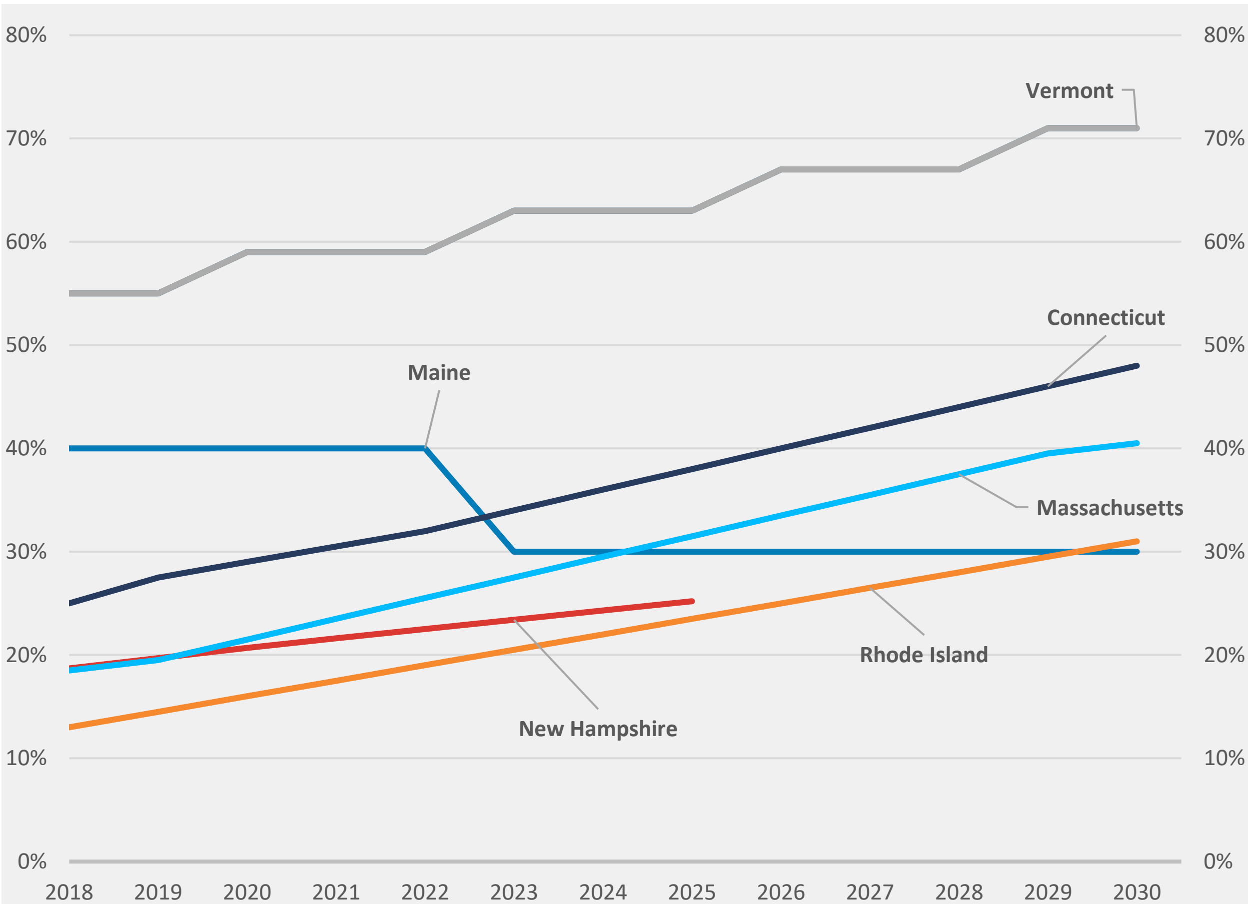
Future authorized procurements will drive even more growth in new clean energy resources. Under 2016 legislation, Massachusetts will solicit an additional 800 MW (3.5 TWh per year) of off-shore wind resources, which are targeted to be in service by 2025. With 2018 legislation, Massachusetts doubled its total off-shore wind resource goal to 3,200 MW by authorizing the future procurement of up to 1,600 MW of additional resources. If Massachusetts were to complete these off-shore wind procurements relatively quickly, the percentage of regional energy needs provided by state sponsored resources would grow to approximately 58% by 2027. None of this accounts for the prospect of additional procurements of new clean energy resources that may occur, as has been authorized in recent years by most state legislatures in the region.

Connecticut and Rhode Island utilities recently completed and submitted contracts for regulatory approval for the purchase of about 2.5 TWh of off-shore wind powered energy (600 MW). In addition, both states have major ongoing solicitations with Connecticut seeking to procure up to 12 TWh per year of zero carbon energy and Rhode Island soliciting an additional 400 MW of off-shore wind resources. Connecticut's solicitation—which allows the state's existing Millstone nuclear power plant to qualify for a longer-term contract if confirmed that it is financially "at risk"—could represent approximately 10% of New England's projected annual electric energy consumption as early as 2020.

2. ***State RPS Programs***

Long standing state RPS programs will continue to provide financial support for certain RPS eligible existing resources while also calling for continued growth in RPS requirements (See Figure 3). For example, each of the southern New England states recently increased its RPS with Connecticut now requiring 48% of its retail consumer electric energy requirements to fulfilled by RPS eligible resources by 2030, Massachusetts reaching 40.5% by 2030 and growing 1% per year thereafter with no expiration date, and Rhode Island, 31% by 2030, growing 1.5% per year thereafter until reaching 38.5%. These changes represent substantially increased RPS requirements relative to the levels previously in place.

Figure 3: New England State RPS Requirements, 2018-2030



Note: Vermont represents approximately 5% of ISO-NE customer load.

One peculiarity of these RPS programs that is important to note is that they do not include all existing renewable resources, due to the lack of uniformity across the various programs as well as restrictions on vintage and project size for certain technologies. Thus, expanded RPS requirements necessitate additional new resource development and may create challenges for resources dependent on wholesale markets, including the existing non-emitting resources excluded from the RPS. This situation presents the very real risk that state policies aimed at reducing greenhouse gas emissions in the electricity sector could ultimately cause retirements of existing non-emitting resources and result in a cycle of constantly procuring new (or retention of existing) non-emitting resources with consumers bearing all of the cost and risk of these projects.

3. ***Accommodating Increased Growth of Intermittent Resources***

With RPS requirements increasing, the supply of intermittent resources such as solar and wind will also continue to grow. For example, ISO New England forecasts that the amount of solar electric capacity in New England will double over the next ten years growing from almost 3,000 MW to nearly 6,000 MW. The growth in supply of intermittent resources is going to require ISO New England to be prepared to balance system supply and demand while accommodating increasingly larger swings in intermittent resource output. To accommodate these swings, flexible, dispatchable resources need to be available to respond (i.e., ramp output up and down) to balance the output variation from other resources as so-called "net-load" changes become larger.[2]

The increase in the volatility of net-load can be expected to be accompanied by material changes in the daily and hourly load shape in ISO New England.[3] Given the relatively small size of the New England marketplace, these changes will require careful monitoring to balance net-loads that are anticipated to approach zero in some intervals.[4] This net-load impact is projected to be similar to the California net-load hourly shape that now follows the pattern of the well-known "duck curve." Substantial growth in intermittent resource output (most notably solar in California) reduces the consumer electricity load that must be met during those hours when the sun is shining. However, once the sun sets, the power system must rely on dispatchable resources to ramp up and meet the demand no longer being met by intermittent resources.

To the extent that dispatchable resources are required to provide the flexibility the electric grid needs, but are operated less overall, the revenues that these resources realize from the energy market will decline. Thus, even if clean energy resources supplant some of New England's least efficient generation, there can be challenges faced by the more flexible resources, especially in instances where a resource requires capital investment to continue to provide that service. Thus, it is important to assure that the full set of services required in the future are properly valued to ensure the market can support the investments needed to perform reliably.

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2 Net-load refers to the electricity required by consumers hour-by-hour and minute-by-minute reduced by the amount of intermittent resource production at any point in time.

3 Volatility refers to a measure of the magnitude of the variation of net-load over time for particular hours or intervals (i.e., portions of an hour which are typically equal to the five-minute period used by electric system operators when balancing supply and demand in the real-time markets).

4 See, for example, ISO Newswire, New ISO-NE webpage highlights the growing impact of solar power across the six states, October 26, 2016, http://isonewswire.com/updates/2016/10/26/new-iso-ne-webpage-highlights-the-growing-impact-of-solar-po.html, accessed September 13, 2018.

C. THE IMPACT OF CLEAN ENERGY RESOURCES ON EXISTING NEW ENGLAND POWER MARKETS AND GENERATORS

Power delivered to New England by resources receiving contracts under state procurement programs will have two direct impacts on New England's power markets and the generators that rely on those markets. First, the power produced by these new resources will displace that of existing electric generation in New England, possibly including other zero-emission resources. Second, the contracted resources can be expected to be offered into ISO New England's markets at offer prices of zero, and possibly less than zero, to ensure their output is always sold in the marketplace.[5] A large increase of zero-priced energy offered into the wholesale market will put downward pressure on wholesale electric energy prices. Lower electric energy prices will impact all resources participating in New England's electricity markets.

1. *Impact on Existing Generation Resource Production*

Many existing resources will see their production levels decline substantially to accommodate the new clean energy resources. However, as noted above, some of the existing generation will still be needed to increase and decrease production throughout the day to accommodate changes in load and intermittent resource production. Given the decrease in overall energy revenues for this set of resources needed to complement the new entry, it is important that the market properly value the full set of services they provide.

Figure 4 provides estimates of the reduction in production that will result for existing electric generation resources in New England to accommodate new clean energy resources.[6] Assuming that existing natural gas-fired resources are the dispatchable resources most likely to see their production reduced to accommodate new additions, as would be expected to occur under the current wholesale market design, the aggregate production from these resources is expected to fall by almost 50% between now and 2027 (declining from 40% to 22%).[7] Absent higher revenue opportunities, this foreshadows increased resource retirements.

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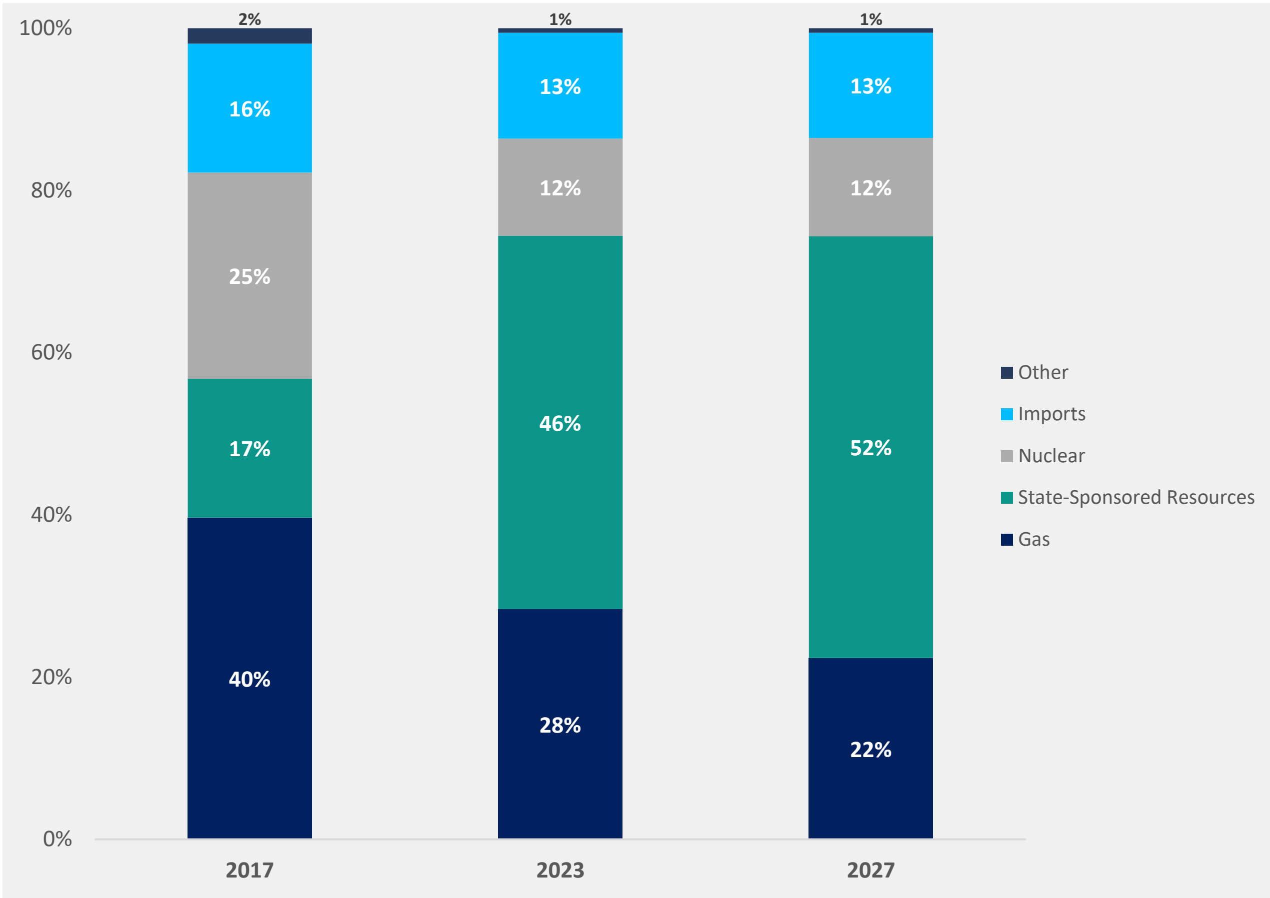
5 Because these resources will be paid for their production based on contract prices, these resources are expected to behave as "price takers" which means they will produce power regardless of the actual market price.

6 The analysis presented here does not explicitly consider the impact on New England's oil-fired steam resources. These resources' operations on oil are concentrated in the few coldest weeks of the year and although they will also be expected to be displaced by clean energy resources, the impact will be on a very small amount of the total annual production.

7 While Figure 4 holds other existing resource production and imports constant, there will be variation year-to-year whereby existing New England hydroelectric resources' production (which is subject to weather variations) and imports will vary leading to some variation in the reduction in production required from natural gas-fired resources.

Figure 1: ISO-NE Generation by Source, MWh
Actual (2017) and Estimated (2023/2027)



Notes: The portion of imports that may meet RPS requirements in 2017 is not added to state-sponsored renewables. Assumes 1) that the Connecticut Zero Carbon Energy procurement awards Millstone an energy supply contract of 12 TWh per year; 2) that 3% of the imports are used to meet state RPS requirements; and, 3) that hydro-electric resources are state-sponsored and receive RPS payments even though these payments are often de minimis.

Of note with respect to Figure 4 is the assumption that the ongoing Connecticut Zero Carbon Energy procurement will result in a contract award to the Millstone nuclear plant for the provision of 12 TWh of energy through at least 2027. However, the Connecticut procurement is open to new and existing eligible resources and it may be the case that a significant portion of the 12 TWh per year will be awarded to new or other existing zero-emission resources. Inasmuch as new zero-emission resources meet a portion of the ongoing Connecticut procurement, this will result in an even greater reduction in existing gas-fired resource production (and possibly other less flexible resources depending upon the rated capacity of the resources procured) in the 2023-2027 time frame.

2. ***Impact on Wholesale Energy Prices and Existing Unit Energy Market Revenues***

Existing merchant generation resources will be impacted by reduced energy market prices driven by price-taking clean energy resources. While the financial impact of reduced revenues cannot be projected with precision, both existing generation resources whose production declines and existing generation resources whose production is largely unchanged (e.g., baseload price-taking units) can expect to realize lower revenues in the wholesale electric energy markets.

For example, consider an existing dispatchable combined cycle electric generation unit that would face declining production, and receive lower energy prices during those hours when it continues to operate. In the first instance, new clean energy resources will enter the market as price-takers (effectively offering their energy at $0/MWh) causing some existing generating units that would have operated in the absence of the contracted resources to be displaced. When generation is displaced, for these (and other) resources to remain viable, the revenues lost will now need to be recovered through the value of the other services resource provides (i.e. capacity and/or ancillary services). Second, when the resource is operating energy prices will be lower than they would have been in the absence of the clean energy resources.[8] Thus, the revenue opportunities will be lower. Moreover, to the extent the resource is the marginal unit, it will earn no margin on its energy sales.

While imperfect, it is possible to consider the impact of declining production and reduced prices using historical data. Historical operating data for a representative sample of combined cycle generating units were gathered and estimated operating revenues were calculated. It was then assumed that the generating units would no longer produce during low demand hours (generally overnight), would realize reduced production during the daytime hours, and would realize lower energy prices. Four straight-forward scenarios are defined to evaluate the impact of combined reductions in production and energy prices that are associated with significant growth in clean energy resources (see Figure 5). Figure 5 shows the estimated decline in revenues based on 2017 data for each of the four scenarios' different combinations of assumed production and energy price reductions.[9] The combined effect of reduced production and lower energy market clearing prices can be expected to reduce revenues significantly absent other material changes to the market design. Moreover, ISO New England's scenario analyses that examined significant future clean energy resource additions show energy market net-revenue declining to practically zero by 2025.[10] As a result, it is important to assure that the market design will adequately value the flexible reliability services that will still be needed.

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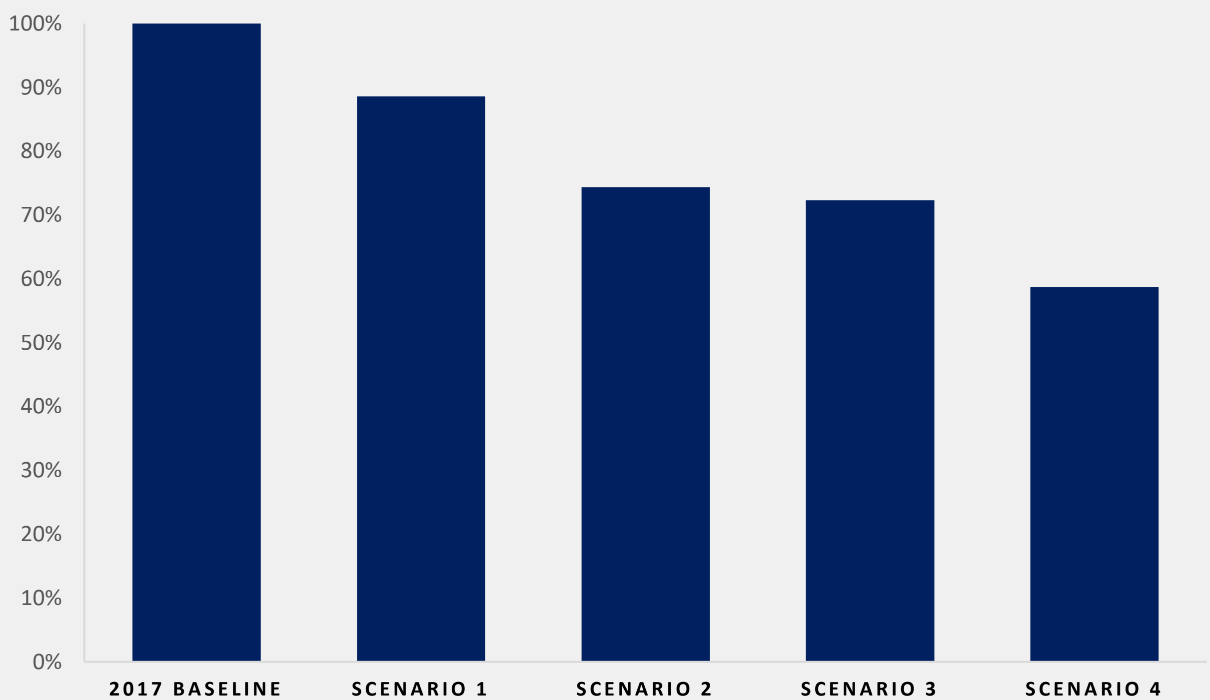
8 The reason that energy prices decline is again due to the fact that the addition of the contracted resources pushes the electric generation supply curve to the right, which results in a lower cost resource setting the market clearing price, all other things being equal.

9 While the results reported here are not forward looking, the assumed production and energy price declines are consistent with ISO New England's 2016 NEPOOL Scenario Analyses (ISO NE 2017), Scenario 3 (Renewables Plus, 2025) at Figures 6-1, 6-2 and Tables 6-6 and 6-7, and market analyses that are supporting the Massachusetts' clean energy procurements (TCR 2018).

10 See ISO NE 2017 at Table 6-11, Scenario 3 (Renewables Plus). Notably ISO New England's scenario analyses show energy market net-revenue declining to almost zero across all scenarios analyzed.

Figure 5: Estimated Percentage Energy Market Revenue Reductions for Select Combined Cycles Due to Increased Clean Energy Resources (2017)



Notes: Overnight production includes production between hours ending 23 and 6. Shoulder months are March, April, September, October, and November.
Scenario 1: DA LMP Price Reduced by $1/MWh, Overnight Prices in Shoulder Months Reduced to Zero and 25% Less Daytime Production in Shoulder Months.
Scenario 2: DA LMP Price Reduced by $2/MWh, Overnight Prices in Shoulder Months Reduced to Zero and 25% Less Daytime Production in All Months.
Scenario 3: DA LMP Price Reduced by $1/MWh, No Overnight Production and 25% Less Daytime Production in Shoulder Months.
Scenario 4: DA LMP Price Reduced by $2/MWh, No Overnight Production and 25% Less Daytime Production in All Months.

Consider next existing generating units whose production is expected to be unchanged, but that are key resources providing zero-emission benefits (e.g., baseload units that self-schedule). In this instance the energy prices upon which the unit's revenues are based will be lower when contract-based resources are displacing other more expensive production. Lower energy prices will directly lower energy market revenues during which the unit is operating.[11] Moreover, if energy prices are pushed to zero, or lower, as the supply of clean energy resources grows, baseload units could be in the position of having to pay ISO New England to accept at least some of its production.[12] Thus, increased additions of sponsored new clean-energy resources will have an adverse financial impact on existing non-sponsored zero-emission resources.

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11 For example, if energy prices are reduced by $1/MWh, a 1,000 MW unit will lose $1,000 of revenue for every hour, which quickly adds up to millions of dollars per year.

12 NEPGA recognizes that the existing storage capability (more than 1,800 MW with approximately 13,000 MWh of storage at existing pumped storage facilities and existing lithium ion battery installations) does offer the opportunity today to move low or zero priced renewable energy to higher demand, higher priced hours.

Next, and ironically, some existing units that qualify for state RPS will also be impacted by reduced energy market revenues. This impact will especially be realized by many existing hydroelectric resources, and other resources that qualify for RPS, but that are not making energy sales under long-term power sale agreements or otherwise receiving revenue from serving consumer loads. These hydroelectric resources not only contribute to meeting state emissions goals, but those with pondage capability also add significant value to reliability given their ability to vary output based on system conditions. But they are often overlooked in the state policies because they are existing resources. Additionally, RPS-qualified resources that see their long-term contracts expire during this period will face this same market dynamic. The substantial addition of new clean energy resources will have wide ranging impacts on most electricity sellers in ISO New England's wholesale energy markets.

Finally, many generation resources' financial valuations can be expected to decline as a result of lower energy market revenues. These reduced valuations are likely to lower the valuations used by tax assessors to determine local taxes paid by asset owners. Thus, local communities can expect tax collections to be affected by reduced asset valuations for generation units.

3. ***Additional New England Power Market Impacts***

The market impact of the growth of clean energy resources on ISO New England's capacity and ancillary services markets is subject to greater uncertainty in comparison to the energy market. The expected impact in the capacity market will depend on how ISO New England's new CASPR market design performs, and how much state sponsored capacity obtains capacity obligations when existing capacity retires. The expected impact in the ancillary services markets will largely depend upon how ISO New England meets future increased ramping requirements.

The expected impact on the capacity market is difficult to assess given the dynamics of offer strategies and the fact that ISO New England's capacity market rules are complex and subject to uncertainty.[13] Under ISO New England's capacity market rules ISO-NE and its Independent Market Monitor (IMM) sets capacity offer thresholds and reviews certain capacity market offers above a specific pre-defined level (referred to as the dynamic delist bid threshold). ISO-NE and its IMM's involvement in establishing capacity resource offer thresholds means that those resources that are likely to be marginal, and have offer prices at or near the market clearing price, are closely monitored. Historical setting of capacity offer thresholds by ISO-NE shows that the establishment of these thresholds greatly influence auction outcomes.[14] While it may be the case that capacity resource offers will be allowed to reflect the costs of capital investment necessary to maintain and enhance the ability to operate reliably and flexibly, there

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[13] There are several factors that will impact future ISO New England capacity market outcomes (e.g., declining demand, changes to the demand curve, participation of demand response, and expected outcomes under the new pay for performance design). The analysis here focuses specifically on the generation resources that ISO New England expects to be most likely to be on the margin, or seek to retire, in upcoming auctions.

[14] See, for example, Alivand, Parviz and Anthony Leroux. August 9, 2017. "Dynamic Delist Bid Threshold for FCA 13-15." ISO New England.

is no certainty that these costs will be permitted in offers. Moreover, under the existing market structure, there is no guarantee that capacity that clears in an auction can meet ISO-NE's future ramping requirements.

With the implementation of CASPR, it is expected that some older infrequently operated resources will be incentivized to retire earlier and be replaced by new clean energy resources.[15] As new clean energy resources become eligible to qualify for participation in capacity auctions they will have an opportunity under CASPR to obtain capacity obligations that retiring resources are willing to relinquish. Over time, as the quantity of new clean energy resources grows enough to allow for existing resource retirements, these new resources will replace resources that were previously marginal. With the amount of clean energy resources entering the market, it also will remove the need for competitive new entry.[16]

While CASPR matches early retirement of older resources with entry of contracted resources to take their place and prevent immediate capacity market price suppression, this displacement slows or delays competitive new entry. In the absence of new entry capacity clearing prices are not expected to rise to the estimated cost of new entry, a key market design attribute underlying merchant resource expectations of capacity market price levels.

The impact on ancillary services markets is also subject to uncertainty. An increase in the quantity of intermittent resources will require ISO New England to consider how it will approach managing increased hourly and intra-hour variations in net-load and associated ramping requirements. ISO New England could consider the introduction of a ramping product to define estimated ramping requirements and provide a financial incentive for dispatchable generation resources to be available to meet ramping requirements. ISO New England could also change how it defines its operating reserve requirements in response to increased ramping requirements and possibly introduce an intermittency adder to the amount of reserves that it typically carries to account for load variations due to changes in forecasted weather conditions and its effect on intermittent resources. Until that time when changes to the market design are evaluated, ancillary services market impacts are unknown as are the prospects of their being sufficient revenue opportunities for resources that provide these reliability services. What is known is that initiatives to value ramping and day ahead scheduled operating reserves are likely to take years to implement after at least a year or more of design within ISO-NE and NEPOOL.

4. ***Longer-Term Impact on New England's Competitive Market Generation Resources***

Over the longer term, lower energy market prices and reduced production can be expected to affect the long-term viability of many existing capacity resources. Some existing resources will be rendered obsolete while other existing resources will remain crucial to efficient, reliable

[15] The intention of CASPR is to provide an auction framework to allow new contracted resources to have an opportunity to obtain a capacity supply obligation at auction prices below their actual costs to build.

[16] Once new clean energy capacity resources become existing capacity resource they can be expected to offer at zero price in future capacity auctions given they are compensated under long-term contracts.

system operation. For New England's competitive power markets to effectively guide ongoing existing capacity resource operation and maintenance and capital investment decision-making there must be an expectation that resources whose operation is needed to balance generation and load will be able to recover costs through a combination of energy, ancillary and capacity market revenues. Inasmuch as the addition of new resources drives down energy market revenues and shrinks the number of resources reliant on the wholesale market, there will be financial pressures driving retirements, including for non-emitting resources that are currently contributing to the region's emission reduction goals. The impact on existing resources will vary based upon resource specific costs and revenues. It is important to signal the need for those existing resources that are also needed going forward to continue reinvestment in their facilities. Absent reflecting the value of their flexible capabilities through competitive market prices, the region risks the possibility that any number of existing resources may face financial difficulties driving the need for out-of-market payments to ensure reliability of the New England electric system.[17] This would be a costly and inefficient result for the region.

There are two key concerns that make the ability of existing resources to remain financially viable over the longer-term an important consideration. First, it is expected that ISO New England will require a significant number of flexible (dispatchable) resources to respond to growing ramping requirements.[18] In particular, resources will be needed to both ramp to respond to changes in net-load variation, and start and stop with greater frequency. While it may currently be the case that little concern has been given to the long-term viability of existing flexible resources, many of these facilities are aging and will require capital investment to remain viable over the longer term.[19] Second, existing resources that have high going forward costs to avoid shutdown, such as a nuclear station, cannot be assumed to operate indefinitely if market revenues are insufficient to recover ongoing costs.

The eventual need for capital investment in existing resources arises as existing generating units reach the point where significant capital investment is required to maintain reliable operations. Many of the newer combined cycles in New England will be approaching 20 years of operation in the next several years. While machinery overhaul cycles vary for the different units, major overhauls require millions of dollars of investment that is unrelated to the operation and maintenance costs incurred year-to-year. Moreover, to the extent such resources must start and stop more frequently, ongoing maintenance costs will rise. Absent an expectation that the marketplace will provide an opportunity to recover these costs, including the potential for a return, resource owners should not be expected to move forward with the investments.

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[17] It is expected that there will be resource retirements as the supply of zero-emission resources increases. The focus of the analysis in this paper is those resources that are expected to be needed for reliability, but that also are expected to be financially challenged as zero-emission supply grows.

[18] While New England's ramping requirement will not necessarily approach the level experienced in California, several thousand megawatts of solar capacity combined with several thousand megawatts of wind resources will create a substantial need for flexible resources to meet ramping requirements.

[19] For example, nearly 9,000 MW of combined cycle capacity was placed into service between 1998-2003. These resources are all approaching 20 years of operation.

Existing clean energy resources may also face financial challenges when faced with declining energy revenues. The most significant concern is likely to be a resource with substantial going forward costs, such as a nuclear unit requiring equipment overhauls or a hydroelectric unit facing costs for re-investment in generation and environmental mitigation infrastructure, which relies significantly on energy and capacity market revenues to remain financially viable.[20] However, there should also be attention paid to resources currently receiving contracts, but whose contracts expire leaving those resources dependent on a robust wholesale marketplace to maintain financial viability. Reduced energy market revenues will have a substantial financial impact that could eventually cause a resource to reach the tipping point where needed investment would no longer make economic sense given the increased likelihood that investment costs would not be recovered in the market.

Finally, as the number of resources relying on the wholesale market shrinks, if the value supplied by existing competitive market resources is not reflected through market prices, they may be unable to remain financially viable while still being needed to balance load. Such a situation should be expected to lead to less efficient out-of-market retention of certain resources to maintain system reliability. Reliance on out-of-market compensation distorts the competitive marketplace and can be expected to increase consumer costs relative to a market-based approach.

Maintaining the benefits of the region's power markets requires that early action be taken to understand the impact of the growth in contracted clean energy resources and to identify market design changes that will be needed to accommodate this new entry while providing an opportunity for needed resources to remain financially viable. At a minimum ISO-NE's wholesale market design should ensure that resources that provide flexibility are compensated appropriately and that the costs necessary to maintain and enhance flexible resources can be expected to be recovered through ISO-NE's energy, ancillary services and capacity markets. ISO-NE should assess market design modifications needed to introduce new products and revise rules that could restrict resources' ability to expect to recover future investment costs. Relying on competitive markets to accommodate growth in clean energy resources provides a proven framework to minimize costs for consumers, maintain electric system reliability, and allow for innovative responses to meet the operational requirements of the future.

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20 For example, a 1,000 MW base-load unit would earn an estimated $60 million per year in capacity payments (at $5/kW-month), but earn more than $150 million in energy market margins (assuming an average energy price of $30/MWh and an average variable operational cost of $12/MWh).

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