Insights from Fossil Fuel Replacement Case Studies

Prepared on behalf of the Berkshire Environmental Action Team

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Executive Summary

To meet its climate goals, Massachusetts will need to replace its remaining 32 gas- and oil-fired electric generating “peaker plants” with reliable renewable energy resources. (Peaker plants sit idle for most of the year, only called on in instances of high electric demand.) Around the United States, and in Massachusetts, aging fossil-fuel power plants are being converted to zero-emission renewable energy facilities, reducing local pollution and helping states meet their climate and decarbonization goals. This Applied Economics Clinic (AEC) report, prepared on behalf of Berkshire Environmental Action Team, reviews six case studies in which fossil fuel-fired electric generation is being replaced by clean energy resources like solar, wind or battery storage. These stories chart a course for Massachusetts as it works to decarbonize its electric power sector.

Case studies of fossil-fuel power plants converting to solar, wind, and battery storage illustrate the feasibility of reducing fossil-fuel dependency while increasing clean energy deployment in the areas most impacted by electric sector pollution. The stories presented in this report demonstrate that existing power plant sites provide ideal locations for new renewable resources, converting power plants can reduce the burden on already overburdened communities, and the conversion of fossil fuel-fired power plants is an important tool for Massachusetts on its pathway to decarbonization (see ES-Table 1).

ES-Table 1. Key takeaways from existing fossil-fuel conversion case studies

Key Takeaway #1: Fossil-fuel sites can be desirable locations for clean energy siting.
Key Takeaway #2: Reducing reliance on fossil-fuel generation can help lessen the burden of environmental and health impacts on already overburdened communities.
Key Takeaway #3: Fossil-fuel plant conversions are a tool that can be used to achieve state and local greenhouse gas emission limits.

Findings from these case studies provide insight into important methods for achieving the Commonwealth’s electric sector emissions limits. The 2022 *Clean Energy and Climate Plan for 2050* outlines a broad emissions reduction goal of reaching net zero emissions by 2050 and a subsector limit for electric power to achieve at least an 85 percent reduction in emissions from 1990 levels.[1] The Plan states that new deployment of more than 50 GW of clean energy resources will be required to meet this goal.[2] In the Commonwealth, some peaker plants are already undergoing clean energy replacements, highlighting the feasibility of this pathway in achieving electric sector emissions limits.

[1] Massachusetts Executive Office of Energy and Environmental Affairs. 2022. *Clean Energy and Climate Plan for 2050*. Available at: https://www.mass.gov/doc/2050-clean-energy-and-climate-plan/download
[2] Ibid. p. 24.

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I. Introduction

Massachusetts has established strong commitments to reducing greenhouse gas emissions, alongside a legal mandate to reach net zero emissions by 2050.[3] In the interim, five-year sector-specific sub-limits and state-wide limits were established to keep the Commonwealth on track to meet its 2050 mandate.[4] Achieving interim limits and the 2050 mandate will require a significant transformation of the Commonwealth's energy system, including the shift away from fossil fuel-fired electric generation toward cleaner energy resources like wind and solar facilities supported by widespread energy storage deployment. This transition has the potential to reduce emissions, improve air quality, and lower public health risks while maintaining grid reliability.[5]

One potential decarbonization pathway for Massachusetts is the conversion of existing fossil fuel-fired power plants into clean energy facilities. The *Massachusetts Clean Energy and Climate Plan for 2025* outlines four key pillars for decarbonization: (1) transitioning end-uses away from fossil fuels; (2) pursuing energy efficiency and flexibility; (3) producing zero- and carbon-low energy; and (4) facilitating carbon sequestration.[6] The conversion of fossil-fuel power plants to clean energy sources would not only aid in achieving zero- and low-carbon- energy, but also offer an opportunity to repurpose existing infrastructure, reducing electric system build out. An examination of real-world examples of such conversions around the United States can provide valuable insights that may guide Massachusetts in advancing its efforts to decarbonize the energy sector.

This Applied Economics Clinic (AEC) report, prepared on behalf of Berkshire Environmental Action Team (BEAT), summarizes six case studies of fossil-fuel plant conversions to clean energy facilities, and provides insights into how comparable Massachusetts peaker plants could be similarly converted to aid in meeting the Commonwealth's climate goals while reducing local air pollution. The report begins in Section II with an overview of the impact of fossil fuel-fired generation on local pollution and subsequent health impacts and global greenhouse gas emissions. Section III presents six case studies of fossil-fuel plant conversions to clean energy resources nationwide. Section IV discusses lessons learned to aid the Commonwealth in reaching its decarbonization targets. Section V concludes the report with key takeaways.

II. Benefits of Fossil-Fuel Power Plant Conversion

Fossil fuel-fired power plants—of which there are 60 in Massachusetts and over 3,400 in the United States—are the largest stationary source of nitrogen oxides (NO_X) and sulfur dioxide (SO_2) emissions in the

[3] Massachusetts Executive Office of Energy and Environmental Affairs. 2022. *Clean Energy and Climate Plan for 2050*. Available at: https://www.mass.gov/doc/2050-clean-energy-and-climate-plan/download

[4] Ibid. p. 25.

[5] Tarekegne, B., Oikonomou, K., Jacroux, E., and O'Neil, R. 2022. "Analysis of Energy Justice and Equity Impacts from Replacing Peaker Plants with Energy Storage." IEEE. Available at: https://www.pnnl.gov/sites/default/files/media/file/Analysis_of_Energy_Justice_and_Equity_Impacts_from_Replacing_Peaker_Plants_with_Energy_Storage.pdf, p. 4.

[6] Massachusetts Executive Office of Energy and Environmental Affairs. 2022. *Clean Energy and Climate Plan for 2050*. p. 31.

nation.[7] Fossil fuel-fired power plants are also responsible for producing a substantial portion of total U.S. mercury (Hg), carbon dioxide (CO_2), and fine particle (PM) emissions.[8] These emissions have the potential to adversely impact the health of surrounding communities and contribute to global climate change impacts associated with increasing greenhouse gas emissions.[9]

All fossil fuel-fired power plants emit CO_2, a greenhouse gas that accounts for the majority of anthropogenic global warming and climate change.[10] In 2022, the U.S. Environmental Protection Agency (EPA) found that nearly 80 percent of the total 6,342 million metric tons of greenhouse gas emissions in the United States were CO_2 emissions.[11] In addition, the EPA attributed 30 percent of total U.S. CO_2 emissions to the combustion of fossil fuels for electricity generation, second only to emissions from the transportation sector.[12] The majority of emissions attributed to the electric sector are released by coal- or gas-fired generators. While only 20 percent of electricity in the United States was generated from coal-fired resources in 2022, coal combustion accounted for 55 percent of the electric sector's total CO_2 emissions.[13] Gas-fired generators produced 39 percent of U.S. electricity in 2022, 1 percent of generation was attributed to oil-fired generators, and the remaining generation came from non-fossil fuel resources.[14]

In addition to emitting greenhouse gases like CO_2, fossil fuel-fired power plants emit local pollutants—SO_2, NO_X, PM, and Hg—that can lead to adverse health impacts for nearby communities.[15] Coal-fired power plants are dirtier than gas- or oil-fired power plants and emitted the highest amount of SO_2, NO_x, and CO_2 in 2022 compared to the other fossil fuels, despite landing second in total generation in the same year (see Table 1). Gas-fired power plants have lower emissions rates than coal-fired or oil-fired power plants, however, gas-fired power plants were responsible for the generation of over 1.6 million GWh of electricity in 2022, more than total generation from coal- and oil-fired resources combined. As a result, gas-fired power plants released 490,600 tons of NO_x in 2022, only 96,800 tons less than coal-fired generators and ten times more NO_x than oil-fired power plants.

[7] (1) U.S. Environmental Protection Agency (EPA). N.d. "Human Health & Environmental Impacts of the Electric Power Sector." Available at: https://www.epa.gov/power-sector/human-health-environmental-impacts-electric-power-sector#:~:text=Electric%20power%20generation%20is%20a,mercury%2C%20cadmium%2C%20and%20arsenic (2) U.S. Energy Information Administration (EIA). June 2024. "Power Plants in the U.S." Available at: https://hub.arcgis.com/datasets/fedmaps::power-plants-in-the-u-s--2/about.
[8] U.S. EPA. N.d. "Human Health & Environmental Impacts of the Electric Power Sector."
[9] U.S. EPA. October 8, 2024. "Power Plants and Neighboring Communities." Available at: https://www.epa.gov/power-sector/power-plants-and-neighboring-communities.
[10] U.S. EPA. April 11, 2024. "Overview of Greenhouse Gases." Available at: https://www.epa.gov/ghgemissions/overview-greenhouse-gases.
[11] In 2022, 79.7 percent of the total greenhouse gas emissions (in million metric tons of CO_2 equivalent) were made up of CO_2. Source: Ibid.
[12] Ibid.
[13] U.S. EPA. July 8, 2024. "Sources of Greenhouse Gas Emissions." Available at: https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions.
[14] Ibid.
[15] U.S. EPA. October 8, 2024. "Power Plants and Neighboring Communities."

Table 1. 2022 United States emissions from fossil-fuel-fired electric generation

Fuel	2022 U.S. generation (GWh)	SO_2		NO_x		CO_2	
		Emissions (short tons)	Emissions rate (lbs/GWh)	Emissions (short tons)	Emissions rate (lbs/GWh)	Emissions (short tons)	Emissions rate (lbs/GWh)
Coal	831,512	889,901	2,140	587,373	1,413	868,201	2,088
Gas	1,687,067	4,112	5	490,579	582	742,560	880
Oil	22,931	68,480	5,973	46,124	4,023	24,795	2,163

Source: U.S. Energy Information Administration (EIA). 2022. "United States Electricity Profile 2022" [Table 5 and Table 7]. Available at: https://www.eia.gov/electricity/state/unitedstates/

Exposure to high concentrations of local pollutants can increase the risk of respiratory disease, heart disease, neurological effects, nervous system effects, and premature death in nearby communities.[16] Low-income, Black, Indigenous, and People of Color (BIPOC) populations, older adults, and children are disproportionately at risk for these negative health outcomes; these populations are more likely to live in locations with greater susceptibility to environmental hazards, higher rates of existing medical conditions, poorly maintained or aging infrastructure, limited financial resources, and/or cultural, language, or citizenship barriers to health care and social services.[17] Beyond the local community, plant-level emissions can reach communities beyond those located in close proximity to fossil fuel-fired power plants. For example, the EPA assumes a three-mile radius when mapping impacts of emissions on neighboring communities, acknowledging that power plant emissions and their harmful impacts on human health and the environment can travel much farther.[18]

Electric-generating peaking plants are among the dirtiest and oldest fossil-fuel power plants in operation. Peaking plants sit idle for most of the year, only called on when the grid is stressed—such as periods of high electric demand—and are designed to be turned on and off faster than other electric generating plants to meet the needs of the grid. Most peaking plants run on oil or gas just like power plants that serve base electric load. Peaker plants rapid ramp-up and shutoff, however, renders them less efficient at controlling pollution output, making them comparatively "dirtier" than non-peaker plants that run more consistently.[19] A U.S. Government Accountability Office's study found that peaker plants emit more pollutants per unit of energy generated than non-peaker plants.[20] While emissions rates are higher for

[16] U.S. EPA. N.d. "Human Health & Environmental Impacts of the Electric Power Sector."
[17] U.S. EPA. N.d. "Climate Change and the Health of Socially Vulnerable People." Available at: https://www.epa.gov/climateimpacts/climate-change-and-health-socially-vulnerable-people.
[18] U.S. EPA. N.d. "Power Plants and Neighboring Communities."
[19] (1) Clean Energy Group. 2021. *ConnectedSolutions: A Program Assessment for Massachusetts.* Prepared by Applied Economics Clinic. Available at: https://www.cleanegroup.org/wp-content/uploads/ConnectedSolutions-An-Assessment-for-Massachusetts.pdf, p. 8; (2) Mass Save. N.d. "Use your Battery Storage Device to Make the Grid More Sustainable." Available at: https://www.masssave.com/residential/rebates-and-incentives/connectedsolutions-batteries.
[20] U.S Government Accountability Office. May 2021. *Electricity: Information on Peak Demand Power Plants.* Available at: https://www.gao.gov/assets/gao-24-106145.pdf, p. 4.

peaker plants than non-peaking plants, 2021 SO_2 emissions from peakers accounted for just 3 percent of U.S. total emissions and 9 percent of U.S. total NO_X emissions.[21] The report further noted that while peaker plants accounted for 19 percent of total nameplate capacity for all U.S power plants in 2021, they only represented 3.1 percent of annual net generation.[22]

Peaker plants release a disproportionate amount of greenhouse gas emissions and local air pollutants for the limited generation they provide. Converting peaker plants into cleaner, more efficient energy infrastructure has the potential to reduce pollution in Massachusetts and across the globe. A recent simulation of peaker plant replacements for Puget Sound Energy conducted by the Pacific Northwest National Laboratory found that replacing peaker plants with wind capacity and energy storage systems reduces the Company's combined total annual emissions of CO_2, NO_X, and SO_2 by 14 percent, from 6.8 million short tons to 5.86 million short tons (a reduction of 0.94 million short tons).[23] Replacing aged peaker plants can maintain grid reliability by allowing the grid operator to pull from excess stored energy produced from renewable energy systems in times of high demand rather than relying on gas-fired peakers.[24] Energy storage, in particular, can help renewable energy such as solar and wind, which are intermittent resources, penetrate the market, reducing Massachusetts' dependence on peaking plants for reliability and reducing emissions.

III. U.S. Case Studies of Fossil-Fuel Power Plant Conversion

Across the United States, several fossil fuel-fired plants have been successfully converted or are undergoing a conversion to clean energy and/or energy storage facilities, carving a potential pathway for reducing greenhouse gas emissions and local air pollutants in Massachusetts. This report examines six case studies of fossil fuel-fired plant conversions or replacements with clean energy resources in California, Connecticut, Massachusetts, and New York. These energy facilities have historically operated fossil fuel-fired generators and are now converting or replacing some, or all, of the plants' capacity with wind-powered or battery storage resources, reducing greenhouse gas emissions and local pollutants emitted from the power plants. These case studies are then discussed in the context of existing Massachusetts peaker plants.

Ravenswood Generating Station, located in New York City, is the largest facility reviewed in this report, providing more than 2,000 megawatts (MW) of electric generating capacity in 2023, compared to the 19-MW Tunnel Jet Peaking Facility in Connecticut, the smallest facility (see Table 2). Apart from Ravenswood Generating Station, the fossil fuel conversion case studies presented in this report are planned to come online between 2024 to 2027. The operation year for the conversion from a primarily gas facility to an

[21] Ibid. p. 5. Note: this study compared peaker and non-peaker plant emissions for plants with nameplate capacities of at least 25 MW.
[22] Ibid. p. 2.
[23] Tarekegne, B., Oikonomou, K., Jacroux, E., and O'Neil, R. 2022. "Analysis of Energy Justice and Equity Impacts from Replacing Peaker Plants with Energy Storage." IEEE, p. 4.
[24] Dueñas, S., Animas, E., Jaide, L., Olinsky-Paul, T., and Tym, O. 2024. *Battery Storage for Fossil-Fueled Peaker Plant Replacement A Maine Case Study.* Strategen Consulting and Clean Energy States Alliance. https://www.cesa.org/wp-content/uploads/Battery-Storage-for-Fossil-Fueled-Peaker-Plant-Replacement-A-Maine-Case-Study.pdf.

offshore wind interconnection at Ravenswood Generating Station has not yet been announced.

Table 2. Power plant to clean energy conversion case studies descriptive data

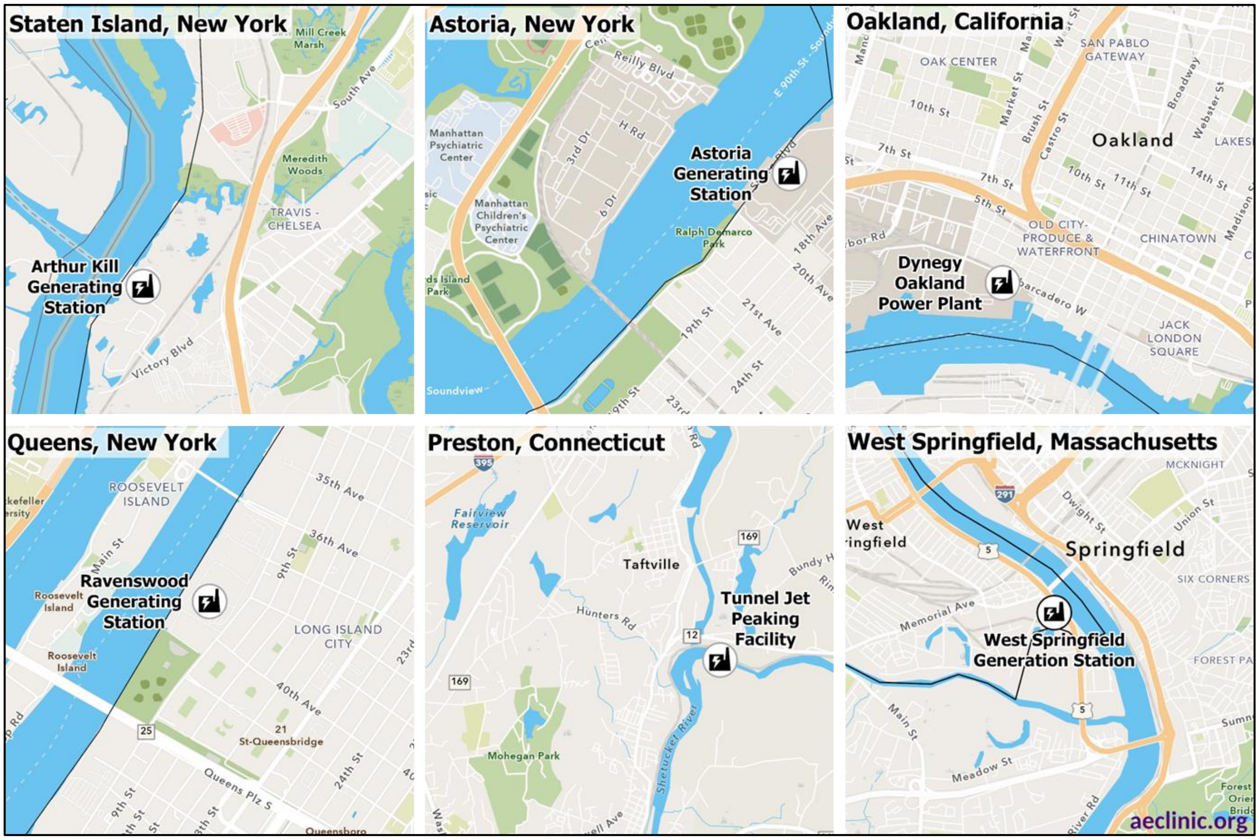
Case Study Fossil Fuel-Fired Facilities							Clean Energy or Storage Replacement		
Facility Name	**Fuel**	**Nameplate Capacity (MW)**	**Capacity Factor (%)**	**Number of units**	**Retirement Capacity (MW)**	**Year of Retirement**	**Resource**	**Nameplate Capacity (MW)**	**Expected Year of Operation**
Arthur Kill Power Station	Gas	896	13.3%	3	18	2025	Storage	15	2025
Astoria Generating Station	Gas	1,345	6.2%	5	16	Delayed to 2027	Storage	135	2024
Dynegy Oakland Power Plant	Jet fuel	149	0.5%	2	149	Unit 1 & 3: TBD; Unit 2: 2021	Storage	74	2025; Phase 1 (43.75 MW)
Ravenswood Generating Station	Gas	2,096	14.7%	5	1,915	Unknown	Wind	1,400	Unknown
Tunnel Jet Peaking Facility	Hydro; Jet Fuel	19	6.6%	3	17	2023 (Jet Fuel Generators)	Storage	17	2025
West Springfield Generation Station	Gas; Oil	0	0.0%	6	353	2021/2022	Storage	45	2025

Source: See Appendix D: Data sources for a full list of citations used for this table. Note: West Springfield Generation Station retired in 2022, thus the nameplate capacity, capacity factor, and number of units reflect the 2022 values. For all other plants, the data reflect 2023 values. The Tunnel Jet facility has 2-MW of hydro generation reported in EIA data; only the jet fuel-fired peaking unit is being retired. At Arthur Kill Power Station, only the 18 MW combustion turbine is being retired.

All of the case study facilities are located in urban areas near water sources, meaning that the fossil-fuel generators that used to operate there posed some very serious risks; polluted water sources harm aquatic life and pose a health risk to humans, affecting the cleanliness and safety of drinking water, agriculture, water recreation, and subsistence fishing, among other things.[25] Arthur Kill Generation Station is located in Staten Island, New York close to the New Jersey border (see Figure 1). Arthur Kill is in a less densely populated area of New York, compared to the other two power plants, but is near local recreation areas which can be affected by emissions from the plant. In addition, the emissions can travel via wind across state lines, potentially affecting the environmental quality of neighboring New Jersey communities located just two miles away and separated by the Hudson River.[26]

[25] (1) U.S. EPA. April 4, 2023. "Reducing Water Pollution from Power Plants." Available at: https://www.epa.gov/perspectives/reducing-water-pollution-power-plants; (2) U.S. EPA. November 15, 2023. "EnviroAtlas Benefit Category: Recreation, Culture, and Aesthetics." Available at: https://www.epa.gov/enviroatlas/enviroatlas-benefit-category-recreation-culture-and-aesthetics; (3) U.S. EPA. November 15, 2023. "EnviroAtlas Benefit Category: Food, Fuel, and Materials." Available at: https://www.epa.gov/enviroatlas/enviroatlas-benefit-category-food-fuel-and-materials.
[26] U.S. EPA. N.d. "Cross-State Air Pollution." Available at: https://www.epa.gov/Cross-State-Air-Pollution.

Figure 1. Power plant to clean energy conversion case study maps



Data source: U.S. EIA. 2023. "Power Plants." Available at: [*https://eia.maps.arcgis.com/home/item.html?id=bf5c5110b1b944d299bb683cdbd02d2a*](https://eia.maps.arcgis.com/home/item.html?id=bf5c5110b1b944d299bb683cdbd02d2a)

Astoria Generation Station and Ravenswood Generation Station are in close proximity to one another in Queens, New York, home to nearly 2.3 million people.[27] Astoria is located directly across the river from Manhattan Psychiatric Center, Manhattan Children's Psychiatric Center, and multiple public parks. Ravenswood is slightly downriver from Astoria and is also in proximity to the Manhattan Psychiatric Center and Central Park. The emissions from these power plants affect the environmental quality in the area and can result in adverse health effects for those who live, work, and visit the area and are exposed to the emissions.[28]

The Tunnel Jet Peaking Facility and West Springfield Generation Station are both located on the Connecticut River and the Dynegy Oakland Power Plant is located on the San Francisco Bay. In addition, the Dynegy Oakland Power Plant is located directly within the Jack London Square neighborhood of Oakland, a heavily trafficked area with many stores, restaurants, and apartments in the neighborhood. While the West Springfield Generation Station and Tunnel Jet Peaking Facility are in commercial areas, there are important community landmarks nearby, such as Springfield College (home to about 3,000 students) and

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[27] NYU Furman Center. 2024. "Queens: Neighborhood Indicators.". Available at: https://furmancenter.org/neighborhoods/view/queens.

[28] U.S. EPA. N.d. "Human Health & Environmental Impacts of the Electric Power Sector."

Mohegan Sun Casino (where approximately 8,000 people work and 25,000 people visit daily) respectively.[29]

Communities that house power plants often have lower income levels, higher poverty rates, and higher shares of BIPOC populations, making them more vulnerable than communities that do not house power plants.[30] The case studies presented here have notable demographic differences to the state they are located in (see Table 3). Queens, New York, the New York City borough that houses both Astoria Generating Station and Ravenswood Generating Station, has a very high percentage of BIPOC population (70 percent) and limited English-speaking households (over 17 percent)—both of which are greater than

Table 3. Case study demographics

Case Study	Case Study Demographics				
	Location	2022 Population (Number)	BIPOC Population (%)	Population Below Poverty Line (%)	Population with Limited English (%)
Arthur Kill Generating Station	Staten Island, NY	492,925	33.8%	16.5%	6.71%
	New York	19,994,379	41.2%	21.0%	7.60%
Astoria Generating Station	Queens, NY	2,360,826	69.5%	20.0%	17.65%
	New York	19,994,379	41.2%	21.0%	7.60%
Dynegy Oakland Power Plant	Oakland, CA	437,825	67.7%	21.4%	7.59%
	California	39,356,104	51.9%	20.0%	8.38%
Ravenswood Generating Station	Queens, NY	2,360,826	69.5%	20.0%	17.65%
	New York	19,994,379	41.2%	21.0%	7.60%
Tunnel Jet Peaking Facility	Preston, CT	4,719	6.7%	8.1%	0.98%
	Connecticut	3,611,317	30.2%	16.1%	5.21%
West Springfield Generation Station	West Springfield, MA	28,755	19.3%	20.3%	3.96%
	Massachusetts	6,984,205	27.3%	15.6%	6.01%

Data source: U.S. Census Bureau. 2022. American Community Survey 5-Year Estimates. [Table IDs: S1602, B02001,

[29] (1) Springfield College. N.d. "Fast Facts." Available at: https://springfield.edu/about/facts; (2) Mohegan Sun. N.d. "FAQ Employment." Available at: https://mohegansun.com/about-mohegan-sun/faq-employment.html; (3) Mohegan Sun. N.d. *Mohegan Sun: An Overview, An Evaluation.* Available at: https://newsroom.mohegansun.com/wp-content/uploads/2017/01/Overview-Web-1.5..20171.pdf, p. 1

[30] Cramer, Z., Steinfield, L., Miranda, J., and Stohler, T. 2023. "Energy distributive injustices: Assessing the demographics of communities surrounding renewable and fossil fuel power plants in the United States." *Energy Research & Social Science, 100,* p 103050. Available at: https://www.sciencedirect.com/science/article/pii/S221462962300110X.

S1701]. Available at: https://data.census.gov/

the shares in New York State. Oakland, California, home to Dynegy Oakland Power Plant, also has high shares of these demographics, at almost 68 percent BIPOC population (a stark difference compared to California's 52 percent), 21 percent of the population below the federal poverty line, and over 7 percent limited English-speaking households. In contrast, Preston, Connecticut, which is home to the Tunnel Jet Peaking Facility, has much lower shares of all three demographics. Staten Island, New York and West Springfield, Massachusetts, home to the Arthur Kill Generating Station and West Springfield Generation Station, have shares along the middle of the spectrum.

Case Study #1: Arthur Kill Generating Station (Staten Island, New York)

The Arthur Kill Generating Station is located in Staten Island, New York City and provided 896-MW of capacity in 2022.[31] As of 2023, Arthur Kill had a capacity factor (i.e., the amount of electricity produced over the year compared to the maximum it could have produced) of 13.3 percent, indicating the plant runs infrequently.[32] Built in 1948 as a single 25-MW gas unit,[33] Arthur Kill added two gas steam turbines in 1959 and 1969; these units replaced Unit 1 which was retired in 1963.[34] Unit 2 provides 397 MW of capacity and Unit 3 515 MW of capacity.[35] In 1970, an 18-MW gas-fired combustion turbine was brought online and operates as a peaking unit at the plant.[36]

As of 2023, Arthur Kill Units 2, 3, and 4 remain in operation.[37] The plant, initially owned by Con Edison, transferred ownership to NRG Energy in 1999.[38] In 2021, ArcLight Energy Partners (ArcLight) acquired a 4.9-GW generating portfolio from NRG Energy, which included the Arthur Kill Generating Station, and announced a potential battery storage project adjacent to the facility.[39] As of May 2024, plans for the plant included a 2025 retirement, with a 15-MW battery storage project to be deployed at the site according to

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[31] (1) Murray, C. May 30, 2024. "Elevate and ArcLight to build New York City's 'largest' BESS at retiring gas plant on Staten Island." *Energy Storage News*. Available at: https://www.energy-storage.news/elevate-arclight-build-60mwh-bess-retiring-gas-plant-new-york-city-largest-date/; (2) U.S. EIA. 2022. Form EIA-860. Available at: https://www.eia.gov/electricity/data/eia860/; (3) NYCIDA. March 3, 2022. *NYCIDA Project Cost/Benefit Analysis.* Available at: https://edc.nyc/sites/default/files/2022-02/Arthur%20Kill%20PHP.pdf.

[32] (1) U.S. EIA. 2023. Form EIA-860; (2) U.S. EIA. 2023. Form EIA-923.

[33] Jones-Gorman, J. 2024. "'Largest' battery storage site in NYC will soon rise in this Staten Island neighborhood." Staten Island Live. Available at: https://www.silive.com/news/2024/06/largest-battery-storage-site-in-nyc-will-soon-rise-in-this-staten-island-neighborhood.html.

[34] (1) Jones-Gorman, J. 2024. "'Largest' battery storage site in NYC will soon rise in this Staten Island neighborhood." Staten Island Live; (2) Staten Island Advance. "From 1882 to 1952, Staten Island produced its own electricity." Available at: https://www.silive.com/specialreports/2011/03/from_1882_to_1952_staten_islan.html.

[35] Staten Island Advance. "From 1882 to 1952, Staten Island produced its own electricity."

[36] U.S. EIA. 2022. Form EIA-860.

[37] U.S. EIA. 2023 Early Release. Form EIA-860.

[38] ConEdison, Inc. June 25, 1999. "Con Edison Completes Sale of Arthur Kill Power Plant in Staten Island and Astoria Gas Turbines in Queens." Available at: https://investor.conedison.com/news-releases/news-release-details/con-edison-completes-sale-arthur-kill-power-plant-staten-island.

[39] PR Newswire. December 6, 2021. "ArcLight Closes Acquisition of 4.9GW Power Generation Portfolio from NRG Energy." Available at: https://www.prnewswire.com/news-releases/arclight-closes-acquisition-of-4-9gw-power-generation-portfolio-from-nrg-energy-301437923.html.

an article in Energy Storage News.[40] The 15-MW battery storage project will replace the majority of the 18 MW being retired by the decommissioning of the 18-MW gas-fired combustion turbine peaking unit. The currently planned battery storage project will be sited on 0.2 square acres of land at the Arthur Kill site, but the containers housing the battery will only utilize 0.1 square acres of the designated space.[41] It is unclear if additional storage resources could be added in the future given a lack of data on the total space available at the Arthur Kill site.

Case Study #2: Astoria Generating Station (Queens, New York)

The Astoria Generating Station and Steam Turbine, located in Queens, New York City, had five units in operation in 2022. Four of the plant's units are gas steam turbines, online since the 1950s and 1960s, totaling 1,330 MW. The fifth unit—a 15-MW gas-fired combustion turbine—began operation in 1967.[42] In 2023, the plant had a nameplate capacity of 1,345 MW and a capacity factor of 6.2 percent.[43] The facility is owned by Alpha Generation, a company that manages a combined 14,000 MW of resources across six states.[44] Eastern Generation, overseen by Alpha Generation, owns around 9,000-MW of generation across its entire portfolio and operates in multiple regional wholesale markets.[45]

In 2019, Astoria Generation Company submitted plans to replace the turbines installed at its nearby Gowanus plant with eight new combustion turbines with a total peaking capacity of 610 MW.[46] The New York State Department of Environmental Conservation found the Gowanus replacement plans to be inconsistent with the State's 2019 Climate Leadership and Community Protection Act, which resulted in the plans being withdrawn by the Company.[47] Following the withdrawal of the turbine construction project, Astoria Generation Company announced new plans that would result in the retirement of the 16-MW gas peaker and the installation of a 135-MW energy storage facility at the Astoria site; the steam turbines will remain in operation under this plan.[48]

Astoria Generation was granted a permit to construct the energy storage facility by the New York State Public Service Commission in June 2022.[49] Since then, Astoria Generating Station's 16-MW gas-fired turbine has submitted a deactivation notice under New York's Peaker Rule, a law introduced in 2019 to

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[40] Murray, C. May 30, 2024. "Elevate and ArcLight to build New York City's 'largest' BESS at retiring gas plant on Staten Island." *Energy Storage News*.
[41] NYCIDA. March 3, 2022. *NYCIDA Project Cost/Benefit Analysis.*
[42] U.S. EIA. 2022. Form EIA-860.
[43] (1) U.S. EIA. 2023. Form EIA-860; (2) U.S. EIA. 2023. Form EIA-923.
[44] Alpha Generation. n.d. "Our Locations." Available at: https://www.alphagen.com/
[45] Eastern Generation and Elevate Renewable Energy. May 22, 2023. *Elevate Renewable Energy and Eastern Generation NYISO Budget and Priorities Work Group* [PowerPoint Slides]. Available at: https://www.nyiso.com/documents/20142/37708419/Elevate%20Renewable%20Project%20Prioritization%20Candidate%20Template%20-%20Steam%20Turbine%20CSR.pdf/06d52da6-115b-5b3b-dc24-d4ded6931936.
[46] PEAK Coalition. 2024. *Accelerate Now!: The Fossil Fuel End Game 2.0.* NYC Environmental Justice Alliance, New York Lawyers for the Public Interest, THE POINT CDC, UPROSE, and Clean Energy Group. Available at: https://www.cleanegroup.org/wp-content/uploads/Accelerate-Now-Fossil-Fuel-End-Game.pdf, p. 11
[47] Ibid.
[48] Ibid.
[49] Ibid.

decrease statewide emissions of smog-forming pollutants from peaker plants.[50] Qualifying facilities under the Peaker Rule must cease operations by 2025 or meet NO_X emissions regulation during the ozone season;[51] the gas-fired turbine at Astoria falls under this law's jurisdiction as it operates as a peaking unit and uses combustion turbine technology, the remaining steam turbines, while operated as peakers, do not fall under this law's jurisdiction because they are not combustion turbines.

Eastern Generation originally expected the 135-MW energy storage facility to come online in May 2025, but the facility will now do so in 2027 according to the New York Independent System Operator (NYISO).[52] The rationale behind the delay to the battery storage facility's operation is currently unclear. NYISO postponed the retirement of four natural gas turbines (two turbines, units 2 and 3, sited at the Gowanus plant and two turbines, units 1 and 2, at the Narrows plants also owned by the Company) in New York City given the plants' designation as necessary for continued reliability, delaying construction of the battery storage facility.[53] Unlike the other case studies discussed in this report, the planned battery storage system replacing the combustion turbine at Astoria will offer more capacity than is being retired (135 MW versus 15 MW). While the exact size of the Astoria site is unknown, decommissioning of the remaining steam turbines could open space for more battery storage on site in the future.

Case Study #3: Dynegy Oakland Power Plant (Oakland, California)

The Dynegy Oakland Power Plant came online in Oakland, California in 1978 and has been owned by Dynegy—a Vistra subsidiary—since it began operation.[54] The facility hosted three jet-fuel powered units that had an aggregate capacity of 224 MW until 2021.[55] In 2021, Unit 2, a 74.5-MW jet-fueled turbine was decommissioned and demolished.[56] Dynegy now operates 149 MW of capacity spread evenly across the two remaining turbines, with a 2023 capacity factor of 0.5 percent.[57]

The Oakland power plant has acted as a peaker for the Alameda County electrical grid.[58] The Oakland plant

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[50] (1) PEAK Coalition. 2024. *Accelerate Now!: The Fossil Fuel End Game 2.0.* NYC Environmental Justice Alliance, New York Lawyers for the Public Interest, THE POINT CDC, UPROSE, and Clean Energy Group; (2) New York Independent System Operator. 2020. *2020 RNA Report*. Available at: https://www.nyiso.com/documents/20142/2248793/2020-RNAReport-Nov2020.pdf.
[51] New York State Governors Department. May 3, 2023. "Governor Hochul Announces New Transmission Line to Deliver Clean Energy in Queens." Available at: https://www.governor.ny.gov/news/governor-hochul-announces-new-transmission-line-deliver-clean-energy-queens#:~:text=In%202019%2C%20the%20New%20York,operation%20during%20the%20ozone%20season.
[52] (1) Colthorpe. A. June 23, 2022. "Eastern Generation gets permit for 135MW battery storage at New York fossil fuel plant site." *Energy Storage News; (2)* Reuters*.* 2023. "New York postpones retiring four power plants to maintain NYC supply.". Available at: https://www.reuters.com/business/energy/new-york-postpones-retiring-four-power-plants-maintain-nyc-supply-2023-11-21/.
[53] (1) Reuters*.* 2023. "New York postpones retiring four power plants to maintain NYC supply."; (2) Crawford, J. January 18, 2024. " Pair of NYC's Few Remaining Peaker Plants Ordered to Delay Retirement Amid Reliability Concerns." Available at: https://insight.factset.com/pair-of-nycs-few-remaining-peaker-plants-ordered-to-delay-retirement-amid-reliability-concerns.
[54] Spector, J. 2019. "Oakland to Swap Jet-Fuel-Burning Peaker Plant for Urban Battery." GTM. Available at: https://www.greentechmedia.com/articles/read/oakland-to-swap-jet-fueled-peaker-plant-for-urban-battery.
[55] (1) Tarekegne, B.W., O'Neil, R.S., & Michener, S.R. October 2021. *Energy Storage and Power Plant Decommissioning.* PNNL. Available at: https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-32214.pdf, p. 13; (2) *Renew California Power* N.d. "Oakland Energy Storage Facility." Available at: https://www.renewcaliforniapower.com/alameda-county/.
[56] Tarekegne, B.W., O'Neil, R.S., & Michener, S.R. October 2021. *Energy Storage and Power Plant Decommissioning.* NREL.
[57] (1) Grid Info*.* N.d. "Dynegy Oakland Power Plant." Available at: https://www.gridinfo.com/plant/dynegy-oakland-power-plant/6211; (2)) U.S. EIA. 2023. Form EIA-860; (3) U.S. EIA. 2023. Form EIA-923.
[58] Ibid.

only supplies 40 MW of electricity to the grid for 10 hours a day.[59] California's grid operator (the California Independent System Operator or CAISO) raised the potential for reliability concerns for the San Francisco East Bay area in its 2015/2016 Independent System Operator Transmission Plan in the event that the Oakland plant retired.[60] In 2018, Pacific Gas & Electric—the utility service provider responsible for maintaining grid reliability in the area—developed a plan for replacing the Oakland plant with distributed resources like behind-the-meter energy storage and renewable generation.[61] CAISO approved the plans for the 2022 retirement and repurposing of the Dynegy Oakland Power Plant into a 74 MW battery storage facility, however, a "Reliability Must Run" contract with CAISO prevented the plant from retiring in 2022.[62] Vistra's amended energy storage plan seeks to complete phase 1—replace decommissioned Unit 2 with 43.25 MW/140MWh of battery storage—by 2025.[63] The 74-MW battery storage project, when complete, will only replace the capacity of one of the previous turbines at the site. While the exact size of the Oakland site is unknown, additional space may be available for more battery storage on site in the future given the specification and layout of the currently planned battery storage project.

Case Study #4: Ravenswood Generating Station (Long Island City, New York)

The Ravenswood Generating Station, located on a 28-acre parcel in Long Island City, New York—approximately three miles east of Manhattan—is the largest fossil fuel-fired power plant in New York State with a 2,162 MW capacity.[64] As of 2023, the plant is powered by five gas turbines; three steam turbines and two combined cycle turbines.[65] In 2023, the capacity factor of the plant was 14.7 percent.[66] The plant was built in 1963 by Con Edison—one of the largest utilities in the region—and hosted two generating units (Units 10 and 20).[67] A third unit (Unit 30) was added in 1965, and was the largest generating unit in the world at that point in time at 1,027 MW.[68] In 2004, a fourth unit (Unit 40) was added to the plant.[69]

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[59] Ibid.

[60] (1) Tarekegne, B.W., O'Neil, R.S., & Michener, S.R. October 2021. *Energy Storage and Power Plant Decommissioning.* PNNL; (2) Enefirst. 2019. Replacing a Polluting Power Plant with Behind-The-Meter Resources. Available at: https://enefirst.eu/wp-content/uploads/ID54_Oakland_RAP.pdf.

[61] Doherty, P. 2020. "PG&E Proposes Two Energy Storage Projects for Oakland Clean Energy Initiative to CPUC." *PG&E.* Available at: https://www.pgecurrents.com/articles/2799-pg-e-proposes-two-energy-storage-projects-oakland-clean-energy-initiative-cpuc.

[62] (1) Tarekegne, B.W., O'Neil, R.S., & Michener, S.R. October 2021. *Energy Storage and Power Plant Decommissioning.* PNNL; (2) Balaraman, K. 2020. "PG&E proposes lithium-ion battery projects to replace Oakland fossil fuel plant." *Utility Dive.* Available at: https://www.utilitydive.com/news/pge-proposes-lithium-ion-battery-projects-to-replace-oakland-fossil-fuel-p/576202/; (3) Mcevoy, J. September 1, 2022. "'A Valuable Backstop': California Turns To Jet Fuel-Burning Power Plant To Keep The Lights On." Daily Caller. Available at: https://dailycaller.com/2022/09/01/california-jet-fuel-power-plant/.

[63] Renew California Power. N.d. "Oakland Energy Storage Facility."

[64] (1) Dawson, A. March 19, 2024. "Ravenswood Generating Station is going green, Borough President Launches community study." LIC Post. Available at: https://licpost.com/ravenswood-generating-station-is-going-green-borough-president-launches-community-study; (2) Lewis, M. 2023. "In a US first, fossil fuel power plant workers will be retrained for offshore." Electrek. Available at: https://electrek.co/2023/07/07/fossil-fuel-power-plant-ravenswood/; (3) U.S. EIA. 2022. Form EIA-860.

[65] Ibid.

[66] (1) U.S. EIA. 2023. Form EIA-860; (2) U.S. EIA. 2023. Form EIA-923.

[67] (1) Renewable Ravenswood. N.d. "Powering the future of Ravenswood." Available at: https://renewableravenswood.com/; (2) Con Edison. N.d. "About Con Edison." Available at: https://www.coned.com/en/about-us/company-information#:~:text=Consolidated%20Edison%2C%20Inc.,and%20%2462%20billion%20in%20assets.&text=We%20place%20select%20properties%20on,from%20licensed%20real%20estate%20firms.

[68] (1) Renewable Ravenswood. N.d. "Powering the future of Ravenswood."; (2) U.S. EIA. 2022. Form EIA-860.

[69] Renewable Ravenswood. N.d. "Powering the future of Ravenswood."

The current owner of Ravenswood Generating Station, Rise Light and Power, acquired the Station in 2017 and together with TotalEnergies—a joint venture called Attentive Energy One, or AE1—developed plans in 2020 to convert the power plant into a clean energy hub referred to as Renewable Ravenswood.[70] AE1's conversion plans retain only Unit 40 with no set retirement date.[71]

The Renewable Ravenswood project will install large-scale batteries to work with solar and wind resources, some of which will be located in Upstate New York. The offshore wind project is expected to deliver 1,400 MW of wind energy to Renewable Ravenswood via proposed underwater cables.[72] So far, information has not been made public regarding how much solar will be connected to the hub.

Case Study #5: Tunnel Jet Peaking Facility (Preston, Connecticut)

The Tunnel Jet Peaking Facility located in Preston, Connecticut hosted a 17-MW kerosene-fired turbine generating unit until its decommissioning in 2023.[73] The unit's capacity factor in 2023 was 6.6 percent.[74] Tunnel Jet's owner, FirstLight, is working in partnership with renewable energy developer New Leaf Energy to replace the decommissioned unit with a 17-MW battery energy storage system co-located at FirstLight's Tunnel Hydro facility on the Quinebaug River.[75] FirstLight's plan is to co-locate the new battery energy storage system with the Company's 2.1-MW Tunnel Hydro facility, a run-of-river hydroelectric power facility on the Quinebaug river, to establish a hybrid hydropower-battery facility.[76] As of 2022, FirstLight anticipated that the operational date of the battery energy storage system will be late 2024 or early 2025.[77] The battery storage project will replace the total capacity lost from decommissioning the kerosene-fired turbine.

Case Study #6: West Springfield Generation Station (Springfield, Massachusetts)

In 1946, the West Springfield coal fired generation plant—located in West Springfield, Massachusetts—was built by the Western Massachusetts Electric Company. [78] While owned by the Western Massachusetts Electric Company, the plant underwent two conversions, from coal-fired to oil-fired in the 1960s and from oil-fired to gas-fired in the 1990s.[79] In 2016, the plant transferred ownership to Cogentrix Energy Power

[70] Ibid.
[71] Ibid.
[72] (1) Ibid; (2) Lewis, M. 2023. "In a US first, fossil fuel power plant workers will be retrained for offshore wind." Electrek.
[73] (1) Murray, C. October 13, 2022. "FirstLight Power to replace Connecticut peaker plant with 17MW battery energy storage system." Available at: https://www.energy-storage.news/firstlight-power-to-replace-connecticut-peaker-plant-with-17mw-battery-energy-storage-system/; (2) Crowley, B. October 13, 2022. "FirstLight to Retire Kerosene-Fired Turbine, Plans Hydro-Powered Battery Replacement in Preston." CT Examiner. Available at: https://ctexaminer.com/2022/10/13/firstlight-to-retire-kerosene-fired-turbine-plans-hydro-powered-battery-replacement-in-preston/.
[74] (1) U.S. EIA. 2023. Form EIA-860; (2) U.S. EIA. 2023. Form EIA-923.
[75] Murray, C. October 13, 2022. "FirstLight Power to replace Connecticut peaker plant with 17MW battery energy storage system."
[76] (1) Ibid; (2) FirstLight. N.d. "Energizing generations with clean, reliable power." Available at: https://firstlight.energy/energy/.
[77] Murray, C. October 13, 2022. "FirstLight Power to replace Connecticut peaker plant with 17MW battery energy storage system."
[78] (1) Munford, A. 2023. "West Springfield explores redevelopment of old power plant." *Mass Live.* Available at: https://www.masslive.com/news/2023/04/west-springfield-explores-redevelopment-of-old-power-plant.html; (2) Shemkus, S. September 13, 2023. "A big battery is replacing this old Massachusetts fossil power plant." *Canary Media*. Available at: https://www.canarymedia.com/articles/batteries/a-big-battery-is-replacing-this-old-massachusetts-fossil-power-plant.
[79] Shemkus, S. September 13, 2023. "A big battery is replacing this old Massachusetts fossil power plant." *Canary Media*.

Management, a subsidiary of the multinational private equity firm the Carlyle Group. [80]

The plant continued to burn gas providing 352 MW of capacity until its retirement in June of 2022.[81] In its final year of operation, the plant operated at a capacity factor of just 0.04 percent, suggesting it was rarely in use during that time.[82] Planning to replace the site with clean energy resources began in 2021, a year prior to the plant's retirement and two years prior to Cogentrix announcing official redevelopment plans.[83] Cogentrix's plans for redevelopment of the site include an $80 million redevelopment project featuring 45 MW of battery storage that is expected to begin operation in 2025.[84] The former plant is sited on a nine-acre parcel of land, leaving room for an additional 55 MW of battery storage, but according to Cogentrix at this time investors are only willing to back the 45-MW project.[85] Additional battery storage on the site may be possible in the future depending on investor sentiment regarding the returns from the first 45 MW of storage added to the site, as well as the remaining open space available for additional resources.

IV. Massachusetts Peaker Plants

In Massachusetts, there are 32 aging peaker plants currently in operation, six of which were selected for comparison to the case studies presented above because of their similarity to the clean energy conversion case studies in terms of capacity, fuel type, and age. The six selected Massachusetts peaking plants are gas- or oil-fired, like the conversion case studies presented above (see Table 4).

Table 4. Massachusetts fossil fuel-fired peaker plants comparable to case study facilities

Case Study	Massachusetts Peaker Plant Name	Town	Fuel	Number of Units	Age (years)	Nameplate Capacity (MW)	Capacity Factor (%)	Generation (MWh)
Arthur Kill Generating Station	Millennium Power	Charlton	Gas	2	23	428	30.8%	1,152,563
Astoria Generating Station	Stony Brook	Ludlow	Gas, Oil, & Solar	10	43	542	2.3%	110,102
Dynegy Oakland Power Plant	Tanner Street Generation	Lowell	Gas	2	32	85	3.0%	22,623
Ravenswood Generating Station	Canal	Sandwich	Gas & Oil	3	56	1,495	4.0%	527,623
Tunnel Jet Peaking Facility	Cherry Street	Hudson	Gas & Oil	5	73	17	0.4%	644
West Springfield Generation Station	Pittsfield Generating LP	Pittsfield	Gas & Oil	4	34	176	3.7%	56,796

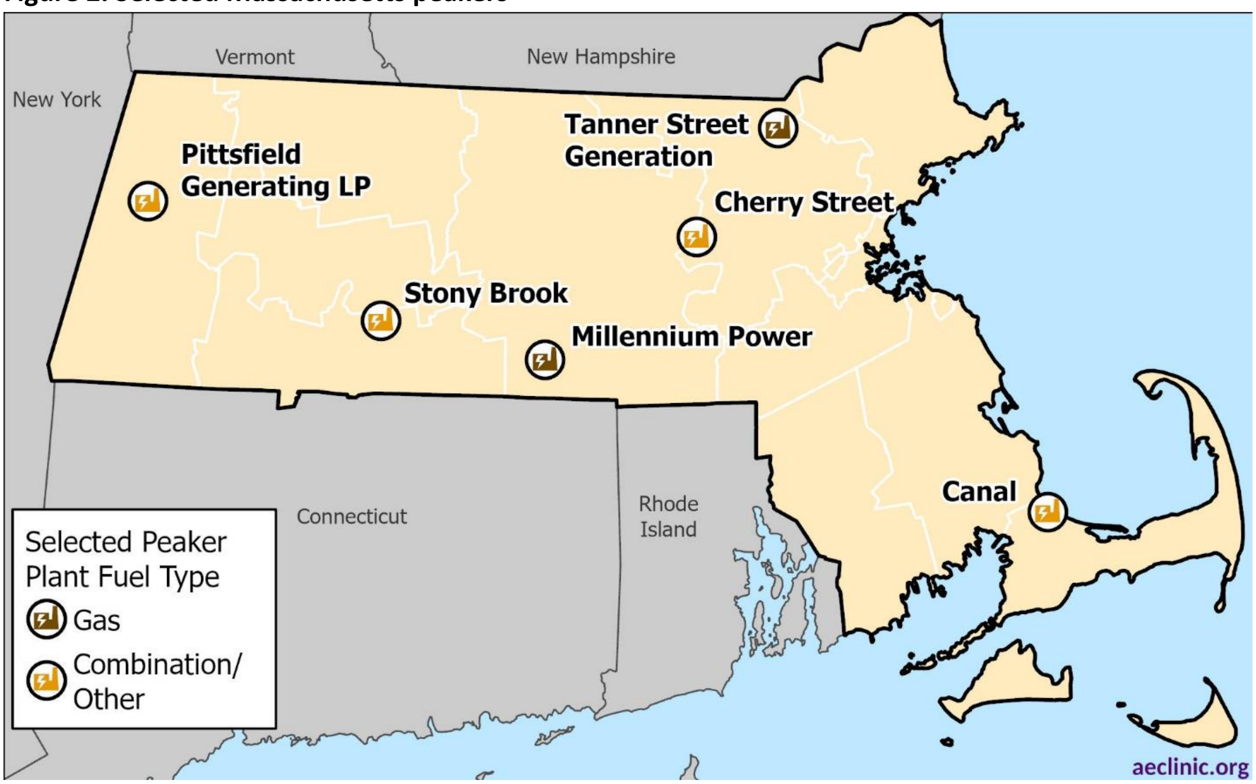
Data source: (1) U.S. EIA. 2022. Form EIA-860. (2) U.S. EIA. 2022. Form EIA-923.

80 Munford, A. 2023. "West Springfield explores redevelopment of old power plant." *Mass Live.*
81 (1) Shemkus, S. September 13, 2023. "A big battery is replacing this old Massachusetts fossil power plant." *Canary Media*.; (2) U.S. EIA. 2022. Form EIA-860.
82 (1) U.S. EIA. 2023. Form EIA-860; (2) U.S. EIA. 2023. Form EIA-923.
83 Shemkus, S. September 13, 2023. "A big battery is replacing this old Massachusetts fossil power plant." *Canary Media*.
84 Ibid.
85 (1) Munford, A. 2023. "West Springfield explores redevelopment of old power plant." *Mass Live.*
(2) Shemkus, S. September 13, 2023. "A big battery is replacing this old Massachusetts fossil power plant." *Canary Media*.

The Massachusetts peaker plants host a wide range of nameplate capacity; the Canal plant has 1,495 MW of capacity, similar to Astoria Generating Station (1,345 MW) and Ravenswood Generating Station (2,096 MW). The Cherry Street plant hosts only 17 MW of capacity, which matches the amount of retired fossil-fuel capacity at the Tunnel Jet Peaking Facility case study and falls just short of the retired fossil-fuel capacity at the Arthur Kill Power Station case study. Similarly, the total capacity at Pittsfield Generating LP is close to that planned for retirement in the Dynegy Oakland Power Plant case study.

These Massachusetts peaker plants span a range of ages, with the youngest plant (Millennium Power) in operation for 23 years and the oldest (Cherry Street) in operation for 73 years. The peaker plants vary in capacity and generation, with Cherry Street hosting 17 MW of capacity and Canal hosting 1,495 MW of capacity. These six peaker plants are located in counties throughout Massachusetts (see Figure 2). The communities housing the six Massachusetts peaker plants highlighted in this report have many similarities with the nationwide case studies presented above: higher BIPOC, low-income, and/or limited English residents.

Figure 2. Selected Massachusetts peakers



Data source: U.S. EIA. 2023. "Power Plants." Available at: https://eia.maps.arcgis.com/home/item.html?id=bf5c5110b1b944d299bb683cdbd02d2a

Tanner Street Generating Facility and Pittsfield Generating Facility have substantial BIPOC and low-income residents

The municipalities housing the six selected peaker plants in the Commonwealth differ in their shares of

BIPOC populations, individuals below the poverty line, and limited English households compared to the state averages (see Table 5). The 2022 share of BIPOC population in Lowell, Massachusetts—which houses the Tanner Street Generation facility—was substantially higher than the state average with 45 percent of the population identified as BIPOC, 25 percent of the population living below the poverty line, and 10 percent of households classified as limited English-speaking. In contrast, Charlton and Sandwich each had very low shares of each of these demographics; in Charlton, 6 percent of the population identified as BIPOC population, 5 percent of the population is living below the poverty line, and less than 1 percent are limited English-speaking households. In Sandwich, 6 percent identify as BIPOC, 9 percent live below the poverty line, and less than 1 percent are limited English-speaking households. Pittsfield's share of individuals below the poverty line is greater than the statewide average at 22 percent, yet the shares for BIPOC and limited English-speaking households are lower. While Ludlow has lower shares of BIPOC and low-income households than the state average, it does have a higher portion of limited English households. Hudson has relatively low shares of these demographics compared to the state averages.

Table 5. Massachusetts municipality demographics

Facility	Municipality	2022 Population (Number)	BIPOC Population (%)	Population Below Poverty Line (%)	Population with Limited English (%)
Canal	**Sandwich**	20,419	6.3%	8.7%	0.18%
Cherry Street	**Hudson**	19,947	16.5%	9.4%	5.52%
Millennium Power	**Charlton**	13,338	6.0%	5.3%	0.46%
Pittsfield Generating LP	**Pittsfield**	43,730	18.0%	22.2%	1.32%
Stony Brook	**Ludlow**	20,883	11.5%	16.9%	9.28%
Tanner Street Generation	**Lowell**	114,737	45.7%	25.1%	10.39%
Massachusetts		**6,984,205**	**27.3%**	**15.6%**	**6.01%**

Data source: U.S. Census Bureau. 2022. American Community Survey 5-Year Estimates. [Table IDs: S1701, B02001, C16002]. Available at: https://data.census.gov/

Opportunity for Massachusetts peaker plant conversion or replacement

The six case studies discussed earlier in this report illustrate the strategic value of repurposing fossil fuel facility sites for clean energy resources, such as storage facilities and clean energy hubs. Energy facilities that were once significant sources of emissions and local air and water pollution are being transformed to reduce reliance on fossil fuels, thereby mitigating environmental burdens on communities disproportionately affected by pollution. Leveraging existing infrastructure for renewable energy sources such as wind, solar, and battery storage illustrates a practical approach to advancing clean energy objectives while addressing both environmental challenges and community needs within the Commonwealth.

Organizations throughout Massachusetts—such as Mass Climate Action Network, Berkshire Environmental

Action Team, Slingshot, and Clean Energy Group—are calling the transition of fossil-fuel peaker plants to clean energy sources a key action necessary to decarbonization.[86] These organizations aim to facilitate the transition to a clean peak by working with communities impacted by fossil-fuel pollution. Community support is a key element of the transition; for example, in 2021, community members in Astoria, New York City, gathered in opposition to a repowering of the Astoria Gas Turbines (a separate plant from the Astoria Generating Station) owned by NRG Energy.[87] NRG's plans to repower the turbines were rejected by New York State regulators, leading the company to retire the gas turbines in 2023 and announce plans to redevelop the site for offshore wind interconnection.[88]

V. Lessons for Massachusetts' Decarbonization Pathways

The retirement and replacement of fossil-fuel-fired generation units presented in the case studies in Section III of this report illustrate the feasibility of lessening fossil-fuel dependency while increasing clean energy deployment in areas heavily impacted by pollution from fossil-fuel power plants. While the circumstances of each case study are unique, common themes among them provide crucial insights into possible decarbonization pathways available for the Commonwealth's remaining fossil fuel facilities, and in particular the six peaker plants most similar to the case studies (see Table 6).

Table 6. Key takeaways from existing fossil-fuel conversion case studies

Key Takeaway #1: Fossil-fuel sites can be desirable locations for clean energy siting.
Key Takeaway #2: Reducing reliance on fossil-fuel generation can help lessen the burden of environmental and health impacts on already overburdened communities.
Key Takeaway #3: Fossil-fuel plant conversions are a tool that can be used to achieve state and local greenhouse gas emission limits.

Key Takeaway #1: Existing plant sites can be desirable locations for future clean energy

Like the six case studies presented above, fossil fuel facilities in Massachusetts have the potential to house new clean energy facilities, reducing the environmental impact on the surrounding community while maintaining system reliability. Beyond providing environmental benefits to the community, conversion to clean energy resources at existing fossil fuel facilities can be cheaper and faster than building a new clean

[86] See Massachusetts Clean Peak Coalition, a Coalition of the aforementioned organizations with the goal of decarbonizing peaking plants in Massachusetts. Source: Massachusetts Clean Peak Coalition. N.d. "Our Vision." Available at: https://cleanthepeakma.org/#vision.

[87] NBC New York. July 9, 2021. "Queens Residents Push Back Against Overhaul of Power Plant Near 'Asthma Alley'." Available at: https://www.nbcnewyork.com/news/local/queens-residents-push-back-against-overhaul-of-power-plant-near-asthma-alley/3148032/.

[88] (1) PEAK Coalition. 2024. *Accelerate Now!: The Fossil Fuel End Game 2.0.* NYC Environmental Justice Alliance, New York Lawyers for the Public Interest, THE POINT CDC, UPROSE, and Clean Energy Group; (2) Astoria Post. February 20, 2023. "Schumer praises sale of Astoria Gas Turbines Site to offshore wind developer." Available at: https://astoriapost.com/schumer-praises-sale-of-astoria-generating-station-to-offshore-wind-developer.

energy facility elsewhere where building new transmission lines can be slow and costly.[89]

Pre-existing fossil fuel facilities offer the infrastructure needed to supply energy to the grid, making them opportune spots for siting clean energy or storage resources.[90] Utilizing existing infrastructure can save energy developers time and money compared to cases where new points of grid interconnection are needed.[91] In addition, as more fossil fuel-fired power plants are being phased out in favor of clean energy resources, converting aging plants helps mitigate their risk of becoming stranded assets as they reach the end of their useful economic life.[92] The strategy of repurposing pre-existing fossil fuel facility infrastructure and sites also prevents undeveloped sites from being disturbed, avoiding the environmental impacts (e.g., impacts to soil, wildlife, water bodies, and local air quality) that are typically associated with a new energy facility.[93]

In Massachusetts, there are 32 aging peaker plants in operation; these sites could be potential locations for clean energy development. (Appendix B provides information on the characteristics of the 32 peaker plants in Massachusetts.) By repurposing power plant sites for clean energy projects such as solar, wind, or battery storage, Massachusetts can capitalize on existing infrastructure and grid connections, reducing both project costs and development timelines.

Key Takeaway #2: Replacing fossil-fuel generation can reduce burdens on nearby communities

Fossil-fuel generation facilities release local pollutants that adversely affect the health of nearby communities and contribute to global greenhouse gas emissions.[94] According to EPA's *Power Plants and Neighboring Communities Mapping Tool*, minority and low-income populations often experience disproportionate adverse health outcomes caused by the environmental issues presented by fossil fuel facilities.[95] A 2022 study from the Harvard T.H. Chan School of Public Health found that minority and low-income populations across the United States are disproportionately exposed to health-threatening higher concentrations of particulate matter ($PM_{2.5}$) air pollution: in 2016, the United States' Black population was exposed to 13.7 percent more $PM_{2.5}$ air pollution than the white population.[96]

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[89] (1) Pitarque, C. July 23, 2024. "Efficient Development of Clean Energy Infrastructure: Converting Retired Fossil Fuel Plants to Battery Storage." *Energy Bar Association*. Available at: https://www.eba-net.org/efficient-development-of-clean-energy-infrastructure-converting-retired-fossil-fuel-plants-to-battery-storage/; (2) McIntire, N., Minondo, A. November 6, 2023. "Batteries Can Be a Game Changer for the Power Grid If We Let Them." NRDC. Available at: https://www.nrdc.org/bio/natalie-mcintire/batteries-can-be-game-changer-power-grid-if-we-let-them.

[90] Shemkus, S. September 13, 2023. "A big battery is replacing this old Massachusetts fossil power plant." *Canary Media*. Available at: https://www.canarymedia.com/articles/batteries/a-big-battery-is-replacing-this-old-massachusetts-fossil-power-plant.

[91] Pitarque, C. July 23, 2024. "Efficient Development of Clean Energy Infrastructure: Converting Retired Fossil Fuel Plants to Battery Storage." *Energy Bar Association.*

[92] Martos, J. 2024. "Oil and gas plants need to be retired five times faster to meet long-term climate goals." *Global Energy Monitor.* Available at: https://globalenergymonitor.org/report/world-must-retire-oil-and-gas-plants-five-times-faster-to-meet-long-term-climate-goals/.

[93] Public Service Commission of Wisconsin. N.d. *Environmental Impacts of Power Plants*. Available at: https://psc.wi.gov/Documents/Brochures/Enviromental%20Impacts%20of%20PP.pdf, p. 2

[94] U.S. EPA. N.d. "Human Health & Environmental Impacts of the Electric Power Sector."

[95] U.S. EPA. September 5, 2024. "Power Plants and Neighboring Communities."

[96] Rura, N. January 12, 2022. "Racial, ethnic minorities and low-income groups in U.S. exposed to higher levels of air pollution." *Harvard T.H. Chan School of Public Health*. Available at: https://www.hsph.harvard.edu/news/press-releases/racial-ethnic-minorities-low-income-groups-u-s-air-pollution/.

Each of the case studies are located in municipalities which house families and communities that are particularly vulnerable due to socioeconomic and environmental factors such as historically marginalized populations, economic challenges, or language barriers. Replacing fossil-fuel generation in the Commonwealth with clean energy resources provides an avenue to reduce the burden on already overburdened communities located near power plants.

In 2022, nearly 7 million people lived in the Commonwealth of Massachusetts, of whom 27 percent of the population identified as BIPOC, 16 percent of individuals lived below the poverty line, and 6 percent of households were classified as limited English-speaking (see Table 5).[97] The demographics of the six Massachusetts peaker plants vary from the state average, illustrating the spectrum of vulnerability experienced by residents in each of the municipalities that house fossil fuel-fired facilities. Although some municipalities have higher proportions of BIPOC populations, low-income residents, and limited English-speaking households—indicating greater socioeconomic vulnerability—the negative health and environmental impacts faced by any community living near a fossil fuel-fired facility can be reduced by transitioning to clean energy sources.

Key Takeaway #3: Fossil-fuel conversion is an important tool at the Commonwealth's disposal to achieve greenhouse gas emissions limits

The Commonwealth will need all possible tools to meet its greenhouse gas emission limits, and converting fossil fuel power plants to clean energy facilities can be an efficient and equitable pathway towards decarbonization. In 2022, the Commonwealth released its *Clean Energy and Climate Plan for 2050*, outlining the broader emissions reduction goal of reaching net zero emissions by 2050, and subsector limits within this goal for transportation, residential heating and cooling, commercial and industrial heating and cooling, electric power, industrial processes, and natural gas distribution and services to achieve at least an 85 percent reduction in emissions from 1990 levels.[98] The Plan states that more than 50 GW of clean energy resources—largely from solar and offshore wind capacity—will be required to meet this goal.[99]

In addition, as a result of the *2021 Act Creating a Next-Generation Roadmap for Massachusetts Climate Policy,* a piece of legislation amending the *Global Warming Solutions Act of 2008* and requiring limits on greenhouse gas emissions for 2025 and 2030, the Commonwealth released the *Clean Energy and Climate Plan for 2025 and 2030*.[100] This plan details the short-term actionable strategies that Massachusetts can employ to achieve a 33 percent reduction in emissions by 2025 and a 50 percent reduction by 2030 (from 1990 levels), which will require emissions from the electric sector to decrease 53 percent by 2025 and 70 percent by 2030.[101] The strategies include procuring clean energy resources, establishing strong clean energy standards and regulations, coordinating regional planning, supporting offshore wind and solar

[97] U.S. Census Bureau. 2022. *American Community Survey 5-Year Estimates. [Table IDs: S1701, B03002, C16002].* Available at: https://data.census.gov/.
[98] Massachusetts Executive Office of Energy and Environmental Affairs. 2022. *Clean Energy and Climate Plan for 2050*.
[99] Ibid. p. 24
[100] Massachusetts Executive Office of Energy and Environmental Affairs. 2022. *Clean Energy and Climate Plan for 2025 and 2030*. Available at: https://www.mass.gov/doc/clean-energy-and-climate-plan-for-2025-and-2030/download.
[101] Ibid. p. 63

development, incorporating decarbonization goals into grid modernization, and ensuring a just transition to cleaner energy that is inclusive and equitable to all.[102]

Replacing existing—or recently retired—fossil-fuel-fired power plants throughout the state, particularly dirty peaker plants, with clean energy or storage resources can assist the Commonwealth in achieving its emissions reduction goals in the electric sector, advance decarbonization, and increase the penetration of renewables. The six referenced case studies undergoing this transition to clean energy resources serve as examples of how this strategy can be implemented, particularly within municipalities experiencing high emissions levels. Battery storage facilities allow for energy to be stored at times of low demand and discharged in times of high demand, which can reduce the need to rely on fossil-fuel peaker plants that are only in operation during these times. When facilities are converted to battery storage, they can also be paired with clean energy generators, such as wind or solar facilities, which not only reduce Massachusetts electric power sector emissions but also contribute to the Commonwealth's grid modernization efforts.

Fossil fuel conversion case studies help chart a course for Massachusetts as it decarbonizes its own power sector

To meet its climate goals while fulfilling its energy needs, Massachusetts will need to replace at least some of its' remaining 32 gas- and oil-fired peaker plants with reliable renewable energy resources. This report details six case studies of fossil fuel-fired power plants across the country that have had some or all of the plant's capacity converted to wind-powered or battery storage resources, reducing greenhouse gas emissions and local pollutants emitted from the power plants, along with six fossil fuel-fired power plants in Massachusetts that are the most similar to the case studies. These case studies provide crucial insights into possible decarbonization pathways available for the Commonwealth's remaining fossil fuel facilities. They demonstrate that fossil fuel sites can serve as desirable locations for clean energy projects, offering a valuable opportunity to reduce reliance on fossil-fuel generation. This not only alleviates the environmental and health burdens on already overburdened communities but also aligns with state and local objectives for reducing greenhouse gas emissions.

The stories of these conversions can aid Massachusetts in planning for the decarbonization of its own power sector by illustrating the possible pathways for the retirement of the Commonwealth's fossil fuel-fired peaking facilities that effectively reduce emissions and subsequent health impacts.

[102] United Nations Development Programme. November 3, 2022. "What is a just transition? And why is it important?" [Blog]. Available at: https://climatepromise.undp.org/news-and-stories/what-just-transition-and-why-it-important. p. 64-73

Appendix A: Massachusetts peaker plants

Table 7. Massachusetts peaker plants

Plant	Fuels Used	Number of Units	Age of Plant (years)	Nameplate Capacity (MW)	2022 Generation (MWh)	Capacity Factor (%)	Planned Plant Retirement
Bellingham Cogeneration Facility	Gas	3	33	386.1	211,088	6.2%	-
Canal	Gas & Oil	3	56	1,495	527,623	4.0%	-
Centech Gas Generator	Gas	1	5	2.5	255	1.2%	-
Cherry Street	Gas & Oil	5	73	17	644	0.4%	2030
Cleary Flood Hybrid	Gas & Other	3	49	121	24,496	2.3%	-
Dartmouth Power Associates LP	Gas	3	32	97	60,470	7.1%	-
Dighton Power Plant	Gas	1	25	200	253,990	14.5%	-
Exelon Framingham LLC	Oil	3	55	43	915	0.2%	-
Exelon Medway LLC	Oil	3	54	135	2,863	0.2%	-
Exelon West Medway II LLC	Gas	2	5	264	232,202	10.1%	-
Front Street	Oil	3	46	8.1	1,445	2.0%	-
High Street Station	Gas & Oil	9	73	11	223	0.2%	-
IXYS - Beverly	Gas & Oil	4	27	2.7	18	0.1%	-
Masspower	Gas	3	31	261	233,904	10.2%	-
Milford Power LP	Gas	2	31	249.3	147,170	6.7%	-
Millennium Power	Gas	2	23	428	1,152,563	30.8%	-
M Street Jet	Oil	1	45	69	385	0.1%	-
Mystic Generating Station	Gas	6	21	1,744	1,616,842	10.6%	2024
Nantucket Hybrid	Oil & Other	3	5	22.4	-724	-0.4%	-
Newark America Mill	Gas	1	17	6	0	0.0%	-
Pittsfield Generating LP	Gas & Oil	4	34	176	56,796	3.7%	-
Potter Station 2	Gas	4	47	217	34,767	1.8%	-
Salem Harbor Power Development LP	Gas	4	6	798.2	544,674	7.8%	-
Shrewsbury	Oil	5	55	14	251	0.2%	-
Signature Breads Chelsea	Oil	1	5	1.5	1	0.0%	-
Stony Brook	Gas, Oil, & Solar	10	43	542	110,102	2.3%	-
Tanner Street Generation	Gas	2	32	85	22,623	3.0%	-
Wilkins Station	Oil	2	49	5	108	0.2%	-
Waters River	Gas	2	53	64.9	6,318	1.1%	2026
Wellesley College Central Utility Plant	Gas & Oil	8	39	14	0	0.0%	-
West Tisbury Generating Facility	Oil	2	49	5.4	1,632	3.5%	-
West Water Street	Oil	4	6	10	1,434	1.6%	-

Data source: (1) U.S. EIA. 2022. Form EIA-860. (2) U.S. EIA. 2022. Form EIA-923. Note: Negative generation for the Nantucket Hybrid facility is due to negative generation from the battery and one oil unit on site.

Appendix B: Selection of considered Massachusetts peaker plants

AEC obtained a list of Massachusetts peaking plants from BEAT. AEC then collected capacity, generation, fuel type, age, and other data from the U.S. EIA for the year 2022. This data was then compared to similar characteristics for each case study, and three to four Massachusetts peaking plants were identified as comparable to each peaker based on fuel type, capacity, and age. The shortlist of potentially comparable peaker plants was presented to the BEAT for each case study. BEAT then selected the MA peaker they believed best matched the case study in terms of facility characteristics and similar demographics in the communities surrounding both the case study and the comparable peaker plant.

Appendix C: Data sources

Table 8. Source articles and data for case study conversion statistics in Table 3

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