DECARBONIZING THE PEAK

A Roadmap for Retiring and Replacing Massachusetts' Fossil Fuel Peaker Plants by 2050

MA CLEAN PEAK COALITION

Synapse Energy Economics, Inc.

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ABOUT THIS REPORT

This report evaluates whether Massachusetts can meet peak electricity demand in 2050 using only zero-emissions resources, as required to achieve the state's legally mandated net-zero emissions goal. The analysis finds that full peak decarbonization is feasible, reliable, and cost-competitive, even as electrification drives a shift to higher, longer, winter-peaking demand. A least-cost portfolio of clean resources combines demand-side measures, energy storage, and wind generation to meet 2050 peak demand. When climate and public health benefits are accounted for, the battery and wind components of this clean peak portfolio are less costly than continued reliance on gas peaker plants or combustion-based alternatives such as hydrogen or renewable natural gas.

The report was prepared by the Massachusetts Clean Peak Coalition—consisting of the Berkshire Environmental Action Team (BEAT), Clean Energy Group, and Slingshot—with analysis by Synapse Energy Economics (Synapse).

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with analysis by Synapse Energy Economics, Inc.

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Executive Summary

Massachusetts has committed to achieve net-zero emissions by 2050, a goal that requires retiring the state's fossil fuel peaker power plants and replacing them with clean, reliable alternatives. Peaker plants are typically called on to run during periods of high electricity demand. They are among the most expensive and polluting resources on the grid and are disproportionately located in low-income communities and communities of color, where they contribute to significant public health impacts.

This report presents a statewide analysis conducted by Synapse Energy Economics (Synapse) on behalf of the Massachusetts Clean Peak Coalition. The analysis evaluates whether Massachusetts can meet peak electricity demand in 2050 using only zero-emissions technologies, while maintaining reliability and containing costs. The findings demonstrate that full peak decarbonization is feasible and achievable, and can be accomplished at costs comparable to, or lower than, continued reliance on gas peakers or combustion of alternative fuels when climate and health impacts are considered.

By 2050, Massachusetts is expected to shift from a summer-peaking to a winter-peaking electricity system due primarily to widespread electrification of heating and transportation. Peak demand will be higher, longer in duration, and occur twice daily during cold winter mornings and evenings. To meet these needs, Synapse identified a least-cost clean peak energy generation portfolio composed entirely of non-combustion resources. The portfolio relies on three primary strategies: (1) aggressive deployment of 4.2 gigawatts of demand-side measures to shift and reduce energy use during peak hours; (2) large-scale deployment of 6.9 gigawatts of energy storage, including long-duration storage capable of operating through multi-day winter cold events; and (3) 6.4 gigawatts of strategically sited onshore and offshore wind generation as it aligns well with winter peak demand.

The analysis finds that, once all cost and benefits are accounted for, the battery and wind components of the clean peak portfolio have an average annualized cost that is lower than the cost of portfolios that continue to rely on gas turbines or transition to hydrogen or renewable natural gas. The costs to acquire the demand response resources are not estimated or accounted for in this analysis. In contrast, combustion-based alternatives such as hydrogen and renewable natural gas are more expensive, perpetuate local air pollution, and carry significant unaccounted infrastructure and lifecycle emissions risks. Clean peak decarbonization is likely to result in increases in average residential electricity bills, as avoided climate and public health impacts are not accounted for in bills.

Based on these findings, the Massachusetts Clean Peak Coalition advances four core recommendations:

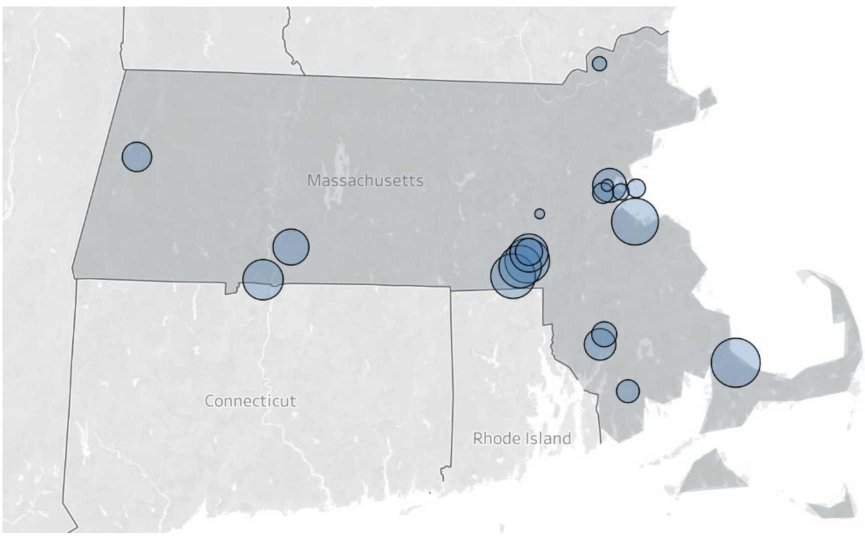
1. **Incentivize demand-side measures to reduce the cost of decarbonization**, with a focus on reducing summer and winter peaks.
2. **Prioritize the development of medium- and long-duration energy storage** technologies to maintain reliability during winter peaks.
3. **Consider local siting constraints and community concerns** in building out wind capacity.
4. **Account for externalities**, such as climate and public health impacts, when evaluating the cost-effectiveness of peak decarbonization.

Taken together, the analysis confirms that decarbonizing peak demand is not an abstract aspiration but a practical and necessary component of Massachusetts' clean energy transition. With deliberate policy choices centered on zero-emissions solutions, equity, and community engagement, the Commonwealth can retire its most harmful power plants, protect public health, and build a cleaner, more resilient electric system by 2050.

Introduction

Peaker power plants have traditionally played an important role in grid reliability by supplying energy during times of high electricity demand and providing capacity when the electric grid is stressed. In addition to serving as a source of peak generation capacity, peakers often provide ancillary services to the grid, such as voltage regulation, frequency response, and black-start capabilities to restart the grid after a major power outage. Peaker plants are less efficient than other types of power plants, they're expensive to run, and they represent a significant source of local pollution as they are often powered by fossil fuels.

Figure 1. **Map of fossil fuel peaker power plants in Massachusetts.**



Peaker plants in Massachusetts are represented by circles. The size of the circle corresponds to the nameplate capacity of the plant, ranging from 42 MW to 1.5 GW.

Massachusetts is home to more than 20 fossil fuel peaker plants, as shown in **Figure 1**.[1] These power plants are primarily located near population centers and are disproportionately located in low-income communities and communities of color.[2] Because of the technologies used and how they operate, peakers typically emit localized pollution, including small particulates ($PM_{2.5}$), nitrogen oxides (NO_x), and sulfur dioxide (SO_2), at a higher rate than baseload power plants. Even when emissions are reported within permitted levels, research has found that emissions from combustion technologies such as peakers are greater than reported and contribute to increased cardiovascular and respiratory illness, as well as premature mortality, in nearby populations.[3] Low-income populations, as well as Black, Indigenous, and people of color (BIPOC) populations, are disproportionately at risk for negative health outcomes caused by peakers, both because they are more likely to live near peaker plants and because they often face additional structural barriers to accessing health care.[4]

Peaker plant owners are well compensated for the services they provide, primarily through what are known as capacity payments – ratepayer-funded payments to peaker plants to sit and wait to be called on. One assessment of capacity payments for peaker plants in New York City found that they can account for as much as 5 percent of the average customer's utility bill, amounting to more than a billion dollars in payments over ten years.[5]
However, all the services provided by fossil peaker plants can be supplied by non-combustion alternatives, with no pollution and for a similar or lower cost when considering climate and health impacts. Because peakers typically only run for short periods of time, a standard four-hour battery storage system can meet the majority of events when a peaker plant is called on. Batteries can also deliver a wide array of grid services, including supporting greater integration of renewable energy onto the grid.[6] For longer peak demand events, longer duration energy storage systems are becoming more widely and economically available and can be paired with solar, wind, and demand reduction measures. In many cases, alternative non-combustion technologies can outperform fossil fuel peakers when it comes to reliability. During severe winter weather events, gas-powered generation is only as reliable as the gas supply, which can be disrupted due to freezing conditions, flooding, or other weather conditions, as seen in national disasters such as Winter Storm Uri and Hurricane Milton.[7,8]

Massachusetts Decarbonization

Massachusetts has a legal mandate to reach net-zero emissions by 2050, with sector-specific and state-wide interim targets established in five-year intervals.[9] Reaching net zero will require a significant overhaul of the state's energy system, including the retirement of the state's fossil fuel peaking capacity and its replacement with zero-emissions alternatives. The 2021 law establishing Massachusetts' 2050 target also emphasized the importance of considering environmental justice and equity when pursuing decarbonization. The law requires consideration of the cumulative impacts of the compounding structural inequalities facing the state's environmental justice communities, such as the air pollution burden of fossil fuel peaker plants.[10] Massachusetts' Clean Energy and Climate Plan for 2025 and 2030 outlines several pillars for decarbonization in addition to transitioning away from fossil fuel use, including pursuing energy efficiency and demand flexibility, and measures such as additional air monitoring to better assess the disproportionate pollution burden in environmental justice communities.[11]

Massachusetts is well-positioned to achieve peak decarbonization thanks in part to the state's Clean Peak Standard, a first-of-its-kind initiative to support the deployment of technologies that can either reduce demand or supply clean electricity during times of peak energy demand. The program compensates energy resources that directly decarbonize energy generation during peak demand periods, including solar, wind, and other eligible generation assets as defined by the state's Renewable Portfolio Standard; energy storage; and demand reduction technologies.[12] As of 2020, the Massachusetts electricity sector had achieved a 54% reduction in emissions from 1990 levels.[13] Decarbonization efforts have included the retirement of several fossil fuel peaker plants, including the West Springfield Generation Station, a former gas-fired peaking facility which is now in the process of developing a 45-megawatt (MW) battery storage facility that will participate in the Clean Peak Standard program.[14]

In 2024, Massachusetts established the Energy Transformation Advisory Board (ETAB) to guide the work of the newly formed Office of Energy Transformation (OET). Upon its formation, OET created working groups focused on three state decarbonization issues: the Everett Marine LNG Terminal, Financing the Transition, and Decarbonizing the Peak. OET's Decarbonizing the Peak Working Group is comprised of representatives from industry, government, environmental justice and advocacy organizations, peaker plant owners, and community members, and has been meeting regularly since late 2024 to discuss system-wide peaker decarbonization in Massachusetts. The analysis detailed in this report was commissioned to help inform the working group's discussion and was conducted in consultation with the environmental justice and community-based members of the working group.

Barriers to Decarbonization

Decarbonizing peak demand in the current energy landscape is not without its challenges. For one, energy load across the entire New England electric grid is growing rapidly due to electrification, with residences and businesses shifting from gas to electricity for space and water heating, appliances, and transportation, and due to the anticipated proliferation of energy-intensive industries such as data centers.[15] As load continues to grow, the level of peak demand is also expected to grow, and more peaking capacity will likely be needed to meet that demand. This means that more clean alternatives must be built to replace existing fossil fuel infrastructure and meet new demand on the horizon.

In addition to rapid load growth, the timing and duration of peak demand periods is also evolving. Electrification, primarily the shift to electric heating, is shifting annual peak demand periods to the coldest days of the year. By the mid-2030s, the New England region is expected to experience the highest levels of electricity demand in the winter, largely to meet heating demand during early morning and evening hours.[16] This is a big shift from the summer peaks of today. At the same time, the continued development of intermittent solar and wind resources is reshaping when the power system needs additional capacity, which will require flexible peaking resources like battery storage to store excess generation during periods of high renewable production and discharge during times of lower generation.[17]

Another challenge to decarbonizing peak demand is how resources are currently compensated through the regional grid operator's capacity market. ISO New England (ISO-NE) selects and allocates funds to energy resources through its forward capacity market, which is designed to procure enough capacity to ensure grid reliability. Selected resources are paid to be prepared to meet energy demand when the grid requires it.[18] However, this process does not credit or prioritize the peak contribution of resources like energy storage, demand response, and renewables at the same level as fossil fuel facilities. ISO-NE's capacity accreditation models consider fossil fuel generators running on gas and oil to be more reliable than alternative resources and therefore compensates them at a higher level through capacity market payments.[19] Because capacity payments may account for millions of dollars in annual income, many power plant owners have little financial incentive to expediently decarbonize. ISO-NE also prioritizes dispatching traditional energy resources before tapping into peak demand reduction technologies, which may result in lost opportunities for demand-side resources to reduce the need for fossil fuel generation and decrease emissions and cost.

ISO-NE is currently in the process of redesigning its forward capacity market, with a proposed shift to a prompt seasonal market, and re-evaluating its capacity accreditation models.[20] Depending on how changes to these processes are structured, the efforts could significantly improve or worsen the outlook for decarbonizing peak demand.

Pittsfield Generating Facility: Illustrating the Challenge of Peaker Replacement

Pittsfield Generating Facility, a 176-MW gas peaker in Pittsfield, Massachusetts owned by the private equity firm Hull Street, illustrates the challenging economics of peaker plant replacement. In 2024, Pittsfield Generating's capacity payments alone (excluding payments associated with actual power generation) exceeded $6 million. Pittsfield Generating is located in an environmental justice neighborhood where the life expectancy of residents is 12.5 years less than for residents of more affluent areas within the same zip code.[1]

First commissioned in 1990, the power plant's aging infrastructure is becoming less efficient with each passing year. Pittsfield city officials estimate that the remaining useful lifespan of the power plant is likely fewer than five years. Given the decline of the plant, its owners have recently appealed their appraised tax contribution to the city assessor's office, citing depreciation. In 2024, Hull Street's successful appeal to the assessor's office to reduce their tax contributions by half left the municipality concerned that while the plant's pollution impacts to neighboring residents will continue in the coming years, its tax revenue contribution will decrease each year. Ultimately this may culminate in a total loss of tax revenue for the city and the creation of yet another brownfield site in an already overburdened neighborhood.

In December 2025, Pittsfield's City Council voted to send a letter to the Massachusetts Office of Energy Transformation urging decarbonization of the plant and transition to battery storage. Despite this local pressure, there is little economic incentive for plant owners to redevelop the site and pursue clean energy alternatives when it remains financially lucrative to continue running the power plant beyond its useful life while collecting millions in capacity payments.

Even for peaker plant owners who do prioritize a transition to clean energy, lengthy interconnection processes and other delays pose daunting challenges for site redevelopment and may increase replacement costs. In the case of Cogentrix's West Springfield peaker, the company planned to use existing interconnections and was well-poised to make the transition to battery storage. Yet, getting through the interconnection study process for the transition took nearly two and a half years, far longer than expected.

In order for plant owners and communities to navigate peaker decarbonization, the economics of fossil fuel peaker plant replacement must be structured to make a clean energy transition financially viable and plant owners must be able to navigate the interconnection process in a reasonable timeframe.

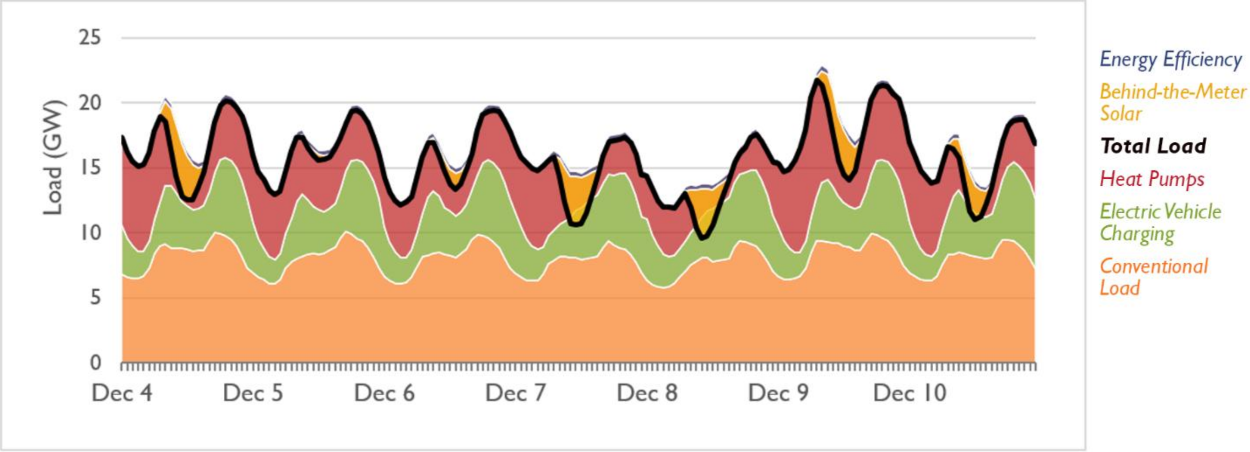
Massachusetts Peak Decarbonization Analysis

On behalf of the Massachusetts Clean Peak Coalition, Synapse provided top-down, statewide technical modeling and analysis of Massachusetts' peaking capacity needs in 2050 and determined a clean peak portfolio of zero-emissions clean peaking resources that could reliably serve those needs. Consistent with state policy, the projections of 2050 Massachusetts peak demand account for current electricity demands as well as the expected additional peak load from heating and transportation electrification. Key outputs from the analysis include the capacity, capital costs, and emissions associated with the clean peak portfolio, as well as a comparison of costs for the clean peak portfolio versus a business-as-usual scenario and a portfolio using alternative fuels.[21] See the Appendix for a full explanation of the methodology and inputs that went into the analysis.

Findings

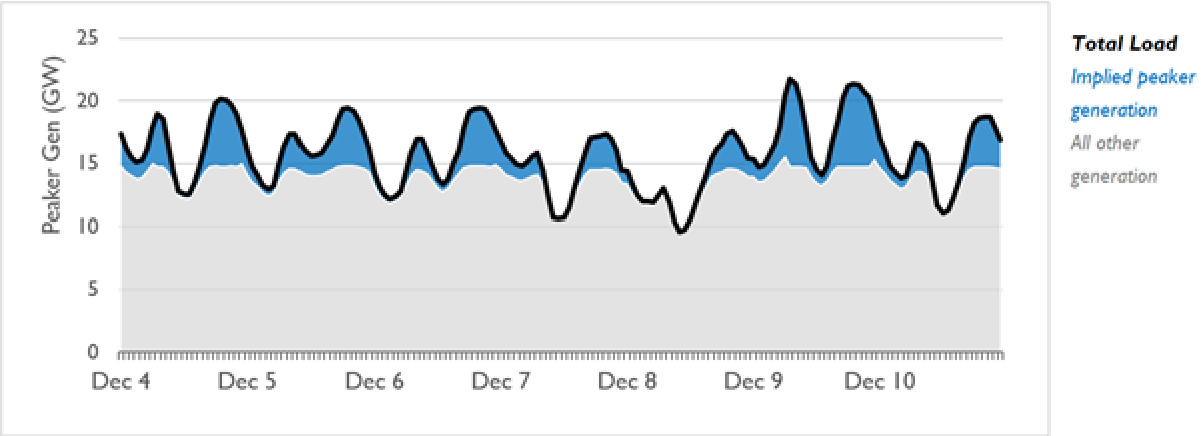
In 2050, demand will be higher than today, and Massachusetts will have shifted from a summer peaking system to a winter peaking system. Massachusetts electricity usage will peak twice per day in the winter (once in the morning from 6am to 11am and once at night from 5pm to midnight) due primarily to heat pump use for space and water heating and electric vehicle charging. These peaks are longer than current peaks and are more pronounced during multi-day periods of extreme cold weather. **Figure 2** illustrates the drivers of the projected energy demand at different times of the day during an extremely cold weather week in 2050.[22]

Figure 2. **Impact of low temperatures on energy demand for heat pumps (red) and electric vehicle charging (green) during an extreme winter weather week in 2050.**



Across an analysis of 24 historical weather years, the maximum amount of peaker generation required in 2050 ranges from 5.4 gigawatts (GW) to 13.9 GW, with an average of 9.0 GW. For reference, the current capacity of peakers in Massachusetts is 4.6 GW. **Figure 3** depicts peak generation (shaded in blue) as a proportion of total generation (indicated by the bolded black line) during the same extreme cold weather week shown in Figure 2. During this week of extreme cold, peaker generation is called to operate for roughly six-hour periods, twice per day.

Figure 3. **Peaker generation required (blue) during an extreme winter weather week in 2050.**



There were many configurations of clean peak portfolio resources that can serve demand during peak hours in 2050 and demand-side reduction measures, wind, and energy storage were core components of all portfolios. The analysis considered a clean peak portfolio where demand-side measures reduce peak load by 24 percent, or 4.2 GW, during the highest load hours of a year. To contribute 24 percent or more to peak load reduction, demand-side measures would likely need to include a suite of load reducing and load shifting measures such as building envelope improvements, energy efficiency improvements, smart appliances, responsive electric vehicle (EV) charging, distributed battery storage and EV vehicle-to-grid dispatch, and the application of newer and more efficient clean heat technologies such as hydronic thermal storage. See the Appendix to view the mix of demand-side measures evaluated for this analysis.

Synapse conducted an analysis to identify the lowest cost utility-scale resources that could reliably meet the remainder of peaking needs following the implementation of demand-side measures. The resources selected to supply the rest of the peak included offshore wind, onshore wind, and 2-, 4-, 8-, and 100-hour duration energy storage. **Table 1** details the capacity and capital costs for each resource and for the portfolio in aggregate. The total capacity of a clean peak portfolio that can reliably provide 9 GW of peak generation is much higher (17.5 GW on average) as the resources in the portfolio do not meet electricity demand at the same time throughout the peak periods. For example, onshore wind production may not always coincide with peak demand periods and shorter-duration storage systems may only meet a portion of load during longer peak demand events.

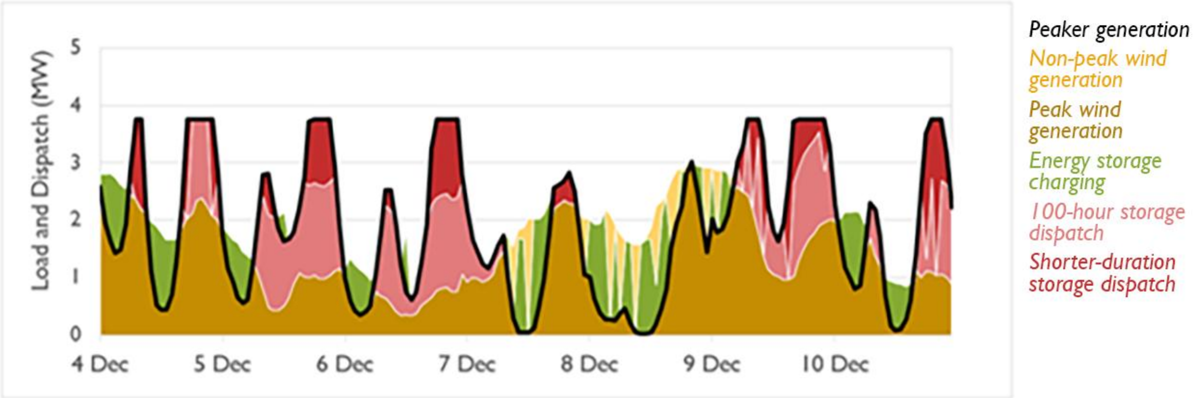
Table 1. **Summary of clean peak portfolio resources**

	Peak Demand Reduction or Nameplate Capacity (GW)	Capital Costs (2022$/kW)
Demand-Side Measures	4.2	Not estimated
Energy Storage	6.9	
100-hour	4.1	$2,230
8-hour	0.1	$1,877
4-hour	2.4	$1,088
2-hour	0.3	$694
Wind	6.4	
Offshore	4.4	$2,848
Onshore	2.0	$1,398
Total Clean Peak Portfolio	17.5	$1,746

Energy storage resources are the largest component of the clean peak portfolio, representing 6.9 GW or 39 percent of the capacity. Despite the high cost for 100-hour batteries relative to other battery options, the model built 4.1 GW of long-duration batteries to serve longer duration peak events during multi-day cold spells. The model also built 2.4 GW of 4-hour batteries, 0.3 GW of 2-hour batteries, and 0.1 GW of 8-hour batteries to serve smaller duration peaks or pair with one another to meet the two daily peaks.

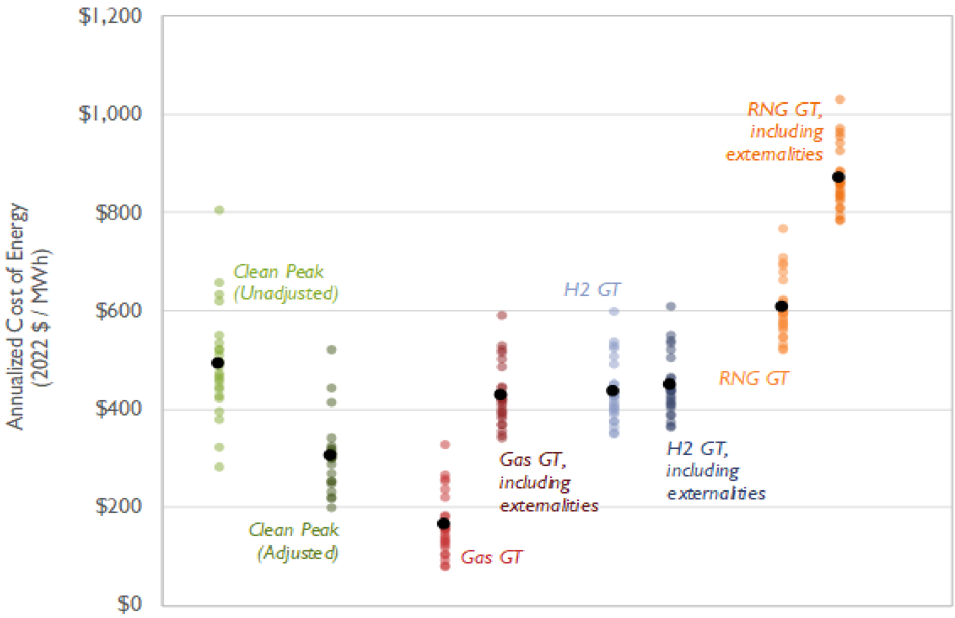
Wind resources also contributed a significant amount of clean peak portfolio capacity, with 6.4 GW or 37 percent of the total. Offshore and onshore wind provide generation that is well-timed to reliably meet winter peaks. While onshore wind is less expensive to build, onshore wind capacity was capped at 2 GW to reflect the constraints of siting onshore wind in Massachusetts and concerns expressed by environmental justice and community-based representatives of the Decarbonizing the Peak Working Group. This increased the capacity of offshore wind to 4.4 GW. Two thirds of the generation from wind plants built to meet the peaks is available for generation during non-peaking times. This is illustrated in **Figure 4**, where the yellow shaded portions show the contribution of additional clean energy generation, such as wind during non-peak hours, over the same extremely cold weather week shown in **Figures 2 and 3**. To account for this excess non-peaking generation, an adjusted annualized cost was calculated for the clean peak portfolio (see **Figure 5** and **Table 2**) to better align the cost of decarbonizing peak demand with the proportion of hours that the resources operated as a peaking resource.

Figure 4. **Operation of clean peak portfolio resources to meet peak demand during an extreme winter weather week in 2050. Additional wind energy generation that is not used to meet peak demand or charge energy storage is shown in yellow.**



To compare the relative cost of the clean peak portfolio with a business-as-usual case that continues to rely on gas turbines (GTs) the analysis calculated the annualized cost of energy for each portfolio. The analysis also evaluated the cost of peak demand portfolios including the combustion of alternative fuels, specifically hydrogen (H2) and renewable natural gas (RNG). Figure 5 shows the range and average annualized cost per megawatt-hour (MWh) of energy for all the peak demand portfolios analyzed. Because peak demand portfolios that do not account for the cost of externalities, such as carbon emissions and public health impacts, do not comply with Massachusetts state policy, the annualized cost of the gas GT, H2 GT, and RNG GT portfolios are presented both with and without the cost of externalities.

Figure 5. **Annualized cost per megawatt-hour of four resource portfolios – Clean Peak, Gas Turbine (GT), Hydrogen (H2) GT, and Renewable Natural Gas (RNG) GT – to meet Massachusetts peak demand in 2050**



On average, the annualized cost of energy for the unadjusted clean peak portfolio, which does not account for the value of non-peak wind generation, is $500/MWh, which is more costly than continued use of gas including externalities ($450/MWh) or switching to hydrogen combustion including externalities ($475/MWh), though the hydrogen calculation does not account for the additional pipeline and power plant conversion costs involved in transporting and burning hydrogen. The unadjusted clean peak portfolio is much less costly than RNG including externalities at $900/MWh. The average annualized energy cost of the adjusted clean peak portfolio, which accounts for the value of additional generation, is $300/MWh, much lower than all GT portfolios including externalities as well as hydrogen and RNG even without the cost of externalities.

Table 2 shows the annualized cost of each portfolio over the peak hours of the year. The annualized cost to meet peak demand in 2050 ranges from $0.4 billion to $6.6 billion, depending on the portfolio and the weather year.

Table 2. **Annualized costs of various resource portfolios to meet Massachusetts peak demand in 2050**

	Annualized Cost (2022$, billions)		
Portfolio	Minimum	Average	Maximum
Clean Peak, unadjusted	$1.60	$2.90	$5.40
Clean Peak, adjusted	$1.10	$1.90	$2.80
Gas, including externalities	$1.90	$2.70	$3.50
Hydrogen, excluding externalities	$1.90	$2.70	$3.60
Hydrogen, including externalities	$2.00	$2.80	$3.70
Renewable Natural Gas, excluding externalities	$2.80	$3.80	$4.80
Renewable Natural Gas, including externalities	$4.30	$5.40	$6.60

To understand the ratepayer impact of meeting peak demand in 2050, the analysis explored the monthly residential bill impact of the various resource portfolios. The bill impact analysis removed externality costs as they do not directly affect bills, then apportioned annualized costs to Massachusetts residential electricity sales.

These values were then multiplied by an average monthly kilowatt-hour electricity consumption per residential customer to create a bill impact in dollars per month. As shown in **Table 3**, the impact on monthly residential electricity bills ranges from $5 to $60, depending on the portfolio and the weather year. Compared to the business-as-usual case where gas turbines continue to meet peak demand, the clean peak portfolio would cost households an additional $10 or $22 per month on average for the adjusted and unadjusted costs respectively.

Table 3. **Residential monthly electric bill impacts for resource portfolios to meet Massachusetts peak demand in 2050**

	Residential Monthly Electric Bill Impact		
Portfolio	Minimum	Average	Maximum
Clean Peak, unadjusted	$18	$33	$60
Clean Peak, adjusted	$13	$21	$31
Gas, excluding externalities	$5	$11	$19
Hydrogen, excluding externalities	$21	$30	$40
Renewable Natural Gas, excluding externalities	$32	$42	$53

Recommendations

Based on the results of the peak decarbonization analysis, the Massachusetts Clean Peak Coalition recommends four key actions to accelerate the retirement of the state's existing fossil fuel peaker plants and incentivize a reliable, cost-effective portfolio of clean peaking resources.

Recommendation #1: Incentivize demand-side measures to reduce the cost of decarbonization, with a focus on reducing summer and winter peaks.

Demand-side resources, such as shifting EV charging, dispatch of distributed battery storage, and improvements in building efficiency, can have a substantial impact on reducing peak demand. By shifting load away from peak hours and decreasing overall energy demand, these measures will play a vital role in reducing the amount of new large-scale resources that need to be developed to meet peak demand in 2050. Given the high cost of building large-scale resources, the adoption and utilization of demand-side resources should be prioritized to maximize cost savings for ratepayers while still meeting decarbonization goals. Many existing demand-side resources are being underutilized because there is no simple pathway, such as participation in a demand response or virtual power plant program, for them to provide peaking services and be appropriately compensated for doing so. The state should expand on programs such as ConnectedSolutions, which compensates customers with smart thermostats and battery systems to reduce load during peak demand periods, and explore additional pathways to include more types of devices in such programs and accelerate the adoption of demand-side resources, particularly in communities with existing peaker plants.[23]

Recommendation #2: Prioritize the development of medium- and long-duration energy storage technologies to maintain reliability during winter peaks.

The analysis found that more frequent and longer-duration winter peaks will require energy storage resources with the ability to discharge for longer periods of time. While the analysis focused on 100-hour batteries due to limitations on available cost data for storage with a duration of between 8 and 100 hours, a mix of various longer-duration storage resources will likely be needed to maintain reliability and contain costs as Massachusetts and the broader ISO-NE region shifts to become a winter-peaking grid. While shorter-duration lithium-ion batteries are currently the most widely deployed form of energy storage and will continue to play an important role in decarbonization, longer-duration technologies, such as 100-hour iron air batteries, are beginning to become much more commercially available and costs are declining. Massachusetts has already established a target of procuring 3,500 MW of medium-duration storage (defined as 4-10 hours) and 750 MW of long-duration storage (defined as 10-24 hours) by 2030. While this target is a strong start, a significant amount of additional longer-duration storage capacity will be required to meet grid reliability needs by 2050.

Recommendation #3: Consider local siting constraints and community concerns in building out wind capacity.

Wind, both offshore and onshore, will play an outsized role in decarbonizing a winter-peaking power system. Offshore wind is more expensive to develop and the industry is currently facing federal obstacles which may impact how quickly resources can be built. While onshore wind capacity is less expensive, it comes with land use and siting concerns, particularly as much of the onshore wind will need to be built in low-density areas such as western Massachusetts to supply power to higher density areas like the Greater Boston area. The development of this sort of large-scale infrastructure, while important for meeting Massachusetts' decarbonization goals, must be done with intentional and proactive engagement with the communities most likely to be impacted.

Recommendation #4: Account for externalities, such as climate and public health impacts, when evaluating the cost-effectiveness of peak decarbonization.

Decarbonizing peak demand will be expensive but pursuing inefficient and potentially harmful solutions like hydrogen and RNG, or maintaining business-as-usual, will not be significantly cheaper and carries additional externalities. As shown in Table 2, the cost of deploying renewable energy and energy storage to decarbonize the peak is comparable to the cost of hydrogen and much less expensive than pursuing RNG combustion when the costs of climate and health impacts are considered. It is also worth noting that it is difficult to accurately price out the costs of hydrogen or RNG combustion, as additional costs, such as for retrofitting existing plants to be able to burn these fuels, are not included. Hydrogen, biodiesel, renewable diesel, renewable natural gas, and biomass can result in significant harm to both the climate and local neighborhoods. Replacing fossil fuel use with these alternative fuels won't meaningfully decrease greenhouse gas emissions, and will often maintain the same, or worse, levels of local air pollution. Information in favor of these types of resources as decarbonization solutions is often incomplete as the emissions accounting does not consider the full lifecycle of emissions. Embracing these solutions instead of emissions-free, non-combustion solutions will force ratepayers to continue paying for expensive fossil fuel infrastructure and remain dependent on emitting sources for decades to come. Massachusetts should instead focus on truly clean, emission-free resources as detailed in this report.

Conclusion

While there are challenges to overcome, the analysis presented in this report demonstrates that there are viable and cost-competitive pathways forward for Massachusetts to meet its 2050 decarbonization goals and fully retire the state's harmful, polluting fossil fuel peaker plants. Focusing peak decarbonization efforts on demand-side measures, energy storage, and wind will enable the state to successfully meet the longer-duration winter peaking needs that the Northeast region will begin to experience in the next decade. While these efforts may result in moderate cost increases for ratepayers, the costs need to be considered within the context of the high social and environmental costs of continuing to depend on polluting gas and oil power plants. If the state is truly committed to pursuing a just transition, it is imperative that efforts to decarbonize the peak focus strictly on zero-emissions technologies that are proven to work.

Appendix

Massachusetts Peak Decarbonization Analysis Modeling Methodology and Approach

Synapse performs operational and planning modeling analyses of electric power systems using industry-standard models to evaluate long-term energy plans and assess the environmental and economic impacts of policy initiatives. For this study, Synapse used EnCompass to model the feasibility, capacity, costs, and emissions reductions associated with serving 2050 Massachusetts load in peak hours with emission-free resources such as demand-side measures, renewable energy, and energy storage. Synapse then compared the annualized energy costs of a clean peak portfolio to that of other fossil fuel and non-fossil fuel peaker generation portfolios in order to estimate the net benefits of the clean peak portfolio as compared to potential alternatives. Lastly, Synapse calculated residential monthly bill impacts for all peak demand portfolios.

Existing Peaker Characterization

The analysis characterizes peaker plants as any unit at any power plant in Massachusetts that is in hourly CAMPD data from the U.S. Environmental Protection Agency.[24] This dataset includes resources that were operational in 2021, 2022, or 2023, have a capacity greater than 25 MW, are at least partially powered by fossil fuels and therefore emit pollutants, and had a capacity factor of 15 percent or less in those years. While the analysis team attempted to align this peaker dataset with the one used in the Massachusetts Decarbonizing the Peak Working Group process, the analysis dataset excludes 16 of the smaller peaker plants included in the working group dataset as the CAMPD data does not include hourly operational data for these plants. The excluded power plants represent a small proportion of peaker capacity and have very low capacity factors. Synapse then developed a relationship between hourly demand for electricity in Massachusetts and peaker dispatch using the historical hourly operational data from 2021 to 2023.[25]

Peak Load Estimates

Next, the analysis team projected load inclusive of conventional load, heat pumps, electric vehicles, energy efficiency, and distributed solar. Synapse used the ISO-NE 2024 load forecast which reflects Massachusetts state policy.[26] The analysis assumed that the Solar Massachusetts Renewable Target (SMART) program continues to drive behind-the-meter solar adoption at similar rates through 2050. Synapse recently developed an analytical process for the *2024 Avoided Energy Supply Components in New England* study for estimating the hourly electric impact of different levels of heat pumps and electric vehicles for various weather years.[27] The analysis used this method to estimate future heat pump and electric vehicle loads in anticipation of a winter peaking system and combined this with hourly load data from 24 historical years (2000-2023) of varying weather conditions.[28] This approach allowed Synapse to model a wide range of possible peak scenarios including the weeks with most extreme winter cold and summer heat.

Demand-Side Clean Peak Resource Characterization

The analysis assumes that the state will leverage incremental cost-effective demand-side resources to further mitigate cost to serve higher peak loads. Synapse did not conduct a demand-side resource potential study to develop an estimate of these resources; rather the team made a rough calculation for each measure and in aggregate based on a series of assumptions. Synapse estimated roughly 4 GW of additional demand-side resources comprised of six different measures. This demand-side resource capacity was removed from the load forecast prior to building supply-side resources.

Table 4 shows the peak reduction estimates by measure and in total and the assumptions made in estimating the peak reduction of each measure.

Table 4. **Demand-side measures and estimated peak reduction capacity included in the peak decarbonization analysis**

Measure	Measure Description	Peak Reduction (GW)
Building envelope improvements	30% whole-home air leakage reduction in ACH50 and R-60 attic floor insulation in 33% of residential households	0.6
Heat pump COP improvements	3.6 at 47 degrees Fahrenheit for all sectors (a 4.7% improvement)	0.6
Total Load Reducing Measures		1.2
Shifting EV charging	Charging reduced in peak hour by 25%	0.9
EV vehicle-to-grid dispatch	25% of available EV electricity capacity dispatched during peak hours	0.9
Distributed battery storage dispatch	2.3 GW of 2-hr batteries online by 2050 and 25% of this capacity enrolled in demand response	0.5
Hydronic thermal storage	Heat pumps in 23% of homes with existing hydronic systems and 5 kWh of peak load shifting for each household	0.5
Total Load Shifting Measures		2.8
Total Demand Response		4

Supply-Side Clean Peak Resource Characterization

Synapse quantified the ability of various types of renewable energy and energy storage resources to provide generation during peak demand periods by comparing actual hourly load and modeled hourly generation data from ISO-NE from the last 30 years to assess contributions to reliability during these periods.

Capital Costs

The model selected clean peak resources based on an estimate of average costs between 2035 and 2050. The model built the least-cost combination of clean peak resources needed to meet every hour of generation, for each weather year, as of 2050.
The source of the cost trajectories for all resources (including gas, hydrogen, and renewable natural gas) was *NREL's 2024 Moderate Annual Technology Baseline (ATB)* forecast.[29] The costs do not include any tax credits. The analysis assumes that all currently existing peaker facilities are required to run on gas, hydrogen, or RNG depending on the scenario. The analysis does not include any retrofit costs or additional infrastructure costs such as pipeline construction or upgrades to operationalize these outcomes.

Externalities

Externalities increase costs for gas- and RNG-fired generation by about $263/MWh. This includes a 2050 social cost of carbon of $516 per short ton assuming a 1.5 percent discount rate, based on research compiled by Synapse in its *Avoided Energy Supply Components (AESC) in New England: 2024 Report*.[30] The analysis externalities also assume impacts to public health using U.S. Environmental Protection Agency's COBRA model.[31]

Residential Sales Allocation and Usage per Customer

To estimate residential monthly bill impacts, Synapse used the most recent sales and customer data from the Energy Information Administration's (EIA) Form 861.[32]

Modeling Limitations and Analytical Caveats

The following modeling assumptions and considerations impacted the results of the analysis:

1. The analysis focused on peaker generation and the resource scenarios and the associated capital costs, annualized energy costs, and bill impacts are only for serving the portion of load that exceeds a certain non-peak demand threshold.

2. The analysis provides a top-down range of peak load forecasts and resource builds to meet these forecasts for the state as a whole. The analysis did not account for transmission or siting constraints at existing or potential new peaking resource sites or in certain geographic areas. The analysis does not provide insight into where new clean peak portfolio resources should, or should not, be sited.

3. The analysis assumes all peaker generation is equally replaceable, provided that adequate replacement generation is available in the same hour.

4. The model assumes that peaker generation grows as demand grows, in proportions suggested by historical data. The analysis also assumes that peakers operate in 2050 during situations that resemble when peakers have operated in the recent past. As clean energy generation is deployed in greater

quantities, it is possible that other peaking needs will arise. The ability of the resources modeled in this analysis to meet those peaking needs has not been quantified.

5. The estimate of demand-side resources used in the analysis is a rough estimate and does not represent the technical, cost-effective, or feasible potential for these resources. [33]

6. The analysis shifted load from demand response resources to off-peak hours and managed these loads to ensure that the shift did not create any new peaks. Demand response load shifting may or may not be managed in this way, and if it is not managed effectively, peaks may develop during different hours of the day.

7. The analysis modeled 2-, 4-, 8-, and 100-hour batteries. The analysis did not model medium duration batteries, such as 12-, 24-, or 36-hour durations, due to a lack of available data on cost and performance parameters.

8. Costs for alternative portfolios such as hydrogen and renewable natural gas are estimates based on the most up to date information and do not include costs to build out distribution infrastructure (e.g., pipelines) for these fuels.

9. Bill impacts are calculated by allocating annualized costs to the residential sector and dividing by an estimate of the number of residential customers. The bill impact calculations represent an average residential customer in that all residential customers consume equal amounts of electricity and pay the same rates. The bill impacts calculations also assume that the percentage of residential sales and number of customers remains constant into the future.

Notes

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26 "Load Forecast," ISO-NE, www.iso-ne.com/system-planning/system-forecasting/load-forecast. Data from 2024 was the latest ISO-NE data available at the time of this analysis. This forecast assumes that energy efficiency measures continue to persist into the future and are installed at a slower rate as (a) efficiency measures become standardized as part of the conventional load forecast and (b) the Massachusetts three-year energy efficiency plan switches its main focus to heat pumps. The forecast aligns with the Clean Heat Standard draft framework from November 2023 which assumed that 2.1 million households and commercial establishments would have heat pumps by 2050 (about 75 percent of all households). Of these buildings with heat pumps, 90 percent would be full replacements and 10 percent would be partial replacements with a fossil fuel heating system for backup. The forecast also assumes that 100 percent of light-duty vehicles are EVs by mid-2040s and that other vehicle types (e.g., buses, heavy-duty vehicles) follow slightly faster or slower adoption trajectories.

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DECARBONIZING THE PEAK

A Roadmap for Retiring and Replacing Massachusetts' Fossil Fuel Peaker Plants by 2050

FEBRUARY 2026

This report was prepared by the Massachusetts Clean Peak Coalition with analysis by Synapse Energy Economics.

The Massachusetts Clean Peak Coalition, consisting of the Berkshire Environmental Action Team (BEAT), Clean Energy Group, and Slingshot, was founded to support and advance community-led transitions of fossil fuel peaker plants across the state of Massachusetts to 100 percent clean, emissions-free alternatives, such as renewable energy, energy storage, and demand response, in order to safeguard the health of all residents, especially those most impacted by the health, economic, and racial injustices of fossil fuel infrastructure.
Learn more at www.cleanthepeakma.org.

Clean Energy Group, a national nonprofit organization, works at the forefront of clean energy innovation to enable a just energy transition to address the urgency of the climate crisis.
Learn more at www.cleanegroup.org.

Berkshire Environmental Action Team (BEAT) is a nonprofit working to protect the environment and enact meaningful change throughout Berkshire County and Western Massachusetts.
Learn more at www.thebeatnews.org.

Slingshot works alongside communities across the Northeastern US that are most impacted by environmental threats to take aim at polluters and build community power.
Learn more at www.slingshot.org.

Synapse Energy Economics is a research and consulting firm focused on the intersection of energy, economics, and the environment.
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