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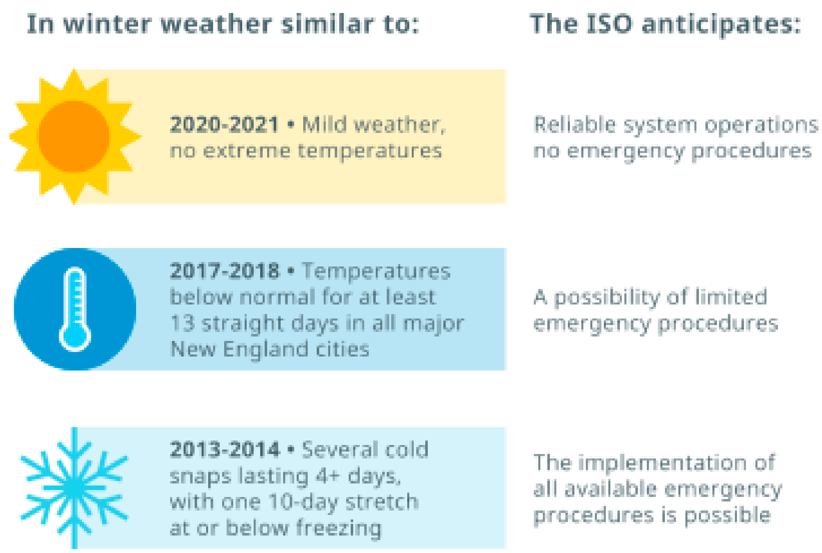
New England's Winter Electricity Challenges Call for a Clean Energy Solution

Each winter, New England's regional electric grid operator—known as the Independent System Operator for New England, or "ISO-NE" —issues an "alert" providing its assessment of how likely it is that the region could face electricity blackouts on the coldest days and nights of the year. Year-after-year, ISO-NE announces the region may have inadequate energy supplies to power the entire electric system without blackouts during the winter. This leaves New Englanders stuck in a Groundhog Day scenario, asking: if this threat to the region's electric grid happens every year, why hasn't it been fixed by now?


ISO-New England: Power Grid On Edge This Winter; Rolling Blackouts Possible

By GARRY RAYNO, InDepthNH.org December 6, 2021

New England's winter reliability challenge stems from the region's overreliance on methane gas, which currently accounts for over 50% of its electricity generation.[1] On cold winter days, some of the gas that the region normally relies on for electricity generation isn't available; instead that gas is diverted to furnaces to keep homes warm, forcing the grid operator to search for alternative, often costlier and even dirtier sources of power, such as oil. As climate change worsens and we face more frequent severe storms and polar vortex conditions, these winter reliability threats are likely to grow more substantial and costly, unless we take steps to solve them now.



The solution to New England's winter reliability challenge will also help address the region's climate and affordability challenges. With record high costs for gas and oil,[2] clean energy will save money while strengthening reliability. Instead of relying on uncertain gas or oil that must be imported, with associated economic and geopolitical risks, New England can take advantage of locally produced wind, solar, and adjustable consumer demand that doesn't contribute emissions that worsen climate change.

Fortunately, the New England states are already hard at work comprehensively supporting the construction of new clean energy resources in the region, driven in large part by emission reduction laws and renewable portfolio standards, all while reducing consumer demand for gas in buildings and improving energy efficiency. But the states' efforts have met barriers at the regional level, where the grid operator keeps rowing in the opposite direction by subsidizing oil and gas generators and excluding clean resources from fair participation across the region. Instead of continuing to hold New England back, ISO-NE and its federal regulator, FERC, must shift their focus to identifying solutions that reduce reliance on costly gas and oil while investing in clean energy solutions that pay off for the region.

This paper describes the acute problem of gas overreliance in New England and identifies solutions we can implement right now as well as over the coming years that will reduce costs for consumers, including exposure to skyrocketing fuel prices tied to volatile international markets and wars abroad, while improving reliability and drastically cutting the emissions that cause many of the extreme weather events challenging our electric grid today.

New England's winter reliability problems stem largely from over-reliance on gas generation.

Over the past decade, New England has become increasingly reliant on burning gas to generate electricity—a development that the region's grid operator, ISO-NE, acknowledges imposes significant risks to reliability during winter cold snaps.[3] In 2000, New England burned gas to generate only about 15% of its total electricity,[4] but last year that number was a whopping 53%.[5] In comparison, renewables as defined by ISO-NE accounted for about 8% of the region's total generation in 2000, and today that number has risen to just 12%.[6]

This heavy reliance on gas is a problem because the region doesn't always have enough gas to generate electricity and heat homes at the same time.[7] With no local gas resources, the region's gas supply must be delivered through either a limited pipeline network or a small number of terminals that can import liquified natural gas (LNG). Because options to store gas are very limited, these deliveries must typically happen as they are needed. As a result, gas-fired power plants can go offline en masse when storms roll into the region, stretching limited gas supplies and deliveries. During a January 2004 winter storm, over 6,000 MW of gas generation was unavailable, much of it due to lack of fuel.[8] ISO-NE recently stated that nearly 4,000 MW of gas generation[9] — about 13% of the region's generation supply[10] — may go offline during extreme cold weather events due to lack of fuel supply.

New England's over-dependence on gas means the region's entire electric system is at risk any time there is a threat to any point in the vulnerable gas supply chain. While the region has thus far avoided intentionally shutting off electricity to customers to keep the electricity system from going down — called "shedding load" — in January 2022, ISO-NE faced a possible energy shortfall that came too close for comfort. One of only two LNG terminals that provide LNG supply to New England lost power, placing additional demands on the gas pipeline system and threatening pressure issues on some gas pipelines as a result of that increased demand.[11]

As one response to these challenges, ISO-NE and FERC have tried to improve coordination between the gas delivery and electric systems — a chronic problem given that gas pipeline operators offer inflexible service in part due to the physical limitations of pipelines.[12] However, a senior official at the North American Electric Reliability Corporation (NERC), recently threw cold water on the idea that better gas-electric coordination will somehow magically improve things, concluding that "[e]very ounce of efficiency has been squeezed out of that."[13]

Unfortunately, ISO-NE has enabled the region's problematic over-reliance on gas to grow in part because the grid operator does not factor fuel supply limitations into the capacity that a gas plant can sell.[14] In New England, power plants can sell their capacity through a capacity market administered by ISO-NE, which is intended to ensure there will be enough power to run the grid. A plant's capacity value is meant to reflect its availability to provide power. Yet even if a gas plant has no ability to obtain gas supply during severe cold snaps, ISO-NE does not reduce the gas plant's capacity value accordingly. This means that a lot of the gas-fired electricity capacity sold in the region — and paid for by homes and businesses on their electricity bills — is phantom capacity that won't be there when the region needs it most.

For years, ISO-NE has tried to patch up and work around failing market rules that exacerbate the region's unsustainable overreliance on gas, including by incentivizing electricity generators to sign so-called "firm" contracts for gas delivery or to stockpile backup fuels like polluting and costly fuel oil. The grid operator has also prevented the retirement of certain LNG-burning generators like the Mystic Generating Station in Massachusetts through hundreds of millions of dollars in subsidies. But none of these band-aid solutions gets at the root of the problem.

To be clear, gas doesn't fail only in New England. Problems with overreliance on gas have featured prominently in nationwide reliability risk assessments by FERC and NERC. For instance, a recent NERC State of Reliability Report concludes that "[g]rowing reliance on natural gas as an electricity generation fuel source increases the potential for common-mode failures that have widespread reliability impacts."[15] NERC notes that the severe outages in Texas during 2021's Winter Storm Uri was caused by "high demand, decreased natural gas production, and decreased processing volumes occasioned by prolonged freezing temperatures and power outages resulted in a number of pipelines" restricting gas flow.[16] Winter Storm Uri caused substantial loss of life in Texas, and while New England has never faced that level of threat, smart planning and investments in clean energy can ensure that it never does.

The solution is to pivot to clean energy.

The solution is not to put good money after bad by building more fossil fuel generation or costly pipelines that will never pay off, but instead to invest in clean solutions that will make the region's electric system more reliable while reducing the emissions causing climate change.[17] Below, we highlight a number of targeted clean reliability solutions that can be implemented quickly to address near-term concerns. We also offer a longer-term vision for a decarbonized and affordable electric system that will keep the lights on and New Englanders healthy and safe.

Low-hanging fruit: clean reliability solutions that can be deployed within months

The New England states are moving rapidly to deploy wind, solar, and energy storage technologies that will be key to reducing reliance on gas, but these resources can take several years to site and construct. Fortunately, New England has other clean reliability solutions at hand that can address near-term winter reliability challenges, including residential demand management, consumer and industrial demand response, and energy efficiency. With just a few steps, these solutions can be deployed to help avoid winter blackouts and protect communities and the climate at the same time. However, to incentivize and fully harness these resources, their value to the regional grid must be recognized and rewarded. Either ISO-NE must compensate the services provided by these clean resources in wintertime, or it must enable electric utilities, and by extension electric customers, to avoid certain costs that ISO-NE would otherwise impose.[18]

1. Residential demand management can be harnessed now to help keep the electric grid reliable.

New England boasts nation-leading state energy efficiency programs, many of which have already established clean reliability programs in the summer that could help keep the lights on in the winter too. Active demand reduction programs in states across the region, including the ConnectedSolutions program in Massachusetts, are one example.[19] The ConnectedSolutions program takes advantage of resources like battery storage located in homes to slash energy use on hot summer days. Smart thermostats, electric car chargers, and other residential technologies can also reduce stress on the electric grid in the same way — by lowering consumer demand when the power grid is stressed. Automatically adjusting a large number of these devices by small amounts that aren't noticeable to the individual consumer can slash demand on the grid and reduce the need for more electricity generators to power up.[20]

Simple, quick steps could expand these programs to provide targeted relief in the winter, not just during the summer as they do today. To reap the benefits of these residential programs in cold weather, the states and ISO-NE should collaborate to start paying for this electricity demand reduction service when it is needed in both the summer and the winter. The smart management of residential devices including battery storage, thermostats, and electric vehicle chargers, when coordinated through state energy efficiency programs, could provide substantial benefits in the winter. But these benefits are currently lost because the value these load reductions provide to winter reliability are not recognized and compensated for. State programs should recognize this value and incorporate it into active demand management programs that are already underway, expanding them for winter mobilization.[21] ISO-NE can also help by quantifying the value of these resources to grid reliability and ensuring that any savings attributable to state programs are compensated appropriately and factored into grid planning and operations.

Massachusetts utilities anticipate that residential and commercial and industrial active demand reduction programs they implement will provide 280 MW of peak demand reduction annually by 2024,[22] which is nearly half the output of New England's last operating coal plant in Bow, New Hampshire. Similar programs in other New England states can provide additional grid resources to draw upon in both the winter and the summer.[23] If the electric grid needs relief, ISO-NE and state regulators should offer a level of compensation that accurately reflects the extent of wintertime needs. As the benefits of program participation rise, more broadly aggregated consumers can provide an even larger resource to assist. In contrast to paying for costly fossil fuels or sinking money into unnecessary large-scale infrastructure, these programs lower consumer costs, strengthen the local economy, and provide communities with relief from the health and climate impacts of fossil fuel emissions.

2. Commercial and industrial demand response programs can be ramped up and paid more to help meet wintertime electric grid needs.

Commercial and industrial (C&I) demand response is an established resource in the region that has more benefits to offer the electric grid in the wintertime than it currently provides. In 2015, ISO-NE launched a grid relief initiative called the Winter Reliability Program,[24] which included a C&I demand response element that enabled the grid operator to call on C&I customers for up to thirty grid reliability events each winter.[25] Under demand response programs like this one, C&I customers can shift the timing of activities like industrial production or deploy on-site demand-reduction devices like lighting controls to provide relief for a stressed grid. For example, cement producers can pause rock crushers, sawmills can temporarily delay operations, and large buildings like courts or schools can make minor adjustments to temperature set-points or fan speeds. For the 2016/2017 Winter Reliability Program, just six customers were able to provide 23 MW of demand response.[26] ISO-NE could attract more participation in winter reliability programs by paying customers at a level that matches the grid benefits they offer can increase the grid relief available to keep the lights on.

FERC recently approved a new winter reliability program developed by ISO-NE called the Inventoried Energy Program, which ISO-NE plans to implement starting in the winter of 2023-2024. Unfortunately, this program does not allow most demand response to be compensated for its contributions to keeping the grid reliable and instead will direct $150 million a year to increasing inventories of on-site fuel like oil and gas located at a power plant. Demand response could fit this model because it comprises resources that are similarly held in reserve and can be called up, but ISO-NE has thus far not seized this opportunity.

To provide more near-term grid relief, ISO-NE should either make space for demand response within the Inventoried Energy Program or should work with the states to establish a wintertime program similar to the ConnectedSolutions program for C&I demand response. ConnectedSolutions is an established model that could be tailored to meet current needs. It includes a pay-for-performance element that encourages strong performance through incentives without imposing outsized fines that would deter participation by C&I participants, whose tolerance for outsized fines is low because their primary jobs comprise activities like running schools or operating stores, not arbitraging wholesale energy markets. For such a program to mobilize the latent potential for demand response in New England, compensation levels must reflect the reliability benefit that C&I can provide to New England's electric grid when generation resources may be constrained. The ability to call on these consumer resources not only helps when power plants face gas supply constraints, it can also reduce the need for new, costly infrastructure as we electrify New England's economy, all while lowering harmful emissions. A renewed ConnectedSolutions program that adequately compensates demand response for its value to winter electric grid reliability could attract additional participation from both existing and new customers.

ISO-NE and the states should take steps to cooperate to ensure that C&I demand response resources can provide another flexible and cost-effective reliability tool to deploy in the near-term and for many winters to come.

3. Energy efficiency programs can accelerate key efficiency measures and reduce reliance on gas for heating.

Energy efficiency has already saved the region a great deal of money while simultaneously avoiding impacts from generation and infrastructure.[27] With the right incentives and program designs, efficiency resources could do even more to help with both winter electric grid reliability. The first step to taking greater advantage of energy efficiency measures to strengthen the reliability of New England's electric grid is to call these measures what they are — reliability tools. When we identify the specific purpose for an energy efficiency measure, we empower ourselves to value and compensate that measure appropriately for a specific service. Right now, state energy efficiency programs are already reducing strain on the grid in both the winter and the summer. But by valuing the benefit that certain measures can offer the electric system on cold winter days and nights, the region can get greater value through ramping up existing measures to achieve more energy savings. We can also potentially identify new efficiency measures that weren't cost-effective before but will be cost-effective when winter reliability benefits are properly valued.

Energy efficiency measures that can provide effective near-term relief for the grid in the winter include those that save electricity as well as gas, such as:

- Switching from electric resistance heat to more efficient heat pumps for winter heating. This is an effort already underway in many parts of the region and can be accelerated with appropriate compensation for reliability benefits.
- Active demand management of gas devices such as the control of gas hot water heaters or smart thermostats for gas-fired furnaces. These measures are already in use and could be expanded with strategic investments and appropriate compensation.
- Switching from gas furnaces to heat pumps, which can reduce the overall use of gas in the region to produce thermal energy. Heat pumps are much more efficient than gas furnaces and can also run on clean renewable power, including rooftop solar. An extra incentive or requirement may be helpful to reduce reliance on residual gas furnaces after heat pumps have been installed, or to promote combined heat and hot water electrification together with solar installations.

The states and ISO-NE, in collaboration with energy efficiency program administrators, should work together to swiftly expand these types of measures in preparation for coming winters. As the New England states reduce the overall use of gas for heating homes and businesses through building electrification, benefits will include a reduction in conflicting uses of gas and the total need for gas in the region, both of which will help electric system reliability.

Transitioning the grid for good: the region's overall path to a clean and reliable electric system

While demand response and efficiency programs can help meet near-term winter reliability needs, the longer-term solution will involve a much wider set of clean energy assets including wind and solar, energy storage, advanced flexible load, and transmission. Fortunately, the region already has in place strategies to accelerate deployment of these resources, thanks to New England states and local governments that have been driving clean energy procurement for many years.

1. A balanced portfolio of complementary renewables like wind and solar are already under development and can help displace fossil fuels.

The workhorses of a clean energy grid are wind and solar resources. All but one of the New England states have adopted aggressive and mandatory clean energy standards and decarbonization targets, together with targeted procurements for offshore wind and energy storage.[28] To meet these standards, installed solar capacity will more than double by 2031.[29] Offshore wind will also be interconnecting to the New England system very quickly in the coming years — approximately 4,700 MW of offshore wind is planned to come online by June 2027, with a winter capacity value estimated at nearly 3,000 MW.[30]

While no generation resource is available all the time, wind and solar production are complementary and when combined can meet demand during most hours of the year.[31] Offshore wind in particular will be critical to serving wintertime electricity demand, enabling significant conservation of gas in the region during extreme cold weather events.[32] A recent independent analysis showed that offshore wind resources would have significantly reduced wholesale power prices and emissions during a prolonged and severe cold snap 2017-2018 due to their consistently high output during these weather conditions.[33] Because offshore wind produces power consistently during the winter, all of the offshore wind capacity coming online in the next five years will materially reduce the region's dependency on constrained gas supply chains.

As wind and solar resources come to dominate the system over time, there will be certain hours of the year when it will be helpful to have available some amount of "dispatchable" resources. On the current electric system, gas resources sometimes play an important role in ramping up and down quickly to fill in any gaps in renewable energy production.[34] ISO-NE acknowledges that this role could be fulfilled just as well by non-emitting energy resources such as co-located storage and renewables.[35] Doing so has the added benefit of avoiding reliance on gas plants that run just a few hours a year and may not provide enough economic justification for pipelines to continue operating. It is critical that regional electricity markets include mechanisms to compensate resources like batteries for the value of these services. We also must start to think and plan differently. A recent study by ISO-NE examining the reliability and cost of different resource mixes assumed batteries would provide none of these services, simply because ISO-NE's software was incapable of modeling batteries in this way.[36] This example shows how arguments that gas is necessary even in a highly decarbonized grid are often based on unfounded or unquestioned assumptions about what alternatives may be available if market signals incent the needed services.

2. Battery storage can be deployed in "stacked" form now to help New England, while in the future long-duration storage will also be key.

In combination with renewable energy and the management of consumer demand, battery storage can help transform New England's energy system to one that is both clean and reliable, starting today. Long duration storage — batteries that last twelve hours or more without recharging — is often considered a panacea for energy in the future, but the truth is that existing energy storage, including batteries that last four hours each, can already be "stacked" today to benefit the electric system. This stacking occurs when multiple batteries are deployed in sequence. For example, as opposed to having a single battery or set of batteries that can last four days, stacking up 100 batteries and deploying them in rounds over the course of four days can provide similar benefits to the electric system. This can be especially powerful when paired with clean energy like distributed solar.

Researchers at both MIT and Stanford recently released reports that document the advantages of deploying energy storage, including technologies available now. The MIT researchers found that storage technologies can "substitute for, or complement, essentially all other elements of a power system" including "generation, transmission, and demand response."[37] Energy storage will be especially valuable once New England's electric system relies on higher volumes of renewable energy that has variable output, and as the states' decarbonization targets ratchet up further. The Stanford researchers further concluded that storage longer than four hours, while helpful, is actually not required to reach a 100% decarbonized electricity system, because combining four-hour batteries can do the same job.[38]

ISO-NE and the New England states cannot afford to wait to deploy more battery storage. ISO-NE predicts that the electric system will need to keep substantial gas facilities in place for the foreseeable future to meet reliability needs, pending new developments like the availability of long duration storage.[39] In fact, energy storage can serve similar balancing functions as gas, while providing relief to the electric system during winter cold spells and reducing transmission needs. ISO-NE and state leaders can ensure energy storage solutions for the grid by re-targeting or supplementing existing programs like ConnectedSolutions and the Inventoried Energy Program to incent energy storage solutions that can cut demand on the electric system in wintertime, while beginning to plan and invest in a long-term energy system that maximizes the use of cost-effective energy storage.

3. Flexible load is a type of advanced demand management that can substantially expand across the region very soon to help the electric system.

Flexible load is a resource that has a great deal of untapped potential that can be rapidly expanded on a wide scale in the next few years, and it is also a key part of the region's long-term reliability picture. Examples of flexible load include some technologies already in place, including some discussed above, such as controllable hot water heaters, but can also include a wide array of "smart" electric technologies in use in homes, businesses, government facilities, and school campuses that are not currently being tapped much or at all. As the region electrifies, these technologies will become more prevalent. The failure to seize the full scope of opportunities provided by these technologies would be a mistake of large proportions, resulting in higher electricity demand and costs, while missing out on a cheap and easy way to shape minute-by-minute electricity demand to match grid needs. Flexible load can help to reduce system peaks, which will be especially important as more buildings and transportation uses of fossil fuels become electrified. Winter mornings are projected to become one of the more challenging times on New England's system as buildings electrify, and are sometimes cited to justify the need for new gas supply even in a highly decarbonized scenario.[40]

It is critical that both ISO-NE and state energy leaders must work to maximize the flexibility of the region's electric load. Appropriate metering or submetering is pivotal, so that the grid operator can have visibility into and make the best use of consumer device aggregations. ISO-NE must adopt rules that enable flexible load resources to participate in its wholesale energy markets as part of broader aggregations of distributed energy resources. States have authority to make change under the rates that consumers pay, including over rate designs and demand management programs that for example incentivize the "smart" charging of electric vehicles at times of the day when the electric system is not under stress.[41] State regulators could also direct utilities to accept — and support — alternative metering (e.g., submeters built into smart devices, or other high quality submetering located on consumer property) when needed to take advantage of these widespread resources. Transparency and state-regional coordination are essential to enable these technologies to meet their potential as grid resources, including their ability to reduce peak consumer demand on the electric system in the winter, and to be deployed in aggregated form in response to winter reliability events.

4. Smart expansions to the transmission system will enable New England to reduce and ultimately eliminate its dependence on gas.

Finally, a carefully expanded transmission system will be vital to an affordable and reliable decarbonized power grid — both to improve connections with neighboring regions and to unlock new clean resources within New England. ISO-NE's recent 2050 Transmission Study documents the need for additional, targeted transmission.[42]

The siting and construction of new transmission lines has been a challenge in New England, as in many other parts of the country, but there are signs of progress towards agreement on how sorely needed transmission expansion can be achieved. FERC is undertaking a rulemaking to overhaul transmission planning to require a more expansive and coordinated consideration of the benefits of transmission, rather than the existing approach that results in overbuilding transmission that hasn't been designed to maximize benefits to the region and that ignores the massive consumer savings that could come from unlocking access to wind and solar power.[43] The reforms under consideration in this rule are consistent with the recommendations made by the New England states last year that "ISO-NE's transmission planning tariff [must be] reformed on a timely basis to implement a state-led, proactive scenario-based planning process for long-term analysis of state mandates and policies as a routine planning practice."[44]

In addition, there are signs of increasing consensus among environmental advocates and stakeholders on the need for transmission to facilitate the clean energy transition that may aid in overcoming siting challenges. In May 2022, RENEW Northeast, whose members are both energy companies and environmental groups, published a blueprint for the development of transmission in New England that emphasizes the need for regional collaboration to get transmission planned and built quickly and efficiently, with minimal impacts.[45] In June, 38 groups, most of them environmental advocacy organizations from across New England such as the Audubon Society of Rhode Island, Natural Resources Council of Maine, and the Environmental League of Massachusetts, issued a letter to the six New England governors advocating the issuance of a multi-state solicitation for transmission to help unlock the region's offshore wind capacity.[46] In August, a diverse coalition called New England for Offshore Wind, which includes environmental advocacy groups as well as labor unions, businesses and business associations, and universities, adopted a shared set of basic principles for the development of transmission in the region. They announced that these principles are intended to help increase consensus and overcome existing hurdles to building transmission for renewables in the region.[47]

Because new transmission for renewables could take years to get planned, approved, and built, this is a pressing priority for those in the region as well as the federal government. Although distributed generation and other demand-side resources are critical to decarbonization, without a balanced set of clean energy resources including wind and solar, the region cannot achieve a reliable, decarbonized energy system. To seize these larger scale clean energy opportunities, the region needs smart investments in transmission.

Conclusion

As New Englanders confront yet more warnings about the reliability of the electric system during the winter, it's worth asking whether it must be this way. Fortunately, New England has clean options to move past over-reliance on gas. Instead of doubling down on expensive, dirty, and increasingly volatile and globally unsecure fossil fuels like gas, New England's leaders, with the support of federal agencies like FERC, should be accelerating efforts to deploy alternatives to gas generation that take advantage of the region's abundant clean energy resources. Every reduction in gas dependency will make New England's grid more reliable, less expensive, healthier for communities, and far less damaging to the stability of the climate.

Primary Authors:

Melissa Birchard, Acadia Center,
mbirchard@acadiacenter.org

Casey Roberts, Sierra Club,
casey.roberts@sierraclub.org

Endnotes

1 *See* https://www.iso-ne.com/about/key-stats/resource-mix (53% of electricity was generated using gas in 2021).

2 *See* https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/natural-gas/072222-new-england-winter-natural-gas-prices-top-40-as-global-lng-market-tightens (noting gas prices above $40/MMBtu for winter 2023).

3 *See*, e.g., 2021 Press Release, ISO New England, Harsh Weather Conditions Could Pose Challenges to New England's Power System This Winter (Dec. 6, 2021), *available at* https://isonewswire.com/2021/12/06/harsh-weather-conditions-could-pose-challenges-to-new-englands-power-system-this-winter/ (stating that "For the past two decades, ISO New England has raised concerns about fuel supply issues and their impact on electricity supply during periods of extreme cold weather. Constraints on the natural gas pipeline system limit the availability of fuel for natural gas- fired power plants, as heating customers are served first through firm service contracts," and reporting that, during winter conditions "[n]atural-gas-fired generating capacity at risk of not being able to get fuel when needed: more than 3,700 MW."); 2020 Press Release, ISO New England, New England Expected to Have Sufficient Electricity Throughout Winter 2020-2021 (Dec. 8, 2020) ("2020 Press Release"), *available at* https://www.iso-ne.com/static-assets/documents/2020/12/20201208_pr_winteroutlook.pdf (stating that "Consecutive days of extremely cold weather can reduce fuel availability for generating power due to regional natural gas pipeline capacity constraints," and reporting that, for winter 2020-21, "[n]atural-gas-fired generating capacity at risk of not being able to get fuel when needed: more than 4,000 MW.").

4 *See* https://www.iso-ne.com/static-assets/documents/2022/06/iso_ne_overview_and_regional_update_cbia_6_2_2022.pdf.

5 https://www.iso-ne.com/about/key-stats/resource-mix.

6 *Id*. ISO-NE defines renewables to exclude hydropower, but to include generation of electricity through burning of refuse, methane, landfill gas, and wood.

7 *See* ISO-NE Key Grid and Market Stats, Resource (also accessible at https://www.iso-ne.com/about/keystats/resource-mix) (". . . interstate pipeline infrastructure has only expanded incrementally over the last several decades, even as reliance on natural gas for home heating and for power generation has grown significantly. During cold weather, most natural gas is committed to local utilities for residential, commercial, and industrial heating. As a result, *we are finding that during severe winter weather, many power plants in New England cannot obtain fuel to generate electricity.*" (emphasis added)).

8 *See* ISO New England Internal Market Monitor, Final Report on Electricity Supply Conditions in New England During the January 14-16, 2004 'Cold Snap" (October 12, 2004), https://www.iso-ne.com/static-assets/documents/2017/09/iso-ne_final_report_jan2004_cold_snap.pdf.

9 *See* ISO-NE, NEPOOL Participants Committee Report at 18 (Nov. 3, 2021), *available at* https://www.iso-ne.com/static-assets/documents/2021/11/november-2021-coo-report.pdf (stating that "[a]pproximately 3,700 MW [of gas generation] may be at risk due to pipeline constraints").

10 The region has about 31,500 MW of generating capability. ISO New England, Key Grid and Market Stats, https://www.iso-ne.com/about/key-stats/ (2022).

11 *See* FERC Docket ER22-1528, ISO New England, Testimony of Vamsi Chadalavada, at 25.

12 *See* Omar Guerra et al., Joint Institute for Strategic Energy Analysis, *Electric Power Grid and Natural Gas Network Operations and Coordination*, p. 2-4, NREL/TP-6A50-77096 (Sept. 2020), https://www.nrel.gov/docs/fy20osti/77096.pdf.

13 *See* Robert Walton, 'Batteries aren't going to do it': NERC's Moura calls for gas investment to maintain reliability, UtilityDive (July 21, 2022), https://www.utilitydive.com/news/nerc-2022-reliability-report-gas-solar/627784/?utm_source=Sailthru&utm_medium=email&utm_campaign=Issue:%202022-07-26%20Utility%20Dive%20Storage%20%5Bissue:43374%5D&utm_term=Utility%20Dive:%20Storage.

14 *See* Newell et al., Brattle Group, *Capacity Resource Accreditation for New England's Clean Energy Transition*, at 11 & n.2.

15 *See* https://www.nerc.com/pa/RAPA/PA/Performance%20Analysis%20DL/NERC_SOR_2022.pdf, at 45.

16 *Id*.

17 As clean energy deployment continues and state laws to encourage electrification of buildings kick in, overall demand for thermal use of gas will decline steeply. This will further worsen the economics for new gas pipelines, which have already failed to pencil out in the New England region. For example, Kinder Morgan withdrew the application for its Northeast Direct pipeline in 2016 when it failed to obtain sufficient contractual commitments to support its development. *See* Letter, Tennessee Gas Pipeline Company, L.L.C., Docket No. CP16-21-000 (May 23, 2016), available at https://climate.law.columbia.edu/sites/default/files/content/NE-Energy-Direct-Project-Notice-of-Withdrawal-of-Certificate-of-Application.pdf.

18 State-policy driven winter efficiency and demand response programs have to date not been valued by ISO-NE in that each utility's share of the "installed capacity" requirement is based on summer peak alone, not winter peaks, even though winter has been a time when the New England grid has faced challenges for many years. *See* https://ma-eeac.org/wp-content/uploads/AESC-Supplemental-Study-Part-I-Winter-Peak.pdf, at 3.

19 *See* https://www.masssave.com/saving/residential-rebates/connectedsolutions-batteries.

20 *See* Order in D.P.U. 21-120 – 21-129, issued Jan. 31, 2022 (authorizing active demand reduction programs that utilize e.g., direct load control, smart thermostats, battery storage, and EV chargers).

21 *See* https://www.cleanegroup.org/wp-content/uploads/Energy-Storage-for-Winter-Reliability.pdf.

22 *See* Order in D.P.U. 21-120 – 21-129 at 55 (citing Statewide Plan, Exh. 1, App. C.1-Electric (Rev.), Table IV.D.3.2.i).

23 *See*, e.g., CT 2022-2024 Conservation & Load Management Plan at 63-64, https://portal.ct.gov/-/media/DEEP/energy/ConserLoadMgmt/Final-2022-2024-Plan-to-EEB-1112021.pdf.

24 *See ISO New England Inc.*, 152 FERC ¶ 61,190 (2015) (conditionally accepting Winter Reliability Program rules).

25 *See* Demand Response Component of the 2015-2018 Winter Reliability Program, https://www.iso-ne.com/static-assets/documents/2016/08/a4_dr_winter_reliability_program_2015_2018.pptx.

26 *See* https://www.iso-ne.com/static-assets/documents/2017/04/april-2017-coo-report.pdf, slide 6.

27 *See, e.g.,* Pat Knight et al., Avoided Energy Supply Components in New England: 2021 Report (2021), https://www.synapse-energy.com/sites/default/files/AESC%202021_20-068.pdf (quantifying avoided energy, fuel, capacity, transmission and distribution costs associated with New England energy efficiency and demand response programs).

28 *See* https://www.iso-ne.com/static-assets/documents/2022/06/iso_ne_overview_and_regional_update_cbia_6_2_2022.pdf, at slides 9 & 10.

29 *Id.* at slide 12.

30 *See* Testimony of Abigail Krich on behalf of Consumer and Clean Energy Advocates, at 6, ISO New England Inc., Docket No. ER22-1528.

31 *See, e.g.,* Caitlin E. Clark et al., Wind and Solar Hybrid Power Plants for Energy Resilience, NREL/TP-5R00-80415 (Jan. 2022), https://www.nrel.gov/docs/fy22osti/80415.pdf (finding that non-mountainous regions of the Northeast have relatively high annual complementarity between wind and solar production); Slusarewicz, J.H., Cohan, D.S., "Assessing solar and wind complementarity in Texas," Renewables 5, 7 (2018), at https://doi.org/10.1186/s40807-018-0054-3.

32 *See* ISO-NE, High-Level Assessment of Potential Impacts of Offshore Wind Additions to the New England Power System During the 2017-2018 Cold Spell (Dec. 17, 2018), https://www.iso-ne.com/static-assets/documents/2018/12/2018_isone_offshore_wind_assessment_mass_cec_production_estimates_12_17_2018_public.pdf.

33 *See* North Carolina State University, "Study finds offshore wind could drive down energy costs in New England, US," ScienceDaily, available at www.sciencedaily.com/releases/2022/04/220421154138.htm.

34 Oftentimes, gas generation's ability to fill this role is constrained by contracts with gas pipelines requiring the plant to take a consistent amount of fuel throughout the day (known as ratable take). *See, e.g.,* N. Jonathan Peress & Natalie Karas, *Aligning U.S. Natural Gas and Electricity Markets to Reduce Costs, Enhance Market Efficiency and Reliability* (Sept. 2017), at https://www.edf.org/sites/default/files/aligning-us-natural-gas-and-electricity-markets.pdf.

35 *See* ISO-NE 2021 Economic Study: Future Grid Reliability Study Phase 1 (July 29, 2022), at 41-43 ("dispatchable resources in the future do not necessarily need to be carbon-emitting, but they should have similar attributes to today's dispatchable resources. Examples of such resources with these key attributes not explicitly studied might include today's fossil fuel units powered by synthetic or renewable fuel, new small modular nuclear units, co-located storage and renewables, large-scale solar or renewables operated in particular ways to maximize dispatchability, or imported hydro-power from Québec."); *see also* https://energy.mit.edu/wp-content/uploads/2022/05/The-Future-of-Energy-Storage.pdf.

36 *Id.* at 36.

37 *See* MIT, The Future of Energy Storage, at xvii (May 2022), https://energy.mit.edu/wp-content/uploads/2022/05/The-Future-of-Energy-Storage.pdf.

38 *See* Jacobson, M. et al., Stanford Univ., "Zero air pollution and zero carbon from all energy at low cost and without blackouts in variable weather throughout the U.S. with 100% wind-water-solar and storage," Renewable Energy 184 (2022) at 436, https://web.stanford.edu/group/efmh/jacobson/Articles/I/21-USStates-PDFs/21-USStatesPaper.pdf.

39 *See, e.g.,* "problem statement" expected to be filed in FERC Docket AD22-9-000, available in draft form at https://isonewswire.com/wp-content/uploads/2022/08/DraftFERCTechConferenceEverettandEnergyAdequacyProblemStatement-8.29-final.pdf (at 1: "it is critical to the region's decarbonization goals that the lights and heat stay on in New England – and, for the foreseeable future, that requires gas," at 2: "both the gas distribution system and the electric power system have a dependence on imported LNG, and this reality will persist until the region invests in access to alternative long duration energy storage infrastructure.").

40 *Id.*

41 *See* https://energynews.us/2022/07/06/national-grid-offers-incentives-for-off-peak-electric-vehicle-charging-are-they-enough/ (describing Massachusetts utility National Grid pilot program to incent off-peak charging).

42 *See* https://www.iso-ne.com/system-planning/transmission-planning/longer-term-transmission-studies/.

43 *See* Federal Energy Regulatory Commission, Explainer on the Transmission Notice of Proposed Rulemaking, https://www.ferc.gov/explainer-transmission-notice-proposed-rulemaking; RM21-17, Building for the Future Through Electric Regional Transmission Planning and Cost Allocation and Generator Interconnection.

44 New England States Committee on Electricity, New England Energy Vision Statement, Report to the Governors, Advancing the Vision 12 (2021), https://newenglandenergyvision.files.wordpress.com/2021/06/advancing-the-vision-report-to-governors-2.pdf.

45 *See* https://renewne.org/wp-content/uploads/2022/05/RENEW-Northeast-Transmission-Blueprint-2022-05-23.pdf

46 *See* https://www.newenglandforoffshorewind.org/wp-content/uploads/2022/06/FINAL-Offshore-Wind-Transmission-Sign-On-Letter.pdf

47 *See* https://www.newenglandforoffshorewind.org/wp-content/uploads/2022/08/FINAL-Transmission-Principles.pdf.