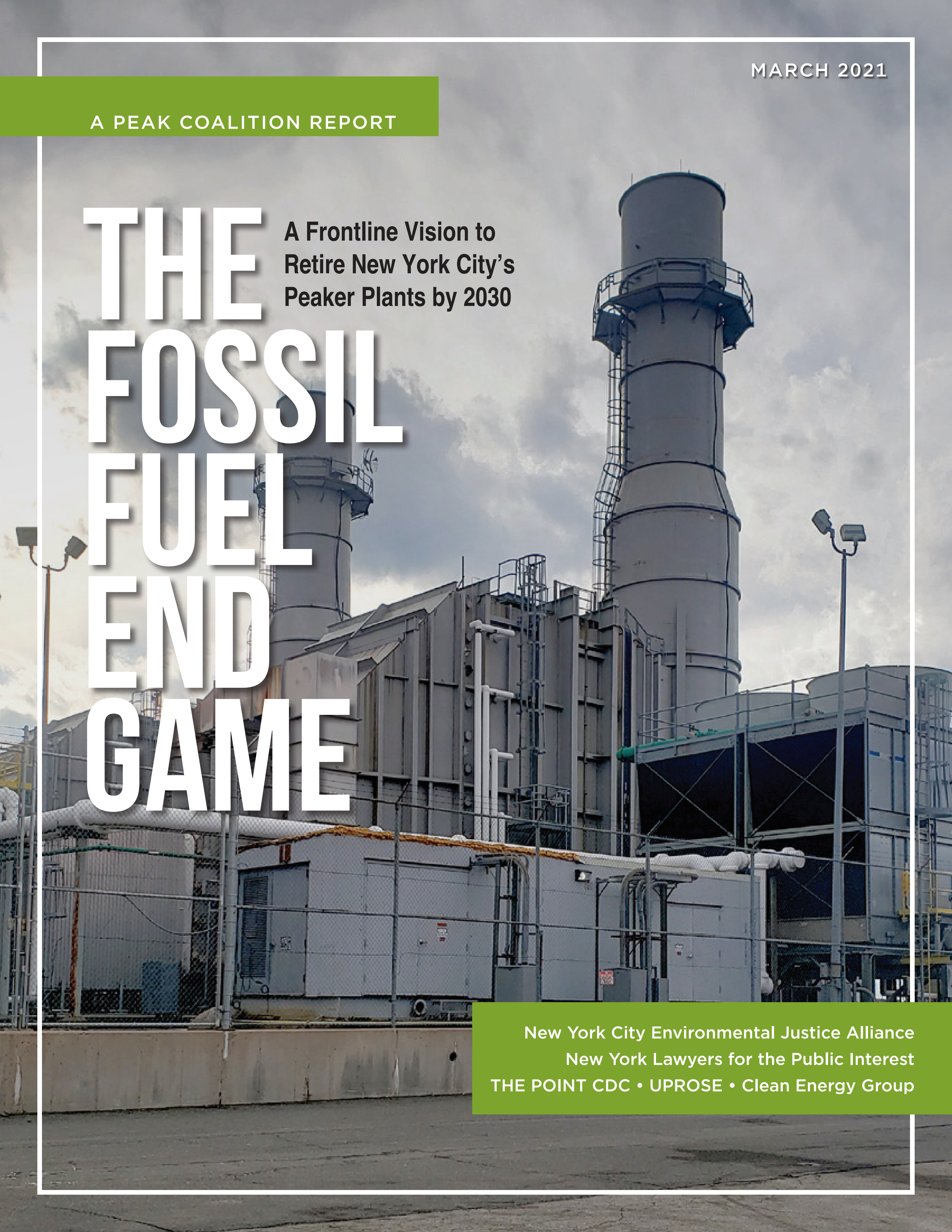

MARCH 2021

A PEAK COALITION REPORT

THE FOSSIL FUEL END GAME

A Frontline Vision to Retire New York City's Peaker Plants by 2030

New York City Environmental Justice Alliance
New York Lawyers for the Public Interest
THE POINT CDC • UPROSE • Clean Energy Group

ABOUT THE PEAK COALITION

The PEAK coalition—UPROSE, THE POINT CDC, New York City Environmental Justice Alliance (NYC-EJA), New York Lawyers for the Public Interest (NYLPI), and Clean Energy Group (CEG)—has come together to end the long-standing pollution burden from power plants on the city's most climate-vulnerable people. This coalition will be the first comprehensive effort in the US to reduce the negative and racially disproportionate health impacts of a city's peaker plants by replacing them with renewable energy and storage solutions. Our collaboration brings technical, legal, public health, and planning expertise to support organizing and advocacy led by communities harmed by peaker plant emissions. Together with communities, we are advocating for a system of localized renewable energy generation and battery storage to replace peaker plants, reduce greenhouse gas (GHG) emissions, lower energy bills, improve equity and public health, and make the electricity system more resilient in the face of increased storms and climate impacts. This report lays the groundwork to make the case for that transformation.

ACKNOWLEDGEMENTS

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Cover Photo: Joseph J. Seymour peaker power plant in Sunset Park, Brooklyn. Courtesy of UPROSE

The Fossil Fuel End Game

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Prepared by

Strategen Consulting on behalf of the PEAK Coalition

Foreword by

New York City Environmental Justice Alliance
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Clean Energy Group

MARCH 2021

www.peakcoalition.org

Foreword

Last year the PEAK Coalition—a group comprised of environmental justice and clean energy advocates that includes New York City Environmental Justice Alliance (NYC-EJA), UPROSE, THE POINT CDC, New York Lawyers for the Public Interest (NYLPI) and Clean Energy Group (CEG)—launched a new campaign to end the long-standing pollution burden and injustice on low-income communities and communities of color from "peaker" power plants in New York City. The campaign is designed to replace the city's entire fleet of fossil-fuel peaker power plants with clean energy alternatives such as renewables and energy storage.

One of the Coalition's first actions was to release a groundbreaking report in May 2020 investigating the economic and environmental costs of New York City's peaker plants, highlighting the harmful environmental health impacts of these plants in environmental justice communities. That report, *Dirty Energy, Big Money,* outlined how New York City's peaker plants—some operating since the 1950s—have perpetuated decades of health disparities from long-term exposure to toxic air pollution in the South Bronx, Sunset Park, Brooklyn, Queens, and other in low-income communities of color where these plants are predominantly located. The report noted the peakers' nitrogen oxide (NO_x) and particulate emissions, linked to

Joseph J. Seymour peaker power plant in Sunset Park, Brooklyn.
Courtesy of UPROSE

increased serious disease and higher mortality rates from COVID-19 exposure. The report also outlined how between 2000 and 2019 the public and private owners of these old, inefficient, and polluting power plants—which sit idle most of the year except when electricity demand is high—took in over $4.5 billion in revenue through capacity payments.

The *Dirty Energy, Big Money* report called for commitments from New York City to move away from this outdated, inequitable, and polluting energy system relying on peaker plants, and to embrace a clean energy system powered by renewables and energy storage—creating a model for operationalizing New York State's landmark *Climate Leadership and Community Protection Act* (CLCPA) by investing in environmental justice communities to enhance community resilience, promote equity, and create local clean energy jobs. In 2021, the PEAK Coalition is laying out a detailed roadmap showing how peakers can be retired and replaced on a timeline consistent with the energy commitments established in the CLCPA, and developing a plan to realize the goal of a New York City free of dirty peaker plants.

The Fossil Fuel End Game, prepared by Strategen Consulting on behalf of the PEAK Coalition, is the first detailed roadmap that sets forth a specific strategy and policies to retire and replace a city's entire fleet of fossil-fuel peaker plants—a feat that can be accomplished by 2030 in New York City.

The report accomplishes multiple goals:

First, it characterizes the New York City peaker fleet and digs deeper into the harmful environmental, health, and economic injustices they cause:

- Environmental justice communities in New York City bear an inequitable burden of pollution from fossil fuel power plants. Of power generated in downstate regions like New York City, 69 percent comes from fossil-fuel burning power plants, relative to nine percent from upstate New York, based on estimates by the state system operator.
- The city has 89 peaking units (individual turbines) spread across 19 power plants, with a combined capacity of 6,093 megawatts (MW). Many of these units are over 50 years old, already well past the normal age of retirement for most types of generators, and some still run on highly polluting fuel-oil or kerosene.
- In 2019, 79 out of these 89 peaking units operated for less than 5 percent of the time (fewer than 500 hours) and 60 of them ran for less than 1 percent of the year (fewer than 100 hours).
- Many of the peakers run for relatively short durations and could be replaced by energy storage at competitive costs. In 2018, over 50 percent of the peaking units in the portfolio ran no more than eight hours in duration each time they fired up; 28 units, totaling 765 MW of installed capacity, had maximum run durations of four hours or less.
- Annually, peakers in New York City emit almost 2.7 million tons of carbon dioxide (CO_2), constituting almost 5 percent of New York City's 2019 CO_2 emissions. Based on New York State Department of Environmental Conservation guidelines on the cost of carbon, the CO_2 emissions of the peaker fleet cost the world more than $300 million each year.

- 750,000 people in New York City live within one mile of a peaker plant; 78 percent of these people are either low-income or people of color.
- In New York State, peakers contribute as much as 94 percent of the state's NO_X emissions on high-ozone days, despite providing as little as 36 percent of the gross energy load. These disproportionately large emissions occur because many of the older peaker plants do not have any form of NO_X controls and are not compatible with emissions-reducing retrofits.
- Because of expensive capacity payments to peaker plant owners and inefficient equipment, electricity from peaker plants in New York City is up to 1,300 percent more expensive than the average cost of electricity in the rest of the state. The owners of these seldom-used power plants received a staggering $4.5 billion in revenue to operate over the course of ten years—money that the PEAK Coalition urges should be invested in renewable energy solutions and green jobs in and near New York City, instead of mostly flowing to out-of-state entities.[i]

Next, this report lays out a comprehensive strategy to feasibly retire New York City's entire fleet of fossil-fuel peaker plants and replace them with renewables and energy storage by 2030, with an equity focus to prioritize retirement of plants in environmental justice communities.

- In the first phase, by 2025, about 3.2 gigawatts (GW)—approximately half of existing peaker plants—can be replaced with a combination of offshore wind, rooftop solar, energy efficiency measures, and battery storage.
- In the second phase, by 2030, all remaining peaker plants in the city, approximately 2.9 GW, can be replaced using a similar combination of resources.

i As noted in *Dirty Energy, Big Money*, the PEAK Coalition publicly and specifically asked the plant owners and public officials to correct any mistakes that might have been made in the multi-billion-dollar capacity payments analysis. As of the date of publication of this report, no one has come forward to correct or dispute the report's findings, so they are reiterated here.

Narrows floating peaker power plant in Sunset Park, Brooklyn.
Courtesy of UPROSE

- The energy services provided by these plants can be replaced by these resources according to the following development schedule:
  - 2.8 GW of rooftop solar by 2025, growing to 5.6 GW by 2030
  - 1.5 GW of offshore wind by 2025, growing to 3 GW by 2030
  - 4,100 gigawatt-hours (GWh) of energy efficiency by 2025, growing to 5,400 GWh by 2030
  - 2.4 GW of 4-hour duration energy storage (or equivalent) by 2025, growing to 4.2 GW of 8-hour duration storage (or equivalent) by 2030
- The majority of these resources are already required by the CLCPA, which establishes specific targets for clean energy development, including 6 GW of rooftop and community solar by 2025, 3 GW of energy storage by 2030, and 9 GW of offshore wind by 2035.
- The proposed retirement and replacement plan will save customers money, with the potential to save $1 billion in energy market costs by 2035.
- Retirement of the city's peaker plants would reduce annual emissions by 2.66 million tons of CO_2, 1,655 tons of NO_X, and 171 tons of SO_2.
- Reduced environmental and health impacts from avoided emissions would be projected to create additional savings of more than $1 billion by 2035.

Finally, the report recognizes that this accelerated clean energy transition, while technically feasible and cost-effective, will require a new era of alignment, coordination, and shared commitment to a renewable energy framework and policies by public agencies and regulators:

- The New York Independent System Operator (NYISO), in coordination with the Federal Energy Regulatory Committee (FERC), must establish market rules and mechanisms that support the competitive and cost-effective deployment of energy storage and other clean resources.
- The New York State Energy Research and Development Authority (NYSERDA) and other state government agencies must continue to advance clean energy solutions like offshore wind, energy storage, energy efficiency, distributed solar, and local and regional transmission and connectivity infrastructure, all of which must be focused on ensuring equitable deployment of these resources in New York City.

Local and state legislators will need to help advance innovative options to site and develop clean resources (specifically rooftop solar and battery storage) within the city while reducing waste and energy demand through efficiency measures. As solar technology has become far more cost-effective, New York City installations have continued to lag, partly due to elevated installation costs and construction restrictions. In fact, distributed solar in the city, supported by the state's solar incentive program, accounts for only 6% of the total capacity installed in the state, while New York City accounts for one-third of the state's energy consumption.

To replace New York City's peaker plants with clean energy solutions, local and state legislators must:

- Fully implement the benchmarking, building retrofit, and distributed energy mandates of the *Climate Mobilization Act* (Local Law 97 of 2019), while rejecting recent attempts by the real estate industry to bypass these measures with renewable energy credits. Retrofits of public buildings (such as schools) in environmental justice communities, including those burdened by peaker plants, must be prioritized.

- Advance and accelerate the installation of solar, battery storage, and other clean energy technologies at publicly owned buildings and land, including Rikers Island and public schools. Prioritize solar and battery installations on buildings such as K-12 schools in environmental justice communities.
- Ensure that New York City receives an equitable share of state and federal renewables and energy efficiency funding through agencies such as NYSERDA in accordance with the CLCPA, with priority given to deploy efficiency measures and distributed energy resources in environmental justice communities.

The PEAK Coalition presents this report as a roadmap to end the long-standing toxic burden of peaker power plants on the city's most climate-vulnerable and pollution-impacted communities. This path prioritizes investment in local communities and creation of local jobs and economic growth. The plan lays out a strategy for New York City to take leadership in achieving the vital climate and equity goals enacted through the CLCPA.

In 2020, NYC-EJA and its member organizations published the city's climate agenda, calling for creating community-based renewable energy programs, replacing peaker power plants, generating clean energy jobs, and preparing more adequately for recurrent extreme weather events, among other climate justice objectives. The agenda highlights that "achieving true climate justice requires more than drawing down emissions and creating jobs—it also requires supporting the health and resilience of every community in our city and honoring the rights of communities to articulate their own climate solutions."

The Fossil Fuel End Game underscores specific clean energy strategies embraced by the PEAK Coalition and its allies in this peaker replacement campaign. Replacement and retirement options, as confirmed by the report, would require a full range of aggressive state and local strategies to accelerate adoption of rooftop solar, energy efficiency, offshore wind, and energy storage technologies. While the PEAK Coalition recognizes this is not a trivial undertaking, advances in clean energy technologies have created a path forward to achieve this critical energy transition.

For too long, communities of color have borne the burden of power plant emissions to keep the lights on for everyone else. With strong leadership from state and city government, in close partnership with impacted communities, New York City can serve as a model to the state and the entire country through its commitment to develop local renewable energy and battery storage systems, while investing in the communities historically harmed by existing fossil fuel infrastructure.

The PEAK Coalition looks forward to the collaborations and innovations ahead to make this clean energy vision a reality.

The Fossil Fuel End Game:

A Frontline Vision to Retire New York City's Peaker Plants by 2030

Prepared for:

THE PEAK COALITION

Clean Energy Group
New York City Environmental Justice Alliance
New York Lawyers for the Public Interest
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Executive Summary

This report describes a technically and economically feasible approach to replace New York City's peaker power plant fleet[1] with locally sited renewables, customer-sited resources, and energy storage over the next decade. As the majority of these plants are located in the South Bronx, Sunset Park, and other under-resourced communities and environmental justice communities, this approach has the potential to prioritize communities impacted by peakers, not only by ceasing the damage to their immediate environment but also by creating new local job opportunities and building local infrastructure for resiliency.

The analysis finds that a phased approach could be used to retire the city's entire 6,093 megawatt (MW) fleet of peaker power plants. About 3,230 MW – approximately half of existing peaker plants – could be replaced by 2025 with a combination of offshore wind, rooftop solar[2], energy efficiency, and energy storage. This can be followed by the full retirement of all remaining peaker plants in the city by 2030 using a similar combination of resources: 5.6 gigawatts (GW) of rooftop solar, 3 GW of offshore wind, 5,400 GWh of energy efficiency, and 4,200 MW of 8-hour (or equivalent) energy storage.

This report outlines how the following peaker plants in New York City would be replaced and retired according to this schedule:

Table 1. Proposed Peaker Unit Retirements by 2025 and 2030

Units to retire by 2025	Capacity (MW)
Arthur Kill (Unit 1)	20
Astoria Gen (GT Unit)	16
Astoria Gen. ST (Unit 2)	180
Astoria GT (All)	558
Gowanus (All)	640
Harlem River (All)	94
Hell Gate (All)	94
Hudson Ave (All)	33
Narrows (All)	352
Ravenswood (Units 1, 10, 11)	69
Ravenswood ST (Unit 3)	1,027
Vernon Blvd (All)	94
59th Street (All)	17
74th Street (All)	37
Total by 2025	**3,231 MW**

Units to retire by 2030	Capacity (MW)
Arthur Kill ST (Units 2,3)	912
Astoria ST (Units 3, 5)	763
East River ST (Unit 7)	200
J.J. Seymour	94
Kent	47
Pouch	47
Ravenswood ST (Units 1, 2)	800
2030 Total	**2,863 MW**

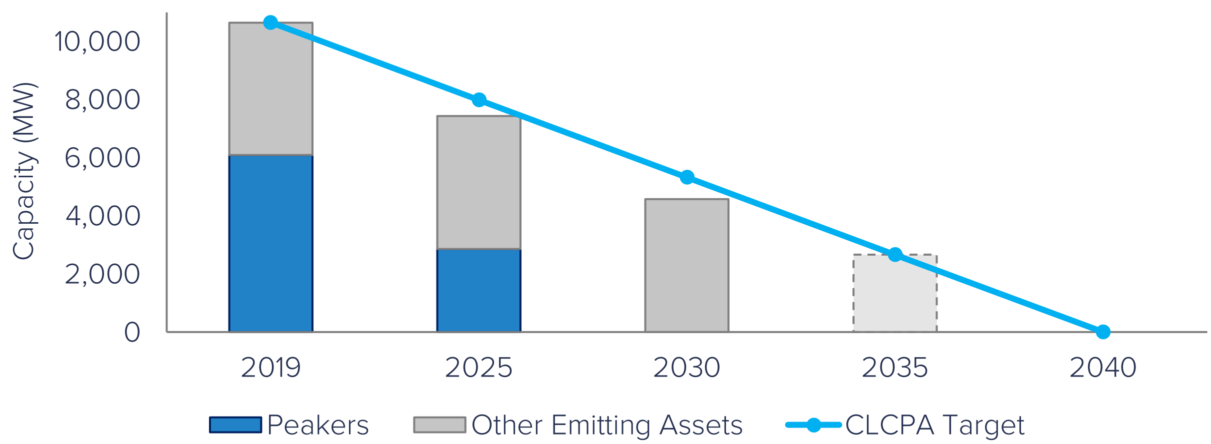
The retirements outlined above represent an opportunity to close nearly 60% of the total existing fossil assets operating in New York City, and bring the city's electric resource portfolio on-trajectory

[1] Peaker power plants are turned on when energy demand rises above normal levels. Peaker plants are highly polluting and tend to be sited in under-resourced and environmental justice communities like the South Bronx and Sunset Park. For additional information on peaker plants and their impacts on New York City communities, see: Peak Coalition, 2020. *Dirty Energy, Big Money: How Private Companies Make Billions from Polluting Fossil Fuel Peaker Plants in New York City's Environmental Justice Communities—and How to Create a Cleaner, More Just Alternative*.

[2] This report focuses on rooftop solar to quantify the technical potential for solar in the city, but other solar resources, such as distributed solar or community solar, could also contribute to local energy needs.

to achieve the community and climate goals laid out in the Climate Leadership and Community Protection Act (CLCPA), and to transition away from fossil fueled resources by 2040. Figure 1 below outlines how this retirement schedule will help New York City align with and achieve the goals established in the CLCPA. This proposal further aligns with CLCPA stated goals to "prioritize measures to maximize net reduction of greenhouse gas emissions and co-pollutants in disadvantaged communities as identified pursuant to [the Climate Justice Working Group]"[3]; these retirements would represent a reduction of 1,655 tons of NO_X and 171 tons of SO_X annually.

Figure 1. Retirement Trajectory of New York City Emitting Power Capacity



Source: Strategen

Retiring these peaker plants and replacing them with renewable resources and energy storage could bring benefits in the form of savings in the capacity market and avoided damages from polluting emissions. This report shows the potential to save $1,005 million in the energy markets and $1,166 million from avoided emissions by 2035 (net present value). Also as a point of comparison, peaker plants received full capacity payments for about $422 million in 2019 and about $4.9 billion during the last decade.[4] These numbers can be compared to the $112 million in incentives for solar projects located in NYC over the last 20 years; or the most recent $573 million expansion of the NY-Sun Program for the State that includes $200 million focused on supporting projects benefitting low- and moderate-income New Yorkers, affordable housing, and disadvantaged communities.

With the passage of the CLCPA, New York and over 200 community groups made a clear statement about their commitment to action on the deeply intertwined issues of climate change and environmental justice with strong emission reduction, renewable energy development, and equity mandates.[5] The CLCPA lays out both the impetus for action and specific targets and mechanisms needed to achieve a clean and equitable future for the state and its residents. Throughout the CLCPA, legislators make it explicitly clear that the State's ability to achieve a healthy and thriving future is deeply dependent on its ability to ensure access to clean energy and clean air for all residents in the State, especially those living in historically disadvantaged communities that have borne the brunt of fossil-fuel infrastructure and air pollution.

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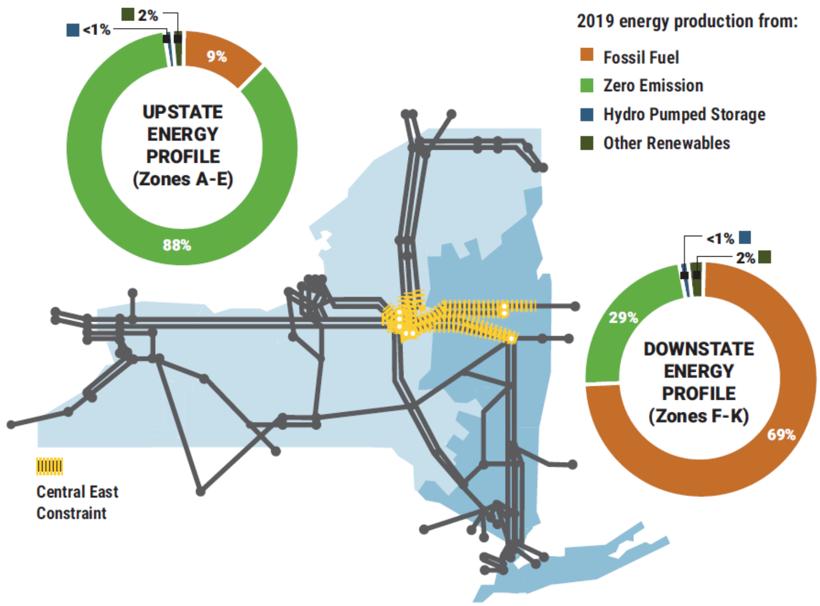
[3] New York State Senate, 2019. *Assembly Bill A8429.*

[4] Approximation based on historical capacity prices from NYISO's strip, monthly and spot auctions in Zone J (N.Y.C.) for summer and winter periods. Assumes 15% benefit on bilateral contracts from strip prices.

[5] CLCPA was championed by NY Renews, a coalition of over 200 environmental, justice, faith, labor, and community groups. The NY Renews coalition drafted the Climate and Community Protection Act (CCPA) to mandate a transition to a just and renewable economy in New York state, which ultimately became the CLCPA.

Of power generated in downstate regions of New York, 69% is estimated to come from fossil fueled resources, relative to 9% in upstate New York. These energy inequalities between regions are the result of many factors, including differences in space availability and transmission constraints that limit the supply of clean energy in the downstate regions. In New York City, these resource hurdles are more severe and virtually all energy generated locally comes from fossil fuels. A vast majority of these fossil fueled resources only run at a fraction of their total capability and during the energy system peaks. Moreover, many of these old peaker plants were built in the 1950s to 1970s and continue to run on heavily polluting fuels like fuel oil or kerosene.

Figure 2: Upstate and Downstate Energy Supply Profile



Source: NYISO, "The Vision for a Greener Grid"

For years, regulators, policymakers and other grid planning organizations faced resource development challenges and reliability concerns that have prevented the replacement of these highly polluting power plants with cleaner resources. That is no longer true. Energy resources such as storage, solar, and wind, are now more accessible and cost-effective assets to meet grid needs across the US. In places like California and Hawaii, solar and storage have already been used for years to help alleviate transmission congestion and retire fossil fueled assets. A number of states, including Colorado[6], Arizona[7] and New Mexico,[8] have concluded that these clean resources are actually a more cost-effective energy solution than fossil-fueled power, and are actively pursuing retirement and replacement strategies. As new solutions come to the market to provide energy and integrate renewables, a clean grid becomes even more feasible.

As New York joins this growing body of states committed to clean energy, it has the opportunity to step forward into the spotlight and demonstrate not only the feasibility of clean resources, but also the way in which these resources can help to transform urban power supply. The analysis

[6] Clean Energy Group, 2018. *Batteries Replacing Gas in California, Coal in Colorado and Indiana*. & Strategen, 2019. *Colorado Coal Plant Valuation Study.* Prepared for Sierra Club.

[7] Strategen, 2019. *Arizona Coal Plant Valuation Study: Economic assessment of coal-burning power plants in Arizona and potential replacement options.* Prepared for Sierra Club.

[8] Greentech Media, 2020. New Mexico's plan to shut down coal without leaving people behind. News Article.

undertaken in this report demonstrates an approach for New York City to begin its transition to a local and more equitable supply of energy that is 100% clean.

Achieving this clean energy vision will require action from policymakers and community leaders across the state. New York's Grid Operator (NYISO), in coordination with the Federal Energy Regulatory Commission (FERC), must establish market rules and mechanisms that support the competitive and cost-effective deployment of energy storage and other clean resources. The New York State Energy Research and Development Authority (NYSERDA) and other state government agencies must continue to advance clean energy solutions like offshore wind, energy storage, energy efficiency and solar, and must further focus their efforts on ensuring equitable deployment of these resources in New York City and its disadvantaged communities. Finally, city and local leaders have a role to play in supporting new energy resource development in and around the city as the difficulties of siting new resources is one foundational challenge that has allowed aging fossil fueled resources to continue to operate to this day. Local leaders will be required to help advance innovative options to site and develop clean resources that can facilitate this transition.

New York has taken the groundbreaking step of explicitly tying its clean energy goals with the need to care for and protect the most vulnerable communities in the state. As state legislators, regulators, and other policy actors begin to unpack the CLCPA to understand how to implement the foundational vision described, it is imperative that the community protection directives outlined in the CLCPA continue to guide and focus the implementation of New York's clean energy vision. It is not enough to implement state-wide clean energy policy; specific attention and care must be dedicated to the issue of pollution in New York City. The communities of New York City deserve the same treatment promised to all other New Yorkers: clean air and a 100% clean energy future.

Key Takeaways from this study:

- 6 GW of fossil fueled power plants in New York City can feasibly be retired and replaced by 2030; nearly 3.2 GW of this can be retired by 2025
- The energy services provided by these plants can be replaced with offshore wind, rooftop solar, energy efficiency, and energy storage.
  - 2.8 GW of rooftop solar will be required by 2025, growing to 5.6 GW by 2030
  - 1.5 GW of offshore wind will be required by 2025, growing to 3 GW by 2030
  - 4100 GWh of energy efficiency required by 2025, growing to 5400 GWh by 2030
  - 2,420 MW of 4-hour storage (or equivalent) will be required by 2025, growing to 4,200 MW of 8-hour storage (or equivalent) by 2030
- Achieving these replacement targets could bring multiple benefits including reduced local and global emissions, the creation of new green jobs in the city, energy resiliency and energy market revenues.
  - The proposed resource development has the potential to save customers $1 billion (net present value) in capacity costs by 2035, primarily due to reduced costs of peaker capacity payments and net costs to install storage.
  - Additionally, reduced environmental and health impacts from avoided emissions could create savings for about $1.17 billion (net present value) by 2035.
- Policymakers, grid operators, and local leaders will need to enable resource development by:
  - Establishing market mechanisms that allow for appropriate compensation of clean, local resources.
  - Continuing to timely advance planned clean energy solutions with a strategic focus on achieving the State's clean energy and community goals.
  - Supporting and enabling the development of clean resources in the city itself.

1. Background

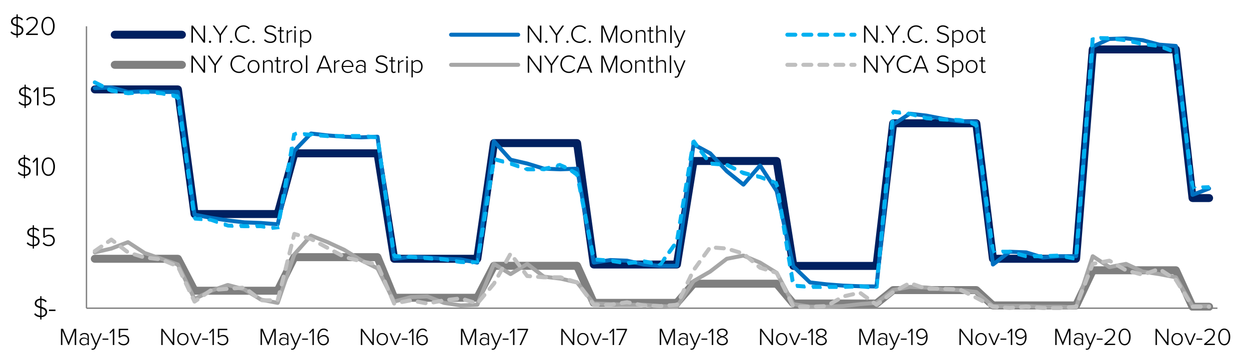
This section lays out the background on the fossil fuel power plants and the relevant regulation that was considered in this study. More specifically, this section describes and characterizes the fossil fueled power plants currently operating in New York City, as well as the New York State and City policy that will impact their operations going forward.

1.1 Fossil Fuel Assets in NYC

New York City is by far the most densely populated urban center in the country. It represents a third of the State's energy consumption, but local generation is severely limited by land availability and power imports are restricted by a transmission bottleneck. These challenges have historically prevented the City's reliance on clean energy resources and raised the need for locally sited fossil-fueled generators. Transmission constraints are so restrictive that while the upstate zones consume about 90% clean energy, the downstate zones source two-thirds of their energy from fossil fuels. In NYC the imbalance is even larger, in fact, nearly all of the energy generated in the city during 2019 came from fossil fueled power plants.[9]

These issues are also some of the reasons that the New York City transmission region has some of the highest capacity prices in the country, nearly five times higher than the rest of the state during summer season. Still, many of the city's power plants are dedicated to addressing local system peaks and only operate during a few hours per year. Nonetheless, New Yorkers pay the full economic and health costs of keeping them in place.

Figure 3. Capacity Prices in NY Control Area and NYC[10]



Source: NYISO ICAP Market Report - December 2020

This is not a new problem and the environmental impacts of peaking power plants in low-income neighborhoods and communities of color have long been tracked by clean energy and community advocates. Although the need for peaking capacity remains, available technologies and recent policy actions have opened a pathway for clean energy in those communities through the replacement of NYC's peaker portfolio.

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[9] NYISO, 2020. *Gold Book: Load and Capacity Data.*

[10] The NYISO installed capacity market serves to maintain reliability of the power system by procuring sufficient resource capability to meet expected maximum energy needs in the New York Control Area and its transmission constrained areas, including N.Y.C. (zone J). The capacity market consists of three auctions that stablish capacity prices for every zone. The Strip auction happens before the delivery period and allows load-serving entities (LSE) to transact capacity for the following six-month period. The Monthly auctions are voluntary and are held 15 days before the start of each procurement month. The Spot auctions are mandatory for all LSEs and run 2-4 days before the start of every month.

1.1.1 The City's Peaker Portfolio

As of January 2021, NYC has a fossil fuel generation fleet of 10,650 MW, which includes both peakers that run infrequently and other power plants that inject power more constantly into the grid.[11] In this report, peaker plants were defined as any fossil-fueled units with an annual generation equal or less than 15% of its maximum installed capacity (i.e., with a capacity factor equal to or less than 15%) during any of the last three years of operations. Based on this definition, NYC has 89 peaking units spread across 19 plants with a combined capacity of 6,093 MW. These peakers include gas turbines[12] and steam turbines (ST)[13], two power generating technologies with different technical capabilities and operational constraints. Table 2 shows the full list of plants, their age, capacity, and owner.

Table 2. NYC Peaker Fleet Summary

Owner	Plant	Nameplate Capacity	Units	Average Age
Astoria Generating Co.	Astoria	16	1	53
	Gowanus	640	32	49
	Narrows	352	16	48
	Astoria ST	943	3	62
ConEd	59 St.	17	1	51
	74 St.	37	2	52
	East River ST	200	1	65
	Hudson Ave	33	2	50
NRG Power	Arthur Kill	20	1	50
	Arthur Kill ST	912	2	56
	Astoria Gas Turbines	558	12	50
NYPA	Harlem River	94	2	19
	Hell Gate	94	2	19
	J.J. Seymour	94	2	19
	Kent	47	1	19
	Pouch	47	1	19
	Vernon Blvd	94	2	19
LS Power	Ravenswood	69	3	51
	Ravenswood ST	1,827	3	56
Grand Total		**6,093**	**89**	**47**

Source: Strategen with data from NYISO's Gold Book 2020

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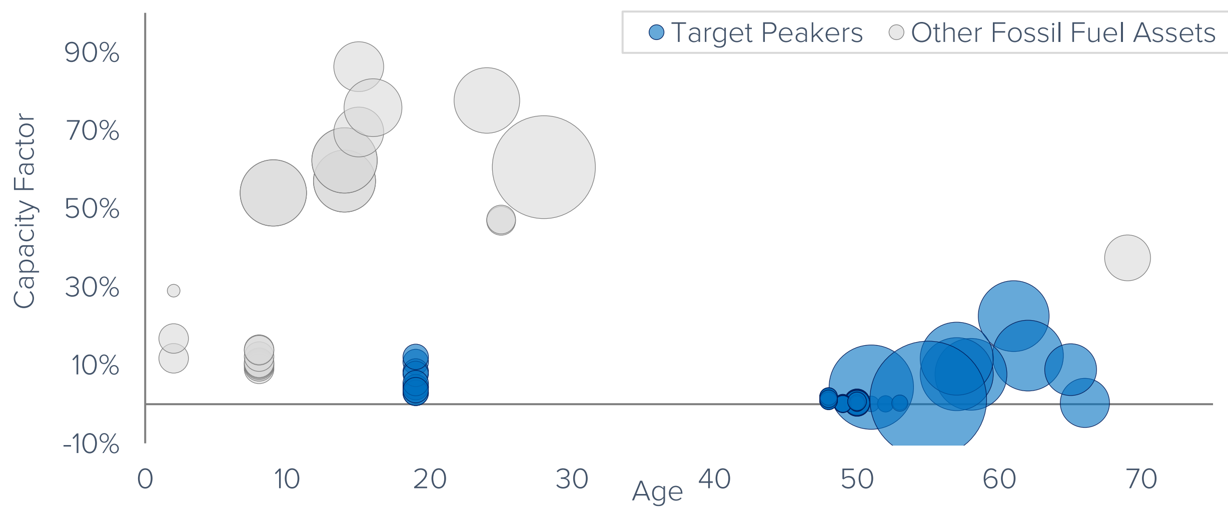
[11] The New York City fossil fueled generation fleet considered in this report focuses exclusively on plants in NYISO Zone J, which includes most of New York City. However, two power plants located in the Rockaway Peninsula, Jamaica Bay (54 MW) and Bayswater (58 MW), are located in NYC territory (Queens) but are electrically connected to Long Island (Zone K) and are not included in this analysis. For more info on replacement options for these plants and Long Island fossil fuel generators more broadly, see Strategen, 2020. *Long Island Fossil Peaker Replacement Study.*

[12] Gas Turbines are a type of internal combustion engine where gas combustion is directly used to spin turbines and generate electricity. These are commonly used as peakers due to its relative system simplicity and space requirements, as well as for their quick starting and ramp-up times. However, the efficiency of this plants significantly decreases when they are not used at full capacity. These are typically composed of small units.

[13] Steam Turbines are a type of external combustion engine where thermal energy (in this case from oil or gas combustion) is used to heat water to produce high pressure steam that is then used to spin turbines and generate electricity. Steam turbines are typically bigger and have a higher thermal efficiency than gas turbines but are less flexible, meaning that they need longer time to get started or turned-off, and to modify their power output. These operational constraints lead to longer run durations and a less efficient peaker dispatch.

Many of these units are over 50 years old, already past the normal age of retirement for most types of generators[14], and some still run on fuel-oil or kerosene. Other newer and more efficient peaker plants with low capacity factors were also considered to assess the opportunity of replacing them with clean energy assets. Figure 4 below shows the age and capacity factor of the portfolio of fossil fuel assets in New York City. This analysis targets some of the oldest plants with the lowest capacity factors.

Figure 4. NYC's Fossil Fuel Generation Portfolio



Source: Strategen

In 2019, 79 out of the 89 peaker units were online for less than 5% of the time and 60 of them for less than 1% of the year. That same year, 55 units had maximum dispatch durations of 8 hours or less. While the older and less used peakers units are a likely target for replacement with stand-alone storage, the rest of the portfolio can be assessed for replacement by considering a combination of storage, renewables and energy efficiency. As discussed later in this report, these levels of resource deployment align with existing State policy targets for clean resources such as offshore wind, energy efficiency and distributed solar.

Of the fossil fueled resources in this portfolio, some are already considered for retirement, repowering[15] or replacement. For example, NYPA has recently announced their intention to "[eliminate] emissions from its natural gas fleet, including small peaking plants in New York City, by 2035".[16] Other owners, like LS Power, are actively converting their existing fleet to battery storage resources.[17]

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[14] S&P Global, 2019. *Average age of US power plant fleet flat for 4th-straight year in 2018*. Accessed Nov. 2020. https://www.spglobal.com/marketintelligence/en/news-insights/trending/gfjqeFt8GTPYNK4WX57z9g2

[15] Astoria Generation Company (AGC) has proposed the 610 MW repowering of its Gowanus power plant. Many community and environmental advocates in NY and the City are opposed to the project. Along with the repowering of Gowanus, AGC proposed to retire the Narrows power plant. NRG Power is also proposing to repower its Astoria Gas Turbines power plant. The project was presented in 2020 and could lead to the 437 MW repowering of the peaker.

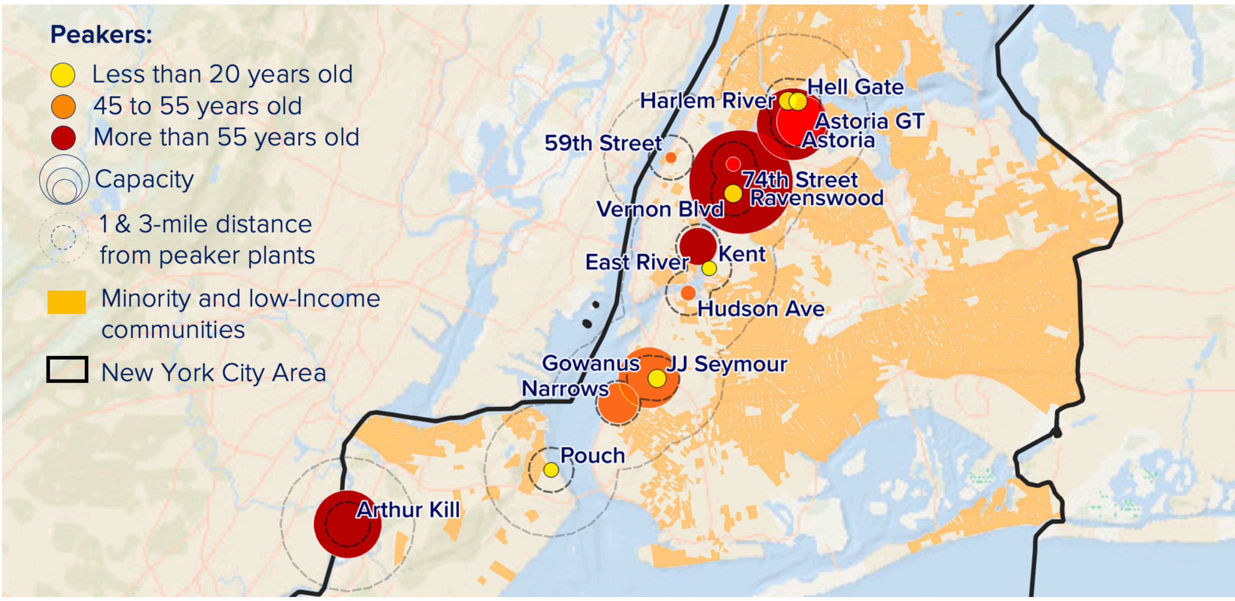
[16] NYPA, press release. *NYPA Approves New Strategic Plan to Provide Clean Energy Roadmap for Next Decade*. (Dec 9, 2020).

[17] LS Power. *LS Power Advances NY State's Renewable Energy Goals with Ravenswood Battery Energy Storage Project.* Accessed Nov. 2020. https://www.lspower.com/ls-power-advances-ny-states-renewable-energy-goals-with-ravenswood-battery-energy-storage-project-2/

1.1.2 Peaker Siting

The location of the peaker fleet is important from a grid planning perspective. Just as NYC is a load zone restricted by transmission constraints, there are load pockets within the city formed by transmission and distribution limitations. This issue raises the need for local generation in specific areas within the city and is taken in consideration, at a high level, in this report. However, the study does not intend to fulfill the need for a detailed reliability study in light of the proposed new resource mix recommendations.

Figure 5. Peaker Sites by Capacity and Average Unit Age



Source: Strategen with US Census and EPA data

Due to the mentioned constraints on the system during peak times, these plants are often located close to the communities they serve. In an urban settlement like NYC, this means that peaker plants are very likely to be located in disadvantaged communities, where urban land is cheaper, exposing their residents to a variety of pollutants such as CO_2, NO_X, SO_2, and PM 2.5. The peaking capacity of the city illustrated in *Figure 5. Peaker Sites by Capacity and Average Unit Age,* is concentrated in the port and industrial areas within Bronx, Queens and Brooklyn that are closer to Manhattan, the city's administrative and economic center. A recent report by Elementa[18] studies this issue with a focus on local subareas, showing how these power plants are not only used to fulfill local needs, but to feed energy into other constrained load pockets where energy demand outsizes generation capacity. The Elementa report also offers some suggestions of how distributed energy resources (DERs) could be used to meet local subarea reliability needs.

1.1.3 Direct Peaker Costs

Electricity from peaker plants is the most expensive energy resource in the system as it comes from centrally-located assets that are used infrequently but must be paid for and maintained to allow availability at times of peak demand. Central location, low utilization and the need for technologies that provide flexibility drive the costs of generation way above those from other energy assets. For this reason, peaker owners charge for the electricity they produce, and more importantly, also charge for the availability of their resources during system peaks. Such availability is paid through

[18] Elementa Engineering, 2020. *Replacing Peaker Plants: DER strategies for Sunset Park, Gowanus and Bay Ridge.*

the capacity market, designed to ensure that the system has enough capacity to provide energy during the times of highest energy demand. While NYC is not the only region with a capacity market, it has some of the highest capacity prices in the country. When capacity costs are averaged over the hours of operation, peaker electricity in New York City is up to 1,300% more expensive than the average cost of electricity in the rest of the state.[19]

In 2019, the peaker portfolio in NY had an average capacity factor of 5.2%, or about 450 hours of operation during the year, with some units running as low as 0.01% of the time. Nonetheless, peaker plants received full capacity payments for about $422 million that year and about $4.9 billion during the last decade.[20]

Table 3. Capacity Costs of NYC's Peaker Fleet

Owner	Plant	Capacity (MW)	2017 ($ Million)	2018 ($ Million)	2019 ($ Million)	2010-2019 ($ Million)
Astoria Generating Co.	Astoria	16	1.1	1.0	1.1	13.4
	Gowanus	640	41.8	39.4	43.8	521.0
	Narrows	352	21.6	20.4	22.7	269.9
	Astoria ST	943	64.5	60.8	69.8	796.3
ConEd	59 St.	17	1.2	1.1	1.2	14.6
	74 St.	37	2.6	2.4	2.7	31.8
	East River ST	200	13.0	12.2	14.1	160.1
	Hudson Ave	33	1.1	1.0	1.1	13.7
NRG Power	Arthur Kill	20	0.9	0.8	0.9	11.1
	Arthur Kill ST	912	60.4	56.9	65.3	746.4
	Astoria Gas Turbines	558	31.3	29.5	32.9	389.5
NYPA	Harlem River	94	5.6	5.3	6.1	69.1
	Hell Gate	94	5.6	5.3	6.1	69.1
	J.J. Seymour	94	5.6	5.3	6.1	69.1
	Kent	47	3.2	3.0	3.5	39.6
	Pouch	47	3.2	3.0	3.4	39.3
	Vernon Blvd	94	5.6	5.3	6.0	68.9
LS Power	Ravenswood	69	3.1	3.0	3.3	39.2
	Ravenswood ST	1,827	121.4	114.4	131.4	1,499.6
Total		**6,093**	**393**	**370**	**422**	**4,862**

Source: Strategen with data from NYISO's Gold Book 2020

Another factor that makes peaker energy more expensive than average is operational inefficiency caused by technological limitations and distribution constraints. For example, there are costs associated with turning on and off certain generating assets that lead plant managers to run them at

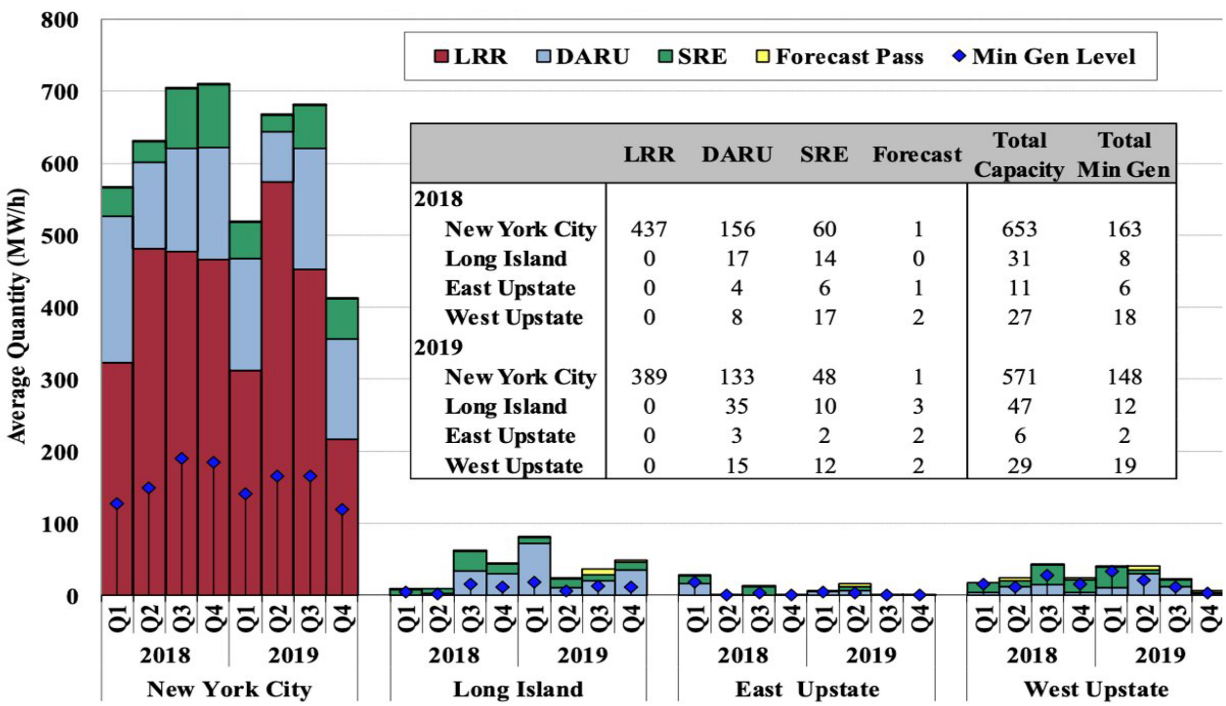
[19] The PEAK Coalition, 2020. *Dirty Energy, Big Money: How private companies make billions from polluting fossil fuel peaker power plants in New York City's environmental justice communities – and how to create a cleaner, more just alternative.*

[20] Approximation based on historical capacity prices from NYISO's strip, monthly and spot auctions in Zone J (N.Y.C.) for summer and winter periods. Assumes 15% benefit on bilateral contracts from strip prices.

uneconomic times, driving up consumer costs and increasing local emissions. From a market perspective, peakers are also called to run uneconomically to ensure local reliability. According to the state's Market Monitor, Potomac Economics, supplemental commitment[21] of NYC's peakers occurs frequently to increase the amount of supply available in real-time for local load pocket reliability (i.e., to meet N-1-1 requirements).[22] This supplemental commitment tends to undermine market incentives for efficiently meeting reliability requirements and often uplifts market prices, which are eventually passed on to customers.[23] Some of these costs could be alleviated through market reforms or through deployment of modern inverter-based resources like locally-sited battery storage which could provide valuable operating reserves in these load pockets. Figure 6 below, by the market monitor, shows the quantities of reliability commitment in the State. In 2019, NYC accounted for 87 percent of the State's total reliability commitment.

This report by the market monitor shows how the limitations of fossil fuel power plants and the design of the market today create inefficiencies that create addition revenues for peakers, which are all ultimately borne by NYC electric customers.

Figure 6. Supplemental Commitment for Reliability in NY by Category and Region 2018-2019



	LRR	DARU	SRE	Forecast	Total Capacity	Total Min Gen
2018						
New York City	437	156	60	1	653	163
Long Island	0	17	14	0	31	8
East Upstate	0	4	6	1	11	6
West Upstate	0	8	17	2	27	18
2019						
New York City	389	133	48	1	571	148
Long Island	0	35	10	3	47	12
East Upstate	0	3	2	2	6	2
West Upstate	0	15	12	2	29	19

Source: Potomac, 2020

[21] Supplemental commitment occurs when a unit is not committed economically in the day-ahead market but is needed for reliability. It primarily occurs through: (a) Day-Ahead Reliability Units ("DARU") commitment occurs at the request of transmission owners for local reliability; (b) Day-Ahead Local Reliability Rule ("LRR") commitment that takes place during the economic commitment within the day-ahead market; and (c) Supplemental Resource Evaluation ("SRE") commitment that occurs after the day-ahead market closes.

[22] N-1-1 requirements ensure that there are enough resources to meet load in case of a N-1-1 scenario. Most local N-1-1 scenarios are driven by the potential loss of the two largest Bulk Power System elements supporting a particular load pocket, for example, the loss of multiple central generators due to contingencies in the natural gas system.

[23] Potomac Economics, 2020. *2019 State of The Market Report for the New York ISO Markets.*

1.2 Local Pollutants & Environmental Justice in NYC

In New York City, there are 750,000 people living within one mile from a peaker plant and 78% of them are either low-income people or people of color. In fact, communities composed of these demographic groups are disproportionately impacted by peakers. Of the people living within one mile of a peaker plant, 280,000 (37%) live in communities that are predominantly occupied by these historically disadvantaged demographic groups.[24] Figure 5 illustrates peaker location in relation to communities of color and low-income communities.

Many of the emissions that come from peakers are local pollutants, meaning that they will stay close to their geographic point of origin, and their impacts will be felt most acutely by the surrounding communities.[25] This implies that the peaker emissions, detailed above, most significantly impact New York City residents who live closer to these peaking plants. Although a one-mile radius is used here to illustrate the scale of the issue, the impacts of peaker emissions vary depending on peaker size and utilization, as well as diverse environmental factors like wind speed and temperature. A recent report by PSE Healthy Energy uses a three-mile radius to quantify the impacts of peaker plants.[26]

1.2.1 Peaker Emissions

The emissions produced by peakers have an adverse impact on New York's air quality and the health of community members. Moreover, these emissions make it almost impossible for the State to achieve compliance with National Ambient Air Quality Standards (NAAQS). In New York, peakers contribute as much as 94% percent of the State's NO_X emissions on high ozone days despite providing as little as 36% of the gross load.[27] These disproportionately large emissions occur because many of the older peaker plants do not have any form of NO_X controls and are not compatible with retrofits.

Peaker plants are also more likely to operate during hot summer days when ozone levels are high and air quality is already poor, exacerbating the impact of their harmful emissions. The most common air pollutants emitted from peaker plants are nitrogen oxides (NO_X), sulfur dioxide (SO_2) and carbon dioxide (CO_2).[28, 29] NO_X is a component of ozone formation. Ozone is a principal component of smog and can result in respiratory health problems and other negative health and environmental impacts.[30] SO_2 can harm the human respiratory system and make breathing difficult, especially for people with asthma, children particularly. SO_2 is also a precursor of small particulate matter ($PM_{2.5}$ or PM_{10}). $PM_{2.5}$ includes dust and smaller particles with a maximum particle diameter of 2.5 microns. These small

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[24] Calculations based on US Census data at the census tract level. Communities predominately formed by people of color or low-income people refers to tracts where these groups represent 60% or more of the total population.

[25] Clean Energy Group, 2016. *Energy Storage for Public Health: A Smarter Way to Deploy Resources.* Accessed Oct. 2020. https://www.cleanegroup.org/energy-storage-public-health-smarter-way-deploy-resources/

[26] Physicians, Scientists, and Engineers for Healthy Energy, 2020. *Energy Storage Peaker Plant Replacement Project.*

[27] NYSDEC. *Adopted Subpart 227-3 Revised Regulatory Impact Statement.* Accessed Oct. 2020. https://www.dec.ny.gov/regulations/116175.html

[28] US Environmental Protection Agency (EPA). *Particulate Matter Emissions*. Accessed Oct. 2020. https://cfpub.epa.gov/roe/indicator.cfm?i=19

[29] Oak Ridge National Laboratory, 2017. *Environmental Quality and the U.S. Power Sector: Air Quality, Land Use and Environmental Justice. Prepared for the US Department of Energy.*

[30] US EPA. *Ground-Level Ozone Basics*. Accessed Oct. 2020. https://www. epa.gov/ground-level-ozone-pollution/ground-level-ozone-basics

particulates have been shown to cause respiratory problems because they can penetrate deeper into the lungs than the larger particulates.[31]

Retirement of the New York City peaker fleet would significantly reduce CO_2, NOx, and SO_2 emissions. Averaging the fleet emissions from 2017 to 2019, retirement of this peaker capacity would result in annual reductions of 2.66 million tons of CO_2, 1,655 tons of NO_X, and 171 tons of SO_2, as shown in Table 4 below.[32]

Table 4. Annual Emissions of the Peaker Fleet in NYC

Owner	Plant	Capacity (MW)	CO_2 (Tons)	NO_X (Tons)	SO_2 (Tons)
Astoria Generating Co.	Astoria Gen	16	859	3.35	0.14
Astoria Generating Co.	Astoria Gen ST	943	609,744	275.03	49.41
Astoria Generating Co.	Gowanus	640	11,307	36.61	2.15
Astoria Generating Co.	Narrows	352	44,949	127.41	8.42
ConEd	59 St.	17	128	1.64	0.02
ConEd	74 St.	37	323	3.12	0.05
ConEd	East River ST	200	127,184	125.23	12.29
ConEd	Hudson Ave	33	1,036	13.67	0.12
LS Power	Ravenswood	69	3,844	16.72	0.49
LS Power	Ravenswood ST	1,827	997,827	590.60	88.64
NRG Power	Arthur Kill	20	665	1.83	0.12
NRG Power	Arthur Kill ST	912	622,416	333.58	3.14
NRG Power	Astoria Gas T.	558	25,651	107.42	4.69
NYPA	Harlem River	94	23,727	2.17	0.12
NYPA	Hell Gate	94	22,980	2.16	0.12
NYPA	J.J. Seymour	94	64,125	5.66	0.38
NYPA	Kent	47	27,685	2.40	0.14
NYPA	Pouch	47	33,686	2.74	0.17
NYPA	Vernon Blvd	94	38,492	4.07	0.16
Total		**6,093**	**2,656,627**	**1,655**	**171**

1.3 Clean Energy Policy in NYC

Considering the monetary and environmental costs of its current generation mix, New York has already established policies and targets to accelerate the deployment of clean energy technologies like energy storage, offshore wind and solar. This section highlights some of the key policies and long-term planning considerations that are currently fostering resource procurements and that were used as part of the base assumptions in this study.

[31] World Health Organization. *Ambient (Outdoor) Air Pollution*. Accessed Oct. 2020. https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health

[32] Data reported from S&P Global Market Intelligence Annual Unit Emissions. Accessed Sep. 2020. Where data was not available, average emission rates by unit age and technology type were used to calculate total emissions per year.

1.3.1 Climate Leadership and Community Protection Act

On July 18, 2019, New York Governor Andrew M. Cuomo signed into law the Climate Leadership and Community Protection Act (CLCPA). New York State's CLCPA is among the most ambitious climate laws in the world and requires New York to reduce economy-wide greenhouse gas emissions 40 percent by 2030 and no less than 85 percent by 2050[33]. These targets are intended to put New York State on the path towards net zero greenhouse gas (GHG) emissions by 2050.[34] Emissions beyond 85% can either be directly reduced or offset through projects that remove GHGs from the atmosphere. With these targets, the CLCPA enacts the most stringent economy-wide carbon target in the US. Additionally, the CLCPA codifies a number of ambitious electric sector targets, including 100% carbon-free electricity by 2040.

CLCPA mandates effectively eliminating the use of all fossil energy resources by 2040, necessitating the retirement of New York's fossil fuel plants in the next 20 years. Thus, investments in a carbon-free replacement resources will need to occur in parallel. To support and enable these broader decarbonization targets, the CLCPA has set specific resource procurement targets leading up to these decade milestones. The targets include 6 GW of rooftop and community solar by 2025, 3 GW of energy storage by 2030, and 9 GW of offshore wind by 2035. With these clear targets, the CLCPA seeks to drive renewable energy procurement and facilitate the rapid growth of a clean energy economy in New York. The CLCPA places substantially increased focus and priority on:

- Increasing access to (and benefits from) clean energy for disadvantaged communities and low-income consumers.
- Creating quality jobs in the green economy and ensuring a "just transition" and protecting ordinary workers as our economy shifts to more sustainable production.
- Prioritizing decarbonization in other sectors that contribute significantly to statewide emissions (e.g. transportation, buildings).[35]

The below paragraphs describe the resource-specific goals and targets laid out in the CLCPA, how they are expected to come to fruition, and how these new resources will impact energy resource needs in New York City.

Offshore Wind: Offshore wind development will be a key component of New York's clean energy goals. With land at a premium in downstate New York, offshore wind has the ability to provide renewable energy to New York's largest load center. Offshore wind provides unique benefits in that it can be located close to densely populated coastal centers like New York City.

New York State, through the CLCPA, has the goal of procuring 9 GW of offshore wind by 2035. The Bureau of Ocean Energy Management (BOEM) has estimated that potential offshore wind lease areas in New York could host up to 11.5 GW of offshore wind capacity, so there is significant potential in the region.[36] Of the total potential of 11.5 GW, BOEM has recommended authorizing leasing areas for up to 9.6 GW of potential capacity.

Current procurement of offshore wind has put New York on track to meet the goal established by CLCPA. As of December 2020, around 1.8 GW of offshore wind are under active development statewide, of which 1.7 GW are under contract with NYSERDA. NYSERDA has executed contracts with Equinor Wind for the 816 MW Empire Wind Project and with Sunrise Wind for the 880 MW Sunrise Wind Project. Combined, these projects provide enough energy to power more than one million New York homes, have the potential to support more than 1,600 jobs, and promote a combined

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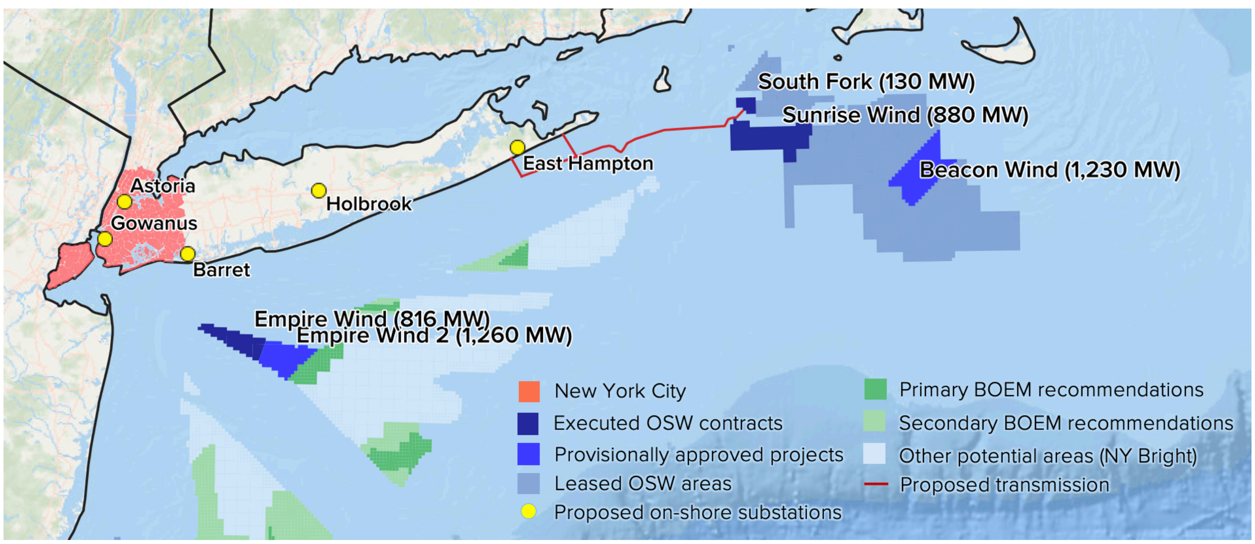
[33] All emissions reductions are relative to 1990 levels.
[34] New York State. *Climate Act*. Accessed Oct. 2020. https://climate.ny.gov
[35] NYSERDA, 2019. *Toward a Clean Energy Future: A Strategic Outlook 2020–2023.*
[36] Wood Mackenzie, 2020. *Economic Impact Study of New Offshore Wind Lease Auctions by BOEM.*

economy activity of $3.2 billion statewide.[37] An additional 130 MW of offshore wind is under contract with the Long Island Power Authority – known as the South Fork. Of these projects, the Empire Wind project is expected to interconnect directly into New York City via the Gowanus substation, while both Sunrise Wind and South Fork are expected to interconnect into Long Island.[38]

In January 2021, NYSERDA closed its second offshore wind solicitation process, provisionally awarding 2,490 MW of offshore wind projects, Empire Wind 2 and Bacon Wind, with complementary multi-port infrastructure investment. The selected projects leverage a combined investment of $644 million for resilient port facilities in the Capital Region and Brooklyn, the largest commitment to offshore wind nationally.[39] Further, Governor Cuomo announced an offshore wind turbine assembly hub in Brooklyn. The project is expected to create 1,200 jobs and is supported by community and environmental justice advocate groups in an effort to revive the industrial waterfront.[40]

While this is significant progress, and positions New York as a leader in offshore wind, additional offshore wind development will be required to achieve the targets laid out in CLCPA. All offshore wind must be located in regions authorized and leased by BOEM, an agency of the US Department of the Interior. The map in Figure 7 shows areas that have been authorized by BOEM – including the areas that already have planned developments and those that will likely be considered for development. As this map shows, the majority of this development is expected to occur proximate to New York City and Long Island, and will likely interconnect into these two regions.

Figure 7. Offshore Leasing Areas and Contracts in NY



Source: NYSERDA, 2021

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[37] NYSERDA programs. *2020 Offshore Wind Solicitation (Closed).* Accessed January 2021.

[38] Planning for the deployment of offshore wind along with the retirement of peakers can help avoid significant onshore transmission upgrades. Retiring peakers would create interconnection capacity in the transmission system to accommodate the load of new renewable resources. Furthermore, sites currently occupied by peakers could host energy storage systems that can facilitate integration of offshore wind and reduce curtailments. For more information on offshore wind interconnection see Brattle Group, 2020. *Offshore Wind Transmission: An Analysis of Options for New York.*

[39] NYSERDA. *2020 Offshore Wind Solicitation (closed)*. Accessed Nov. 2020. https://www.nyserda.ny.gov/All%20Programs/Programs/Offshore%20Wind/Focus%20Areas/Offshore%20Wind%20Solicitations/2020%20Solicitation

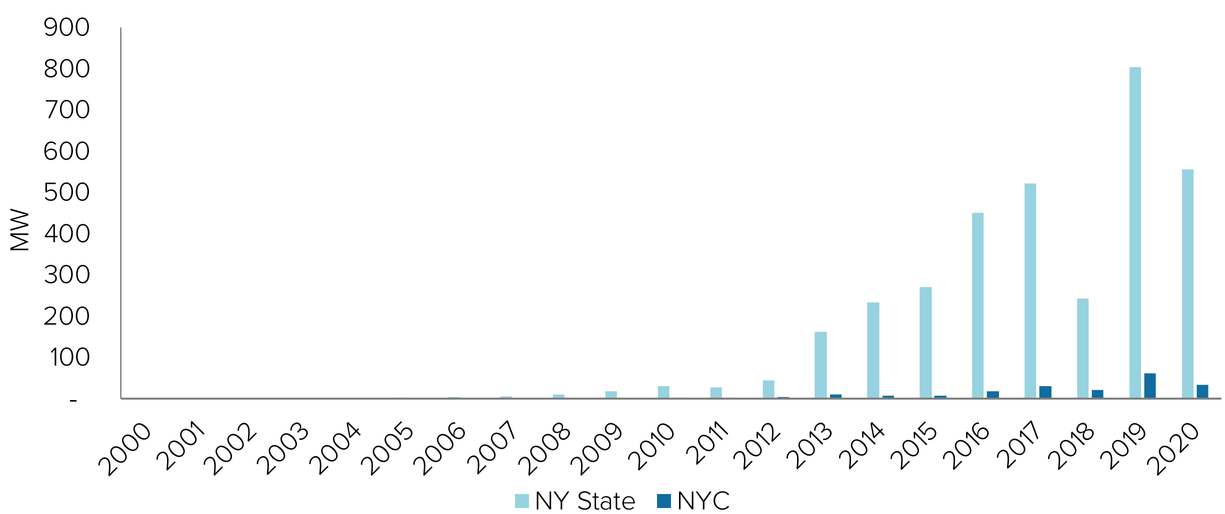
[40] The City. *Meet the Green Agitators Who Planted Seeds for Brooklyn's Coming Wind Turbine Assembly Hub* (January 17, 2021)

Community and Residential Solar: The CLCPA includes a goal of 6,000 MW of solar installed in New York by 2025, encompassing both community-scale projects and on-site, behind the meter generation. Community solar increases access to clean energy for homeowners and renters who do not have ideal conditions to install solar panels at their own household often without any upfront costs or participation fees for such projects.

Both NYSERDA's Retail Energy Storage Incentive program and the State's NY-Sun program have been supporting the rapid growth of solar in New York. The NY-Sun program was established by Governor Cuomo to scale-up solar in the State. A $573 million expansion of the NY-Sun Program was approved in May 2020 which includes $200 million focused on supporting projects benefitting low- and moderate-income New Yorkers, affordable housing, and disadvantaged communities. This has been complemented by funding from sources such as NYSERDA's Retail Energy Storage Incentive program. The program provides funding for commercial customers developing standalone, grid-connected energy storage or systems paired with new or existing clean, on-site generation, such as solar. NYSERDA's current project pipeline includes about 50 community solar projects paired with energy storage to be built in the next two to three years.[41] Such investments and initiatives have helped the State increase solar installations by 1,800% and decrease the cost of solar by nearly 60% since 2011.

Although solar installations in the State have ramped up in the last decade, installations in NYC have lagged behind significantly relative to the rest of the state. In fact, distributed solar in the city, supported by the NY Incentive program, accounts for only 6% of the total capacity installed in the State while NYC represents a third of the State's energy consumption. The disparate levels of solar deployment shown in Figure 8 below indicate that residents of New York City access a significantly smaller portion of this incentive funding than residents in other parts of the State, despite the fact that funding for the NY-Sun incentive program comes from the statewide programs, including New York State Clean Energy Fund (CEF) and Regional Greenhouse Gas Initiative (RGGI).

Figure 8. Growth of Distributed Solar in New York



Source: Strategen based on data from NYSERDA[42]

[41] NY Governor's Office, pressroom. *During Climate Week, Governor Cuomo Announces First Completed Community Solar Plus Energy Storage Project in New York*. (Sep 21, 2020).

[42] NYSERDA-Supported Solar Projects. Accessed Oct. 2020.
https://www.nyserda.ny.gov/All-Programs/Programs/NY-Sun/Solar-Data-Maps

Energy Efficiency: The CLCPA included an energy efficiency target of reducing on-site energy consumption by 185 trillion Btu relative to forecasted site fueling and powering energy consumption in 2025. In meeting this energy efficiency target, New York will deliver nearly one-third of its 40% reduction in greenhouse gas emissions mandate.[43] Key initiatives in New York to promote energy efficiency include Build Smart NY, Smart Street Lighting NY, and the Five Cities Energy Program.

Through 2025, New York State will invest over $6.8 billion in energy efficiency, primarily as a result of utility and NYSERDA funding.[44] The December 2018 Public Service Commission Orders on New Efficiency New York more than doubled utility investment in energy efficiency.[45] Additionally, CLCPA requires the Commission to "include mechanisms to ensure that, where practicable, at least twenty percent of investments in residential energy efficiency, including multi-family housing, can be invested in a manner which will benefit disadvantaged communities . . . including low to moderate income consumers."[46]

Additionally, in NYC, the Local Law 97 was enacted in 2019 as a part of the Climate Mobilization Act. The law places carbon caps on buildings larger than 25,000 square feet and requires 26% carbon reduction from today's levels. The law affects about 50,000 buildings (59% of the city's residential building stock and 41% of commercial), where many buildings are significantly above emissions limits and will require comprehensive retrofits or alternate compliance by 2030.[47] Options for compliance include adoption of energy saving measures, purchase of renewable energy credits in NYC, greenhouse gas offsets, and peak energy storage.

Energy Storage: The CLCPA includes a mandate for 1,500 MW of energy storage by 2025 and 3,000 MW by 2030 to support the optimization of the many gigawatts of renewable sources also procured as a result of the CLCPA. As of December 2020, New York already has reported 706 MW of awarded and contracted energy storage projects, and financial incentives in the state have helped develop an interconnection queue close to 10 GW, though many of these projects may not be built due to unfavorable project-specific economics.[48] NYSERDA announced a $405 million grant program for energy storage projects in 2019[49] and the New York Green Bank has allocated $200 million to provide low-interest financing for viable storage projects.[50] Additionally, system owners can get tax benefits from New York City's property tax abatement program as well as federal benefits including depreciation deductions or investment tax credits.[51]

In addition to direct procurement and resource development activities, New York is also pursuing regulatory and market reforms that will facilitate participation and compensation of storage assets in wholesale energy markets. The NY Independent System Operator (NYISO) has been one of the first in the US to enable distributed energy storage assets to participate in wholesale markets and has developed a comprehensive program to allow energy storage systems to participate in NYISO state-

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[43] NYSERDA, 2018. *New Efficiency: New York*.

[44] NYSERDA, 2019. *Toward a Clean Energy Future: A Strategic Outlook 2020–2023.*

[45] NYPSC, 2018. *CASE 18-M-0084.*

[46] NYSERDA, 2020. *White Paper on Clean Energy Standard Procurements to Implement New York's Climate Leadership and Community Protection Act.* Case 15-E-0302

[47] Urban Green, 2020. *NYC Building Emissions Law Summary: Local Law 97.*

[48] NY DPS, 2020. State of Storage in New York. Annual energy storage deployment report pursuant to public service law §74.

[49] NYSERDA. *Incentive Dashboard.* Accessed Dec. 2020. https://www.nyserda.ny.gov/All-Programs/Programs/Energy-Storage/Developers-Contractors-and-Vendors/Retail-Incentive-Offer/Incentive-Dashboard

[50] NY Green Bank. *RFP 13: Financing for Energy Storage Projects.* Accessed Dec. 2020. https://portal.greenbank.ny.gov/CORE_Solicitation_Detail_Page?SolicitationId=a0rt000000koxpAAAQ

[51] NYSERDA, *New York Energy Storage Tax Incentive Reference Guide.*

wide energy, capacity, reserves and voltage support programs.[52] The NYISO is in the process of rolling out and clarifying the rules to help create an open and competitive marketplace for energy storage assets.

1.3.2 NO_X Rule

Another factor driving the need for new and cleaner resources in the city is the "Peaker Rule", a regulation with the primary goal of reducing the allowable NO_X emissions during ozone season. As discussed in Section 1.2 Local Pollutants & Environmental Justice in NYC, peakers contribute significantly towards local pollutants in New York City, especially during the summer. In response to New York's nonattainment for the 2008 and 2015 ozone National Ambient Air Quality Standards (NAAQS), the New York Department of Environmental Conservation (DEC) established rules to reduce local NO_X emissions from peaker plants.[53] The regulation applies to all simple cycle and regenerative combustion turbines (SCCTs) larger than 15 MW and will affect approximately 3,400 MW of the oldest SCCT capacity in New York City and Long Island.

More specifically, this rule imposes new and tougher emission limits on simple cycle and regenerative turbines. SCCTs built before 1986 contribute up to 94% of NO_X emissions on high ozone days while providing only 36% of the gross load, so retirement of these generation resources will address NAAQS nonattainment.[54] Based on estimates by DEC, replacing and retiring these older fossil units could reduce 1,849 tons of NO_X emissions on some of the highest ozone days of the year, and will have the biggest impact on nearby communities, many of which have been designated as *Potential Environmental Justice Areas*.

New York DEC has established a phased approach, with a NO_X emission limit of 100 parts per million (ppm) going into effect on May 1, 2023. Two years later, the limit will drop to 25 ppm for units using gaseous fuels and 42 ppm for units burning liquid fuels. The affected units will have to either retire, seasonally suspend operations or retrofit their assets with emission controls or renewables plus storage to reduce emissions.

Further, the new emission rules stipulate that in 2023 peaking units will only be able to average emissions with similar units at the facility or with approved energy storage and renewable energy resources during the ozone season. This is contrast to current regulation, 6 NYCRR Part 227-2, allows plant owners to average emission rates from across all facilities, including turbines and boilers.[55] This means that under the current rules a facility owner can average the emissions from its lower-emitting plants with the emissions from higher-emitting sources and calculate an average value for NO_X compliance purposes. This practice, while limiting system-wide emissions, fails to recognize the localized impacts of NO_X. Under the new rules, this practice will no longer be allowable in 2023.

As a part of this process, NYISO is planning to review any planned unit shutdown to ensure grid reliability.[56] For example, NYISO's 2020 Reliability Needs Assessment included a review of 69 units in zone J that are not compliant to the NO_X rule in preparation for deactivation.

In NYC, 79 out of 89 units contemplated in this analysis are subject to the rule and one is ready for retirement. In terms of capacity this represents 2,211 MW of the total 6,093 MW of peaker capacity as outlined in section 1.1. To date, of the 79 units subject to this rule, only the 10 units owned by NYPA

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[52] NYISO, press release. *NYISO Implements Industry-Leading Rules for Energy Storage Resources*. (Sep 8, 2020).

[53] *Adopted Subpart 227-3 Revised Regulatory Impact Statement. Op. cit.*

[54] *Ibid.*

[55] *Ibid.*

[56] *Ibid.*

are compliant with it, though all units are required to have a compliance plan. Table 5 below shows the NO_x regulation applicability and compliance plans for all the plants considered in this analysis.

Table 5. NO_x rule compliance plans

Owner	Plant Name	Nameplate Capacity	Subject to NO_x Rule?	Compliance Plan
Astoria Generating Co.	Astoria Gen.	16	Yes	Ozone Season Stop, 2025
Astoria Generating Co.	Astoria Gen. ST	943	No	N/A
Astoria Generating Co.	Gowanus	640	Yes	Ozone Season Stop, half by 2023 and remainder by 2025
Astoria Generating Co.	Narrows	352	Yes	Ozone Season Stop, 2025
ConEd	59th Street	17.1	Yes	Black-start only by 2025
ConEd	74th Street	37	Yes	Black-start only by 2023
ConEd	East River ST	200	No	N/A
ConEd	Hudson Ave	32.6	Yes	Retire in 2023 (one unit ready for retirement)
LS Power	Ravenswood	68.6	Yes	Retire by 2023
LS Power	Ravenswood ST	1,827	No	N/A
NRG Power	Arthur Kill	20	Yes	Redacted, expected to retire by 2025
NRG Power	Arthur Kill ST	911.7	No	N/A
NRG Power	Astoria GT	558	Yes	Redacted, expected to retire by 2023
NYPA	Harlem River	94	Yes	Existing Controls
NYPA	Hell Gate	94	Yes	Existing Controls
NYPA	J.J. Seymour	94	Yes	Existing Controls
NYPA	Kent	47	Yes	Existing Controls
NYPA	Pouch	47	Yes	Existing Controls
NYPA	Vernon Blvd	94	Yes	Existing Controls

The DEC has stated that it expects that most impacted facilities will opt to replace or shut down non-compliant SCCTs because those installed prior to 1986 are typically not conducive to the addition of retrofit pollution control technology and will face high installation costs for any emissions control solutions.[57] These impacts are considered and explored later in this report by examining the explicit retirement of plants.

Most recently, NYPA, the owner of the 10 newest peaker units in NYC, announced its goal of achieving carbon neutrality by 2035 for its gas fleet. The goal is part of its VISION2030 which includes a path to decarbonization by transitioning NYPA's natural gas plants to low or zero carbon emission five years ahead of the State's goal of carbon-free electricity by 2040.[58]

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[57] New York State Department of Environmental Conservation, 2019. *Adopted Subpart 227-3 Revised Regulatory Impact Statement*

[58] NYPA, press release. *NYPA Approves New Strategic Plan to Provide Clean Energy Roadmap for Next Decade*. (December 09, 2020).

2. A Vision for Clean Energy in NYC

As the largest and most urbanized region in the US, New York City represents one of the most significant challenges for demonstrating how clean energy resources can replace existing fossil assets in urban areas. This section lays out the unique challenges to clean resource development in the city, describes how fossil fueled peakers have historically contributed to the city's energy solutions, and establishes an approach for how clean energy resources can meet these needs.

2.1 New York City Grid Planning Considerations

The present transmission network in New York City presents a challenge for achieving the State's renewable energy and equity goals. As discussed in the Executive Summary, electrical supply in the downstate region depends heavily on fossil fueled power, caused in part by transmission limitations that prevent the import of cleaner power from upstate. The city needs cleaner, locally-sited resources to meet the demands of the grid and create quality jobs and resilience capabilities for the local communities. The development of local energy resources has been limited by high property prices and strict regulations of urban space, as well as outdated market structures that limit the fair valuation of clean energy resources. A vision for clean energy in the city must acknowledge and understand these challenges in order to turn towards viable solutions.

2.1.1 Electrical Topography

New York City presents the largest region of power demand in the State, but power delivery from upstate New York is restricted by transmission constraints. As a point of comparison, upstate New York generates about 90% of its energy from renewables, versus barely 30% in downstate New York.[59] This highlights the need for local generation in specific areas within the City, known as load pockets. Some load pockets in NYC have transmission limits that mean they are reliant on local generation capacity to maintain electric service during challenging operating conditions. Specifically, there are two constrained load pockets in New York City: Astoria East/Corona, which includes the feeders from the Hell Gate, Astoria Annex, Rainey, and Jamaica substations; and Greenwood/Fox Hills, which includes the feeders from the Vernon, Gowanus, and Fresh Kills substations.[60]

Many peaker units in New York City are located within these load pockets and operate to maintain reliability. Local reliability constraints may limit replacement options for the peakers within the Astoria East/Corona and Greenwood/Fox Hills load pockets. For example, Con Edison requires 10-minute reserves to meet operations criteria[61], so the resources that replace the peakers retired in the New York City load pockets need to be both capable of providing a 10-minute operating reserve[62] and some of the replacement resources do need to be sited locally to address local reliability needs. Generation sited outside of the Con Edison load pockets would not fully resolve capacity and reliability needs as local deficiencies would not be addressed.

2.1.2 Challenges for Urban Resource Development

Urban density in New York City makes clean energy development challenging due to the lack of available land for development and the high price of urban land. An acre of central land within New York City is about 72 times more expensive than the equivalent in Atlanta or Pittsburgh, and about

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[59] NYISO, 2020. *Power Trends 2020: The vision for a greener grid.*

[60] NYISO, 2019. *2019-2028 Comprehensive Reliability Plan*.

[61] *Ibid.*

[62] 10-minute operating reserve refers to capacity that can be brought online in 10 minutes or less during times of abnormally high demand, usually due to normal forecasting error or blackouts. Most energy storage systems have rapid response times, typically less than a minute, so they can outperform this requirement.

1,400 times more than in small Rust Belt and Sunbelt metros.[63] Although land is less expensive outside central areas, these numbers clearly illustrate the scale of the challenge.

In addition to land constraints, New York City has some of the strictest building codes and zoning regulations in the country, which limit the space that buildings can take up and affect the installation of renewable generation systems and improvements to the energy efficiency of buildings. Permitting processes differ based on the capacity of electric generating facilities; those greater than 25 MW are subject to the Article 10 process.[64] This process is lengthy, complicated, expensive, and has an uncertain outcome. Facilities below 25 MW are governed by the State Environmental Quality Review Act (SEQRA) and local zoning laws which affect the rooftop area that energy-efficient HVAC units and community distributed generation systems are allowed to occupy.[65] Further, rooftops are already space constrained due to mechanical equipment and the necessary clearances required for Fire Department access.

New York's CLCPA also includes ambitious targets for offshore wind which has significant potential for renewable energy generation but its own unique complexities when it comes to siting the turbines themselves, transmission lines, and interconnection points which is even further complicated by federal jurisdiction beyond three miles offshore.

However, there are creative ways to get around some of these challenges. Local zoning regulations affecting rooftops can be solved by installing solar panels on canopies as there are separate regulations regarding the allowable height for canopies.[66] Additionally, storage can be installed on the distribution system at the community level. Further, a floating port concept has been unveiled by an Australian company, Windthorst, with the intention of addressing the challenges of offshore wind installation and support the growth in such projects.[67]

2.2 Role of Peakers

Fossil fueled peakers currently have an important role in delivering reliable power to New York City residents. To successfully unwind the city's dependence on fossil fuel resources, it is important to understand the historic role, function, and limitations of these assets.

Today, peakers play an important role in supporting reliable electric service for New Yorkers. Some of them also produce steam that feeds the city's "district heating" system, providing heat and cooling to many buildings in Manhattan.[68] To understand how peakers could be replaced by clean energy resources, this analysis explores how the peaking portfolio identified above has historically operated to provide power. More specifically, the peaker fleet was analyzed on a unit-by-unit, hourly basis using historic generation profiles as reported to the EPA for the years 2017, 2018 and 2019.

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[63] Bloomberg CityLab, 2017. *The Staggering Value of Urban Land.* Accessed Nov 2020. https://www.bloomberg.com/news/articles/2017-11-02/america-s-urban-land-is-worth-a-staggering-amount

[64] Article 10 intended a streamlined approach to sitting large-scale energy facilities, but to date most projects are months or years behind schedule. For more information see: New York League of Conservation Voters Education Fund, 2019. *Breaking Down the Barriers to Siting Renewable Energy in New York State*. Accessed Nov 2020. https://nylcvef.org/wp-content/uploads/2019/02/renewable-siting-whitepaper.pdf

[65] *Ibid.*

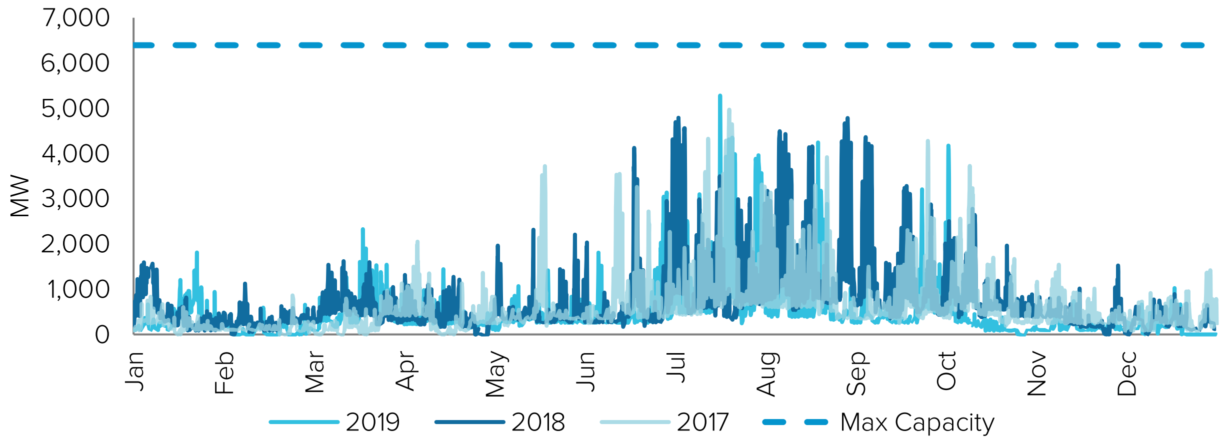
[66] *Ibid.*

[67]OE Digital, 2020. *Windthrust Working on All-in-One Floating Port and Instillation Vessel for Offshore Wind Sector*. Accessed Nov 2020. https://www.oedigital.com/news/483344-windthrust-working-on-all-in-one-floating-port-and-installation-vessel-for-offshore-wind-sector

[68] ConEd operates the largest district heating system in the United States, serving over 1,700 customers. The steam is produced at six power plants in NYC, including peaker plants like 74th Street, 59th Street and East River. For more information see: https://www1.nyc.gov/assets/lpc/downloads/pdf/presentation-materials/20180109/855-11th-Avenue.pdf

In recent years, the full capacity of the fleet of peakers in New York City has not been required to meet peaking needs in Zone J. In 2018, the year with the most challenging peak, only 4,790 MW out of 6,200 MW (or about 77% of total peaking capacity) was ever used simultaneously. Moreover, more than half of the peaker fleet is rarely used simultaneously, in fact, this only happened during 44 hours of the year (0.5% of the time) and in very short event durations.

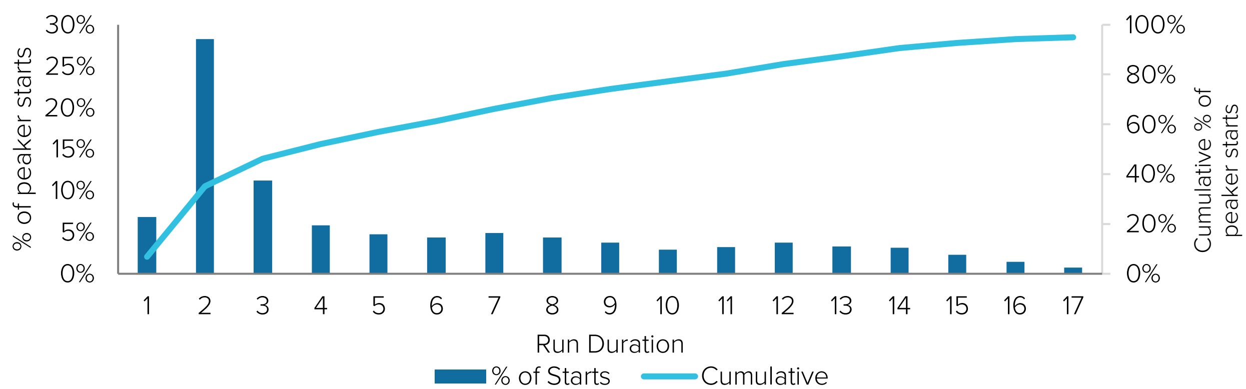
Figure 9. Historical Peaker Generation and Installed Capacity



Source: EPA as reported by S&P, 2020

An analysis of the peaker starts and run duration showed that many of the peakers run for relatively short durations that could be served by energy storage at competitive costs. In 2018, over 50% of the units in the portfolio ran a maximum duration for 8 hours or less when considering the lower 90 percentile of run durations.[69] From all unit starts, about 70% lasted less than 8 hours as illustrated below.

Figure 10. Peaker Starts and Run Duration



Source: Strategen, 2020

[69] Strategen used a 90th percentile approach on duration to determine the replacement needs of NYC fossil assets while taking in consideration five factors that would otherwise overestimate the reliability value of peakers in a traditional "longest peaker runtime" approach. These include 1) peaker unit dispatch versus available zone level capacity, 2) peaker unit dispatch versus plant level capacity, 3) peaker unit dispatch for localized non-peaking needs, 3) inconsistent levels of peaker output during longer-runtimes, and 5) unit operational constraints. We believe this criterion is still relatively conservative but does not needlessly limit resource replacement options to arbitrarily long durations. For more information on this approach see: Strategen, 2020. *Long Island Fossil Peaker Replacement Study.*

Assuming a 90-percentile approach on unit duration to account for system characteristics and its reliability needs, 28 units with 765 MW of installed capacity have maximum durations of four hours or less, making them attractive candidates for replacement with storage even in a 1-to-1 basis. Another 19 units summing 485 MW have durations of five to eight hours and 33 additional units, with 962 MW, have maximum durations of nine to 17 hours. The reminder of the peaker fleet is composed by nine large steam units, accounting for 3,882 MW or 64% of the total fleet capacity. These units have maximum dispatch durations that go from 80 to 1,500 hours but are also the perfect example of over-dispatch driven by technology constraints, as explained in the Section 1.1.1 The City's Peaker Portfolio.

2.3 A Clean Energy Vision for New York City

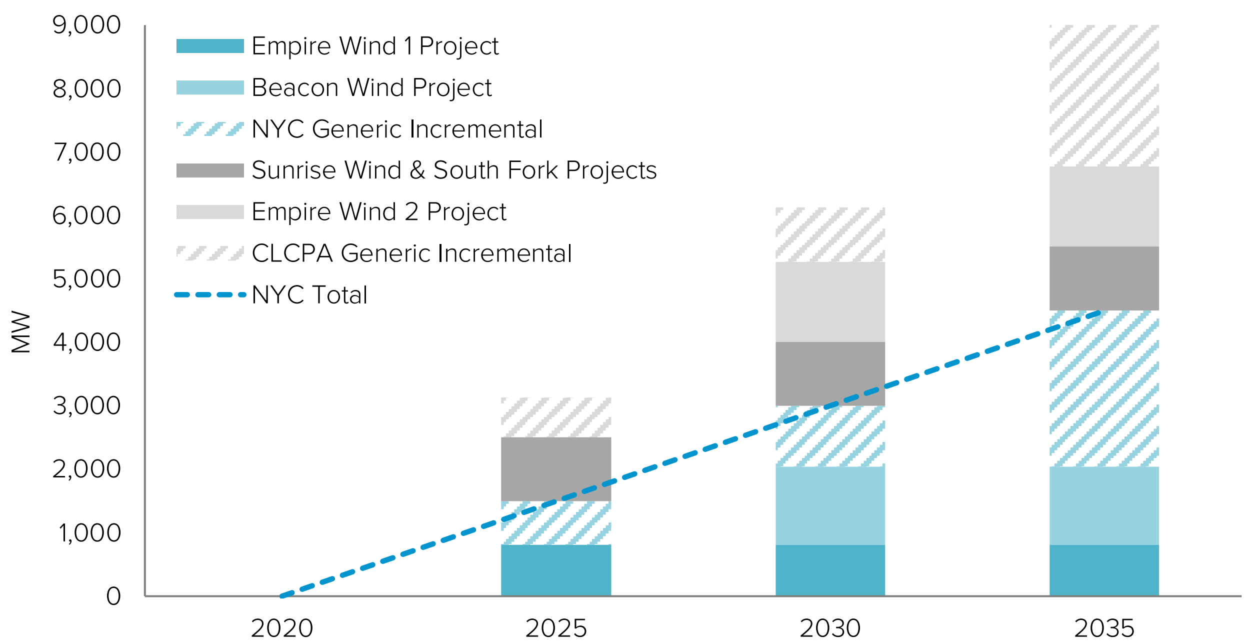
Previous sections developed a general understanding of the context and considerations in planning for a clean grid in NYC. This section describes a feasible scenario of clean energy development based on the state's existing clean energy targets.

2.3.1 Foundational Clean Energy Resources

Strategen analysis focused on defining credible deployment scenarios of renewables and energy efficiency in the City as well as on identifying the amount of energy storage that would be needed to replace historic peaker energy at times of peak need. This approach focused on energy storage as a key integration resource for the replacement of the peaker fleet in the following decade. The specific resource assumptions are explained in the following paragraphs.

Offshore Wind: The renewable procurement scenario proposed here assumes that the State will realize its 9 GW by 2035 target through steady development of new capacity, and that NYC will host 50% of total statewide offshore wind capacity. These assumptions result in a forecast of 3 GW of offshore wind connecting into NYC by 2025 and 4.5 GW by 2030, as shown in *Figure 11. Projected Offshore Wind in New York City.*

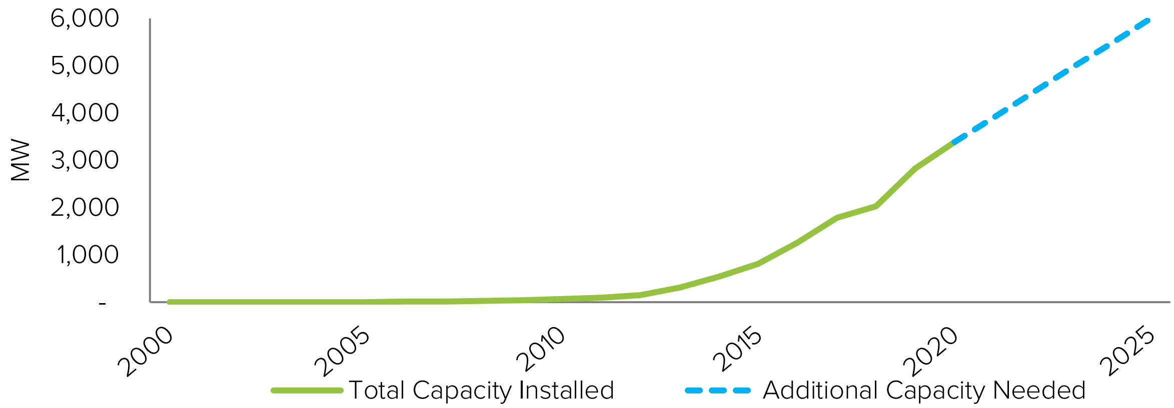
Figure 11. Projected Offshore Wind in New York City



Source: NYSERDA and BOEM, 2020

Community and Residential Solar: NY has a target of 6 GW of distributed solar by 2025. As shown in *Figure 12. Historical Distributed Solar Deployment*, this target is in line with the historical solar deployment in the State during the last decade.

Figure 12. Historical Distributed Solar Deployment



Source: NY-Sun and NYSERDA, 2020

Yet, as shown previously in Figure 8, distributed solar deployment levels in New York City during the same period are much lower than what has been seen elsewhere in the state, representing only 6% of the total installed capacity. New York City is afflicted with many of the canonical challenges that inhibit rooftop solar development including challenging local regulation, shared rooftop space, a significant population that rents, and aging buildings and electrical infrastructure. However, New York City is also one of the areas that could most substantially benefit from rooftop solar, which is a clean energy solution particularly well suited for regions that need voltage and frequency support or local load reduction but have limited physical footprint for resource development. Moreover, rooftop solar represents a chance to invest in local communities in a way that creates durable value for residents through bill credits and reductions and supports community agency in local energy supply.

Given the potential significant value proposition for rooftop solar, the analysis in this paper considers a high-deployment case for the City. This high-deployment case is consistent with the deployment level that the City might see if all future deployments to meet the State's 6 GW target were focused on rooftop solar deployments in the City. This represents nearly 520 MW of annual rooftop solar capacity additions. If similar levels of rooftop solar deployment were continued through the rest of the decade, New York City could reach 2.8 GW of installed rooftop solar capacity by 2025 and 5.4 GW by 2030.

For context, NREL assessed the city's technical potential for rooftop solar to be about 8.6 GW.[70] NREL's report quantified the technical potential of all suitable rooftop areas to generate energy using solar panels. More specifically, NREL used light detection and ranging (lidar) data, geographic information system (GIS) methods, and PV-generation modeling to calculate the suitability of rooftops for hosting PV panels in 128 cities nationwide. Furthermore, the 2016 report assumed a PV panel power density of 160 watts/m^2. Today, premium panels in the market can deliver 215 watts/m^2,[71] significantly increasing the city's technical potential for rooftop solar to 11.5 GW.

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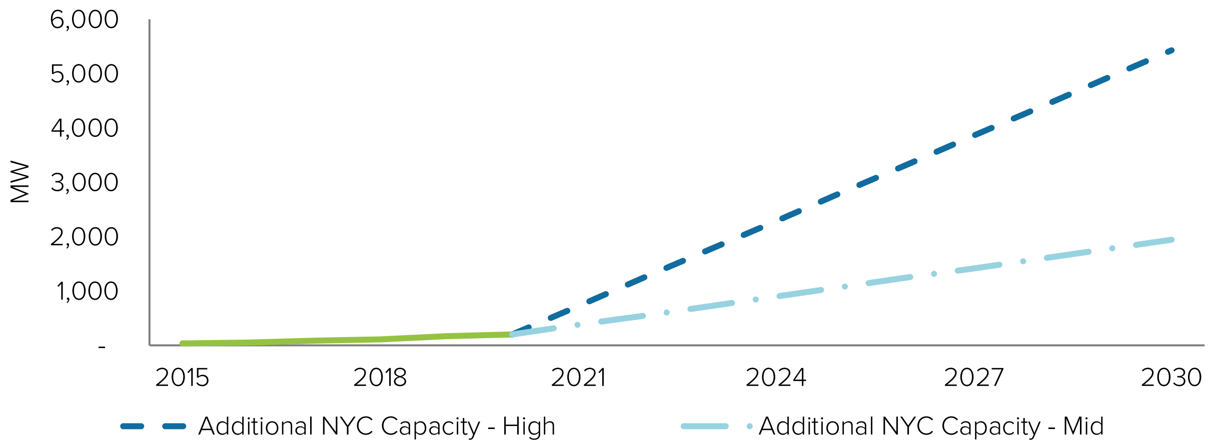
[70] NREL, 2016. *Rooftop Solar Photovoltaic Technical Potential in the United States: A Detailed Assessment.*

[71] In the last 5 years, average panel conversion efficiency has increased from 15% to 20%, with available premium modules from brands like SunPower, LG, Trina, etc., achieving 20 to 23% efficiency.

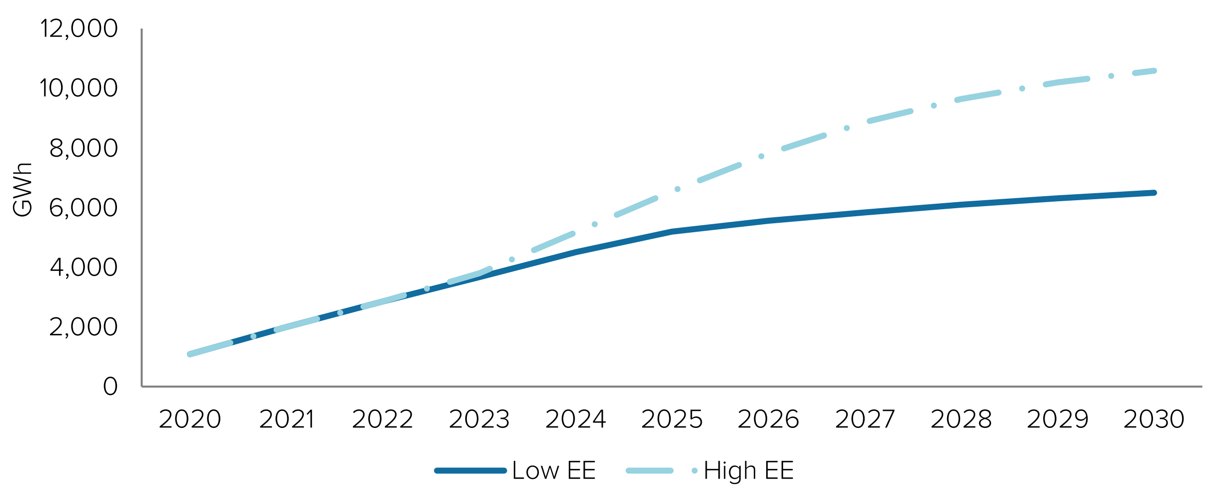
Figure 13: Potential Rooftop Solar Additions in NYC



Source: Strategen with data from NY Sun and NYSERDA

Energy Efficiency: The NY Independent System Operator (NYISO) publishes an assessment of the region's load in its annual Gold Book report.[72] The report provides a variety of load forecasts based on economic impacts from observed trends. Specific to the State's outlook on energy efficiency, many of these impacts are due to State energy policies and programs like the CLCPA, the Clean Energy Standard and the Clean Energy Fund, as well as improved energy efficiency codes and standards. The graph below shows two Energy Efficiency (EE) deployment scenarios developed in the Gold Book. In this analysis, Strategen used the low energy efficiency adoption scenario for NYC that includes 5,200 GWh by 2025 and 6,500 GWh by 2030. While the analysis assumed a conservative (low) attainment of current EE policy measures based on historical underachievement of EE targets, it is worth mentioning that pursuing high levels of energy efficiency might be the most effective way to reduce reliance on fossil-fueled peakers, thus, reduce the marginal cost of replacement storage.

Figure 14. Energy Efficiency Adoption Scenarios in NYC



Source: NYISO, 2020

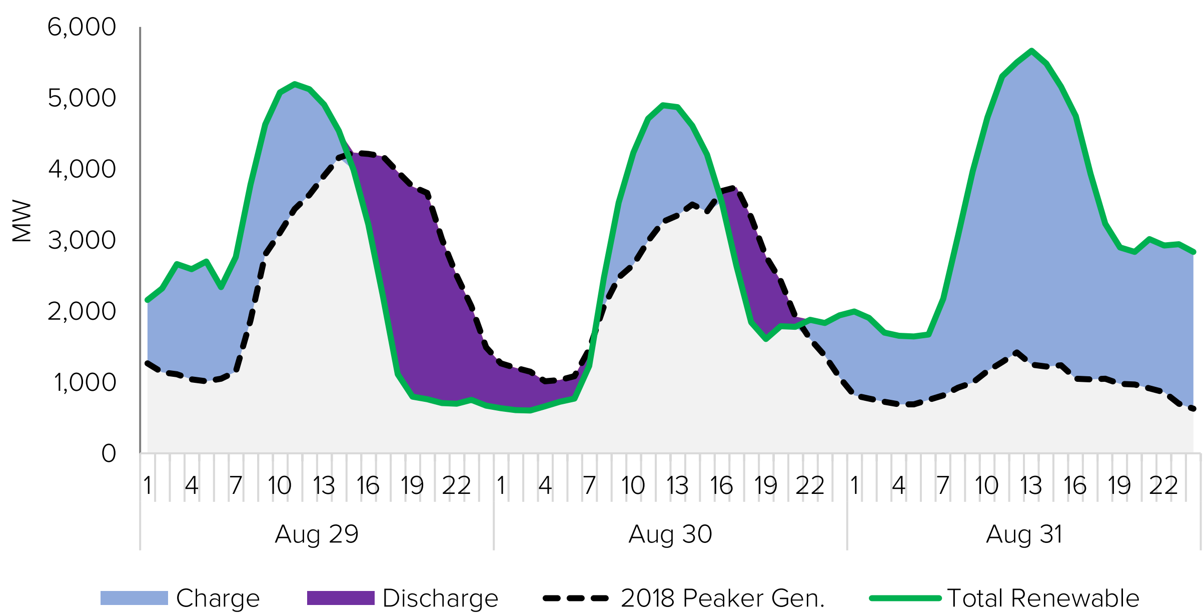
[72] NYISO, 2020. *Gold Book: Load & Capacity Data*

Energy Storage: In 2018, the NY Public Service Commission established the goal of procuring 1.5 GW of storage by 2025 and 3 GW by 2030. While the State is on trajectory to meet its goal, the need for locally-sited storage in the City needs to be addressed to effectively replace peaker plants. Our analysis suggests that the city will need about 4.2 GW of 8-hour duration storage (or equivalent) to effectively replace peaker plants by 2030 in a scenario where the clean energy targets previously stated are met. This can be procured using different storage technologies, locations, sizes and durations but as a reference, this could mean 33,500 MWh of energy storage capacity.

In order to quantify the storage needed to replace peaker plant generation in the proposed clean energy scenario, the analysis used a linear energy dispatch model to quantify the need integrating resources to meet peak fossil asset dispatch on an hourly basis. This model was run for study years of 2025 and 2030 to align with the proposed phased retirement approach. Energy storage was modeled to provide energy arbitrage services, that is, storing clean energy when it is produced but not used, and discharging it into the grid at times of need. The proposed renewable generation for the study years was based on generation profiles specific for the NYC area, while the peaker capacity was modeled using the historic 2018 unit generation profiles[73].

Figure 15 illustrates how storage is needed to match the clean energy resources with energy demand. The specific days shown in the chart – August 29th through August 31st – represent some of the days with the highest utilization of the peaking portfolio due to higher energy demand. Simultaneously, renewable generation from offshore wind declines. This creates a situation where energy storage is called upon to close the gap between energy demand and renewable production. The areas shown in blue indicated times when storage is charging up from clean resources, while the areas in purple show times where the stored energy is called upon to meet demand.

Figure 15. Energy Storage Dispatch During System Peak, 2030



Source: Strategen, 2020

[73] 2018 was used as the reference year for this analysis because it is the period when peaker plants were used the most in terms of total generation and duration of unit operations, between 2017 and 2019. Thus, 2018 is the year with the most challenging recent peak to be served with renewables and short-duration energy storage assets. Years prior to 2017 were not considered due to changes to the peaker and fossil asset fleet.

2.3.2 A Roadmap for Peaker Retirement

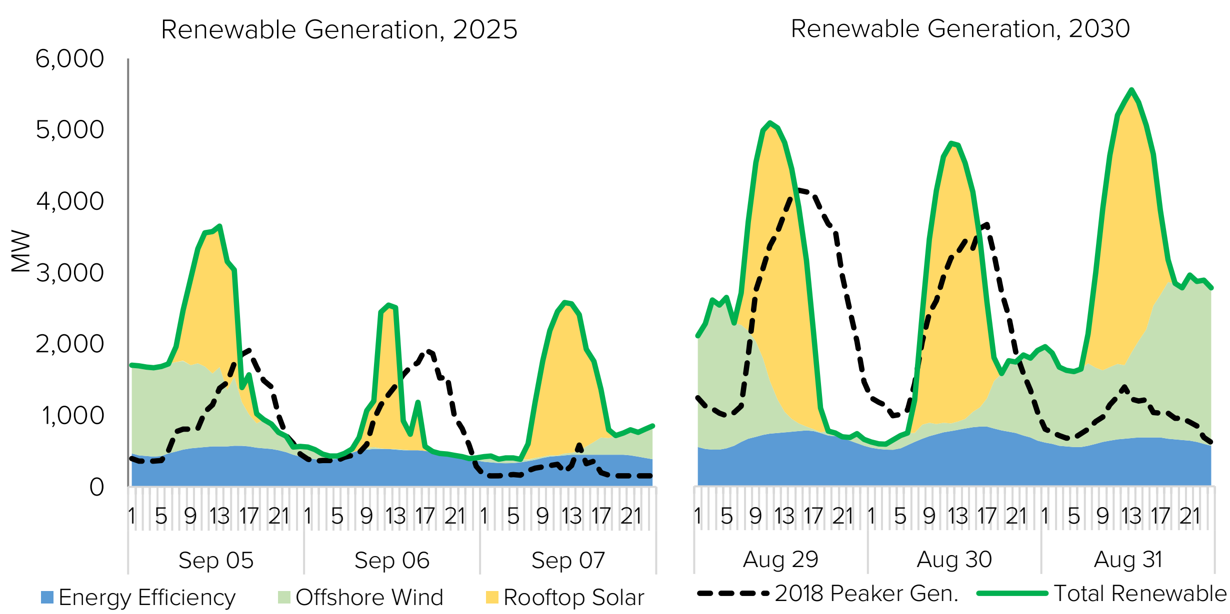
The following roadmap proposes a way to enable the retirement of the entire NYC peaker fleet in the next decade. This approach has the potential to prioritize communities impacted by peakers, not only by ceasing the damage to their immediate environment but also by creating new local job opportunities and building local resiliency.

The roadmap proposes 2025 and 2030 as the guiding dates by when the peaker fleet could be partially and totally retired. The peakers to be retired by 2025, totaling 3,230 MW, were selected based on factors such as utilization, dispatch duration, NO_X rule compliance plans, and location. Although the roadmap is focused on technical feasibility and not constrained by being economical relative to the current energy market, it does strive for cost-effectiveness. The retirement of the remaining 2,860 MW was pushed to 2030 due to the expected deployment dates of new renewables and energy efficiency resources, and the declining cost of the needed storage to integrate such resources.

Overall, the resources in the clean energy mix are not dispatchable and depend on storage to match energy need during system peaks. As explained previously, resource profiles from diverse locations within the NYC footprint were used to approximate the potential energy output of wind and solar during every hour of the year and the different behavior of these resources have distinct impacts on the grid. While current policy targets promise to bring online large quantities of offshore wind, this resource has its lowest performance during the summer months when the energy demand reaches its peak and peaker plants are used the most. In fact, offshore wind capacity during August is about a third of January's output. The opposite is true for solar. Although solar does require storge to align with peaking needs, this can be done in a daily basis and managed by short duration storage. Finally, energy efficiency is expected to come from a variety of appliances and assets, so load will align with overall demand, making EE a very effective asset to replace peaker plants.

The following figure shows the behavior of the replacement resources in both reference years, illustrating the way in which energy storage is needed to align the renewable energy (green line) with the system peaks (black dashed line) that would otherwise be filled by fossil-fueled peaker plants.

Figure 16. Replacement Resources by 2025 and 2030



Source: Strategen, 2020

The following table summarizes the proposed replacement resources by 2025 and 2030 to enable a community focused vision for transition of the energy system in NYC. Here, 4-hour and 8-hour duration energy storage is used as a point of reference but the need in MWh (9,680 by 2025 and 33,600 MWh by 2030) could be served by a mix of storage resources with varying durations. Furthermore, the roadmap below assumes a 'low' Energy Efficiency level of deployment; it is worth noting that the use of NYISO's "high" EE growth forecast adds 10,000 GWh of energy efficiency by 2030 and can reduce need to about 2,600 MW of 4-hr storage by that year.

Table 6. Summary of Replacement Resources

Replacement Resource	Requirements by 2025	Requirements by 2030 (cumulative)	Comments
Rooftop Solar	2.8 GW	5.6 GW	About 520 MW per year. Significant increase over historic additions. Incremental to CLCPA targets, but potentially cost-effective.
Offshore Wind	1.5 GW	3 GW	About 300 MW per year must interconnect into NYC, where about 800 MW has already been contracted. Consistent with CLCPA targets.
Energy Efficiency	4,100 GWh	5,400 GWh	Consistent with NYISO's "low" EE growth forecast.
Energy Storage	2.42 GW of 4-hour storage (equivalent)	4.2 GW of 8-hour storage (equivalent)	Incremental relative to CLCPA given existing storage targets of 3 GW

The cost of following this roadmap will depend on the marginal resources needed relative to the current procurement plans by the State. These are mainly represented by storage assets required to match clean energy production with peaking demand. Although the quantities detailed here are significantly higher than the State's targets, reaching higher levels of energy efficiency (still in line with NYISO's forecast) would lead to significant reductions in resource needs and cost. If the high EE adoption scenario is reached, the amount of storage needed by 2030 could be as low as a third of the capacity stated in this roadmap. The following table details the units and capacity that could be retired by the proposed dates.

Table 7. Proposed Peaker Unit Retirements by 2025 and 2030

Units to retire by 2025	Capacity (MW)
Arthur Kill (Unit 1)	20
Astoria Gen (GT Unit)	16
Astoria Gen. ST (Unit 2)	180
Astoria GT (All)	558
Gowanus (All)	640
Harlem River (All)	94
Hell Gate (All)	94
Hudson Ave (All)	33
Narrows (All)	352
Ravenswood (Units 1, 10, 11)	69
Ravenswood ST (Unit 3)	1,027
Vernon Blvd (All)	94
59th Street (All)	17
74th Street (All)	37
Total by 2025	**3,231 MW**

Units to retire by 2030	Capacity (MW)
Arthur Kill ST (Units 2,3)	912
Astoria ST (Units 3, 5)	763
East River ST (Unit 7)	200
J.J. Seymour	94
Kent	47
Pouch	47
Ravenswood ST (Units 1, 2)	800
2030 Total	**2,863 MW**

2.3.3 A Dynamic Path Forward

The clean energy vision for peaker retirement and replacement outlined above describes a specific approach that is particularly focused on the deployment of community resources consistent with the existing state policy goals and resource development targets. The proposed plan looks to prioritize investment in local communities through locally sited solar, improvements to energy usage and efficiency, and wholesale resources like wind and storage that will connect directly into New York City and help to spur jobs and economic growth.

However, this specific vision and approach is most certainly not the only way that New York City can facilitate the retirement of peaking power plants. The state of New York is pursuing transmission options that would help to bring clean power from upstate New York to downstate regions.[74] Some utilities in the region are continuing to advance their renewable energy portfolios in the form of new on-shore wind and utility-scale solar.[75] All of these investments in clean energy solutions have the potential to help replace power that is currently sourced from peaking power plants. The State's push for a more diversified portfolio of clean energy solutions – be they transmission, storage, or renewables – makes this vision more attainable, rather than less. These new resources will only help to reduce the necessary deployment levels outlined above, and to reduce the resource thresholds that are required to enable power plant retirement.

Potential for Distributed Solar and Storage

One specific option that the city and state could choose to pursue is an increased focus on distributed storage to support local reliability and resource sufficiency. Although this analysis focused on storage from In Front of the Meter (IFOM) storage solutions to help integrate renewables and demand, storage resources could also be sited behind the customer meter (BTM) and paired with solar. BTM storage could provide additional benefits in the form of customer savings, reduced demand on the distribution system, and management of local demand. Recent studies have shown how aggregation of storage through Virtual Power Plants (VPPs) or other mechanisms can be used to meet local demand.[76]

To the extent that customer solutions include storage resources, these resources will be able to reduce the need for IFOM storage solutions. For example, recent analysis by experts supporting the PEAK Coalition estimate potential for 5,600 MW of rooftop solar and 16,800 MWh of BTM storage (or 2.1 GW of 8-hour storage) in New York City. This could potentially help to reduce the above estimated need for 4.2 GW of storage identified above. The need for IFOM storage may not be reduced on a 1-for-1 basis with the installation of BTM storage as some of these resources may dispatch for more localized needs (either to minimize customer bills or meet local area needs) and thus may not be available for use for system level renewable balancing.

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[74] NY Governor's Office, pressroom. *Governor Announces PSC Approval of Major Transmission Line Project from Oneida County to Albany County*. (Jan 21, 2021).

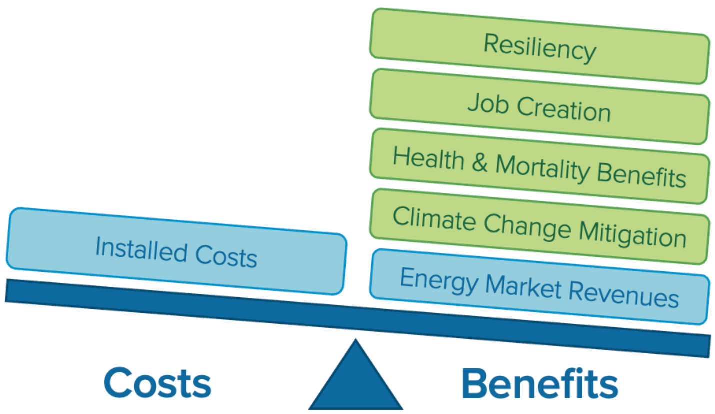
[75] New York State Department of Public Service, 2020. *SIR Inventory Information: Utility Interconnection Queue Data.*

[76] See, for example: Australian Renewable Energy Agency (ARENA), 2020. Virtual Power Plant in South Australia – Stage 1 & 2 Reports. Accessed December 2020. https://arena.gov.au/knowledge-bank/virtual-power-plant-south-australia/

2.4 Cost & Benefits

There are many benefits of a successful clean energy transition which include energy market savings, reduced local and global pollutants, increased resiliency, and job creation. Beyond just providing less expensive energy, renewable resources and storage improve public health by reducing harmful air pollutants that cause diseases like asthma and heart disease. Building new resources within the city will also create well-paying local jobs and boost the city's economy, and decentralized energy assets can create resiliency against system failures and extreme climate events. Though all of these are important from a local perspective, traditional grid planning focuses on assessing the costs of installing new assets against the potential revenues in the energy markets. This section approximates all these factors at a high level and focuses on modelling the cost of storage as the marginal resource needed to realize the proposed roadmap.

Figure 17. Costs and Benefits of Peaker Retirement



Source: Strategen, 2020

2.4.1 Storage Resource Cost-effectiveness

Based on the proposed roadmap for retirement and the forecasted cost of storage and energy prices, this section describes the marginal costs and savings of the roadmap. These costs and savings are the difference between the expected net cost of storage and the current average capacity costs in the city. These are "energy market revenues" as illustrated above. The net cost of storage presented here is the levelized cost of storage, based on a best-case cost scenario[77] that includes costs of annual operations, maintenance and augmentation minus the expected revenues from the sale of energy and ancillary services[78] in the zone J energy markets. In practical terms, it is the marginal cost that should be paid to storage through capacity markets to allow its economical deployment. Thus, it is compared to the actual capacity prices in NYC that are currently paid to peakers among other energy assets.

[77] Energy storage capital cost based on Lazard's 2020 low-cost scenario for in-front-of-the-meter (IFOM) systems. Assumes 20% cost adder for New York City, 20-year asset lifetime, 9% WACC, 1.26% annual cost of warranty and augmentation, and general operations and maintenance cost of $0.25/kWh, with a 3% annual escalator.

[78] Ancillary services (AS) help grid operators maintain a reliable electricity system. Ancillary services maintain the proper flow and direction of electricity, address imbalances between supply and demand, and help the system recover after a power system event. In NY the main markets include spinning, non-spinning reserves and regulation. These markets are limited and might represent a small portion of revenues if storage were to be added today, but the surge of intermittent renewables could augment the size and value of the AS market.

Figure 18. Net Cost Decline of 4- Battery Storage

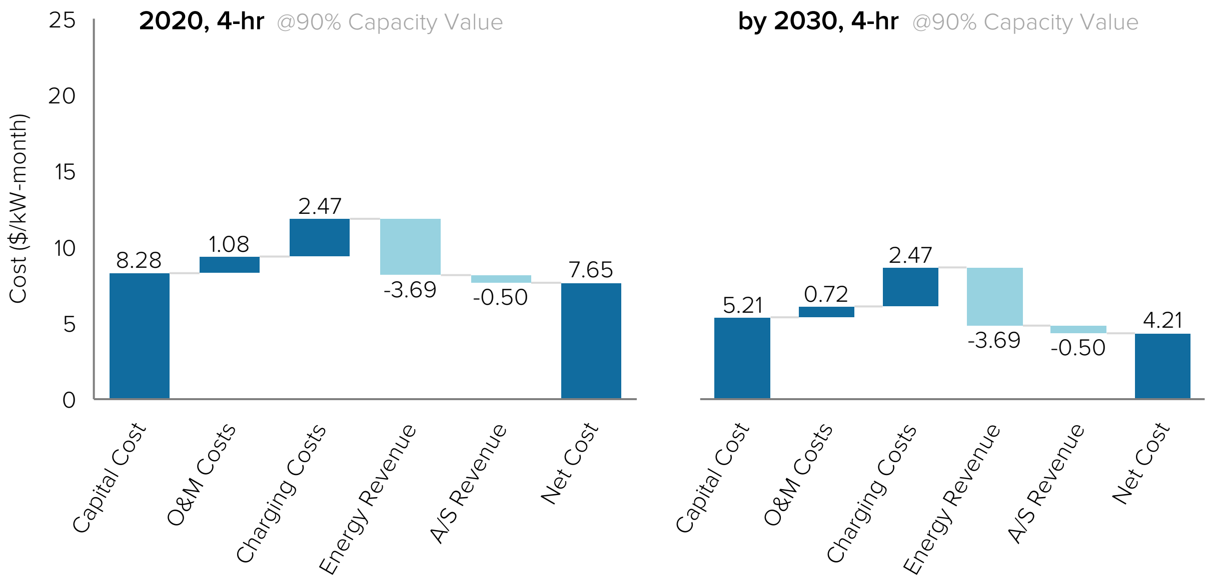
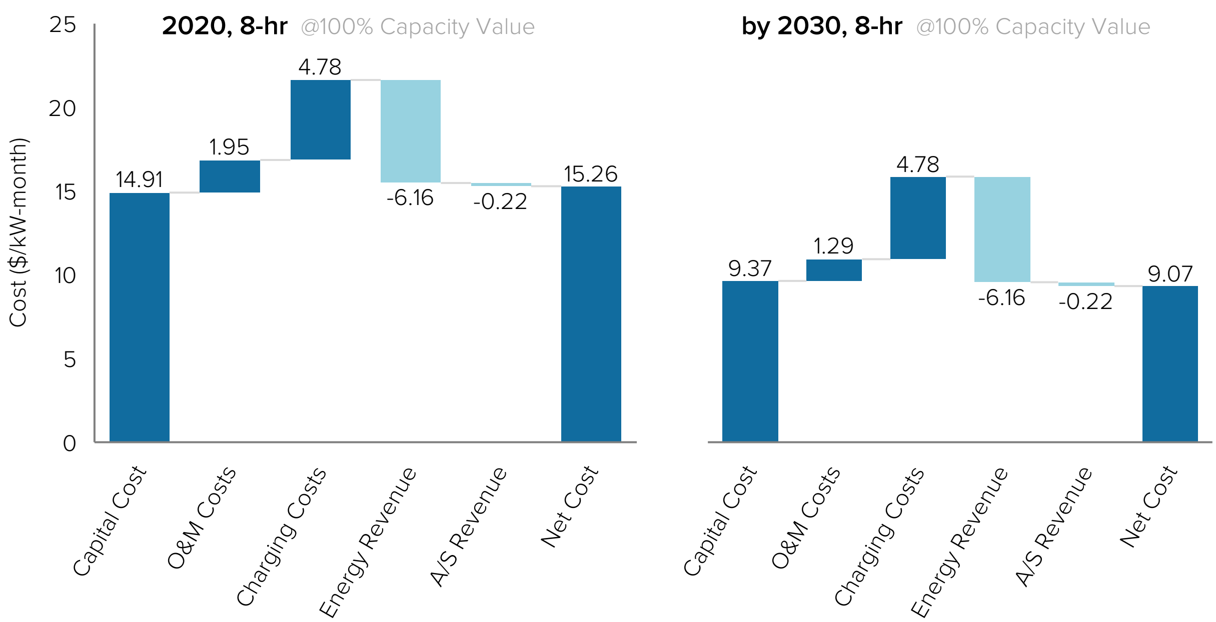


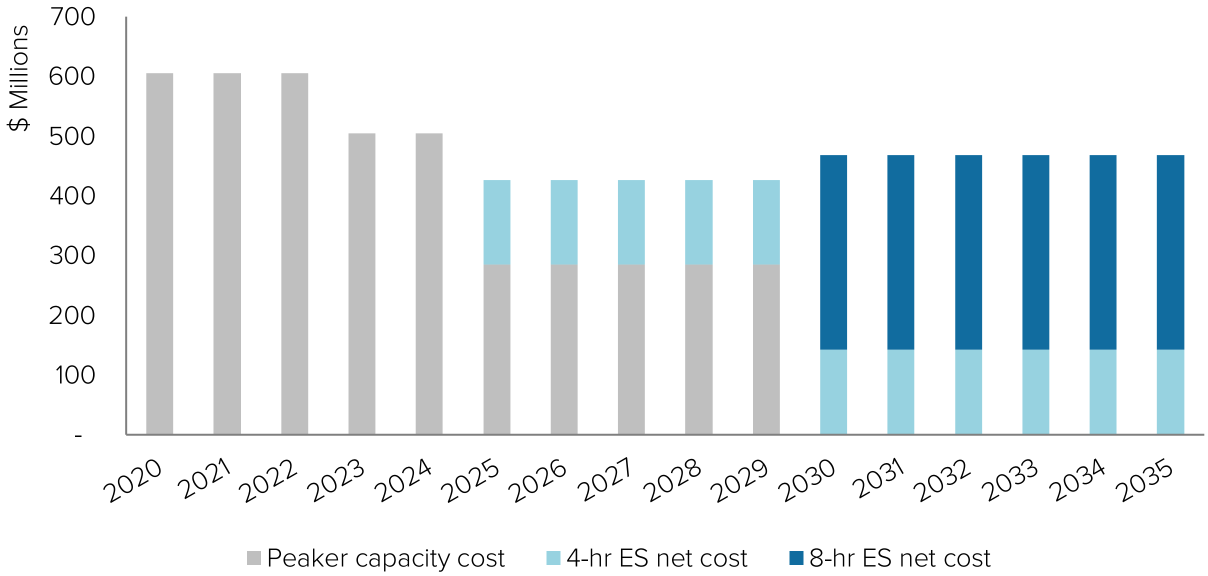
Figure 19. Net Cost Decline of 8-hour Battery Storage



Source: Strategen based on Lazard, 2020

To effectively compare the costs and revenues of storage assets in the energy markets over time, the retirement dates of the peaker fleet were broken down to reflect the "peaker rule" compliance plans of each plant. The following cost estimates consider that 1,016 MW of peaker capacity will be retired by 2023, 2,214 MW will be retired by 2025, and of the remining 2,863 MW will be retired by 2030. While the load from 2023 peaker retirements could be replaced by renewables and energy efficiency, the 2025 and 2030 retirements will need 2,420 MW of 4-hour storage and 2,990 MW of (additional) 8-hour storage respectively. Considering this approach, the roadmap has a potential net present value of $1,005 million by 2035.[79]

Figure 20. Annual Costs from Peaker Replacement



Source: Strategen

As a point for comparison, over the last 20 years, New York has invested about $112 million in incentives for solar projects located in NYC. Additionally, a $573 million expansion of the NY-Sun Program for the State was approved in 2020 which includes $200 million focused on supporting projects benefitting low- and moderate-income New Yorkers, affordable housing, and disadvantaged communities.

2.4.2 Reduced Pollutants

Reduced Local Emissions: The emission impacts of peakers can be, in part, quantified through the emission of local pollutants (SO_2 and NO_X), which cause damage near their emissions source and cause incidences of respiratory illness, cancer, disease, and premature mortality. Local emissions from the peaker fleet in NYC cost the State an estimated $43 million annually (increasing to $50 million by 2030) based on the morbidity and mortality of NO_X and SO_2 as precursors of $PM_{2.5}$.[80]

Reduced Global Emissions: Reducing global emissions from peakers is a different challenge; this means the mitigation and reduction of greenhouse gas emissions, most importantly carbon dioxide. Global emissions cause damage by concentrating in the atmosphere and have an effect on climate changes worldwide, regardless of where the source of emission is located. These climate changes signify societal impacts related to changes in net agricultural productivity, property damages from increased flood risks, human health, energy system costs, and other aspects of the economy that

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[79] Key drivers of the $1,005 million in savings by 2035 (NPV) include the average cost of capacity in zone J during the last 5 years in the capacity market ($8.28/kW-month), and the net cost of storage modeled based on 2019 energy market prices (as reported by NYISO) and 2020 industry cost reports leading to $4.9/kW-month for 4-hour storage procured by 2025 and $9.07/kW-month for 8-hour storage in 2030. The costs of storage assume the use of li-ion energy storage systems, but other technologies could bring additional costs and/or benefits. The net present value calculation used a 7% annual discount rate.

[80] U.S Environmental Protection Agency, Estimating the Benefit per Ton of Reducing PM 2.5 Precursors from 17 Sectors, https://www.epa.gov/benmap/estimating-benefit-ton-reducing-pm25-precursors-17-sectors

are accounted for in the value of carbon. Most recently, the NY DEC established guidelines for the valuation of carbon by state agencies.[81] Based on models used by the federal EPA, the guidelines establish discount rate parameters to calculate the monetary value of greenhouse gas emissions in a way that reflects the scope and scale of carbon impacts for public safety and welfare decisions and better estimates the value of avoided damages from these emissions.

Annually, the peakers in New York City emit almost 2.7 million tons of CO_2, equivalent to almost 5% of New York City's 2019 CO_2 emissions, so retirement of peakers will make a dent into the State's CLCPA targets. Based on the NY DEC guidelines on the value of carbon[82], the CO_2 emissions of the peaker fleet cost the world about $332 million annually (increasing to $377 million by 2030).

As described in section one, the retirement of the NYC peaker fleet would result in annual reductions of 2.66 million tons of CO_2, 1,655 tons of NO_X, and 171 tons of SO_2. Replacing these plants with clean energy assets by 2030 could save the State an estimated $426 million per year. Following the proposed replacement roadmap, savings by 2035 could bring a net present value of $1,166 million.[83]

Table 8. Economic Impact of Peaker Plants in NYC[84]

Pollutant	Economic Value ($/ton)			Annual Peaker Emissions (Tons)	Annual Economic Impact by 2030 ($)
	2020	*2025*	*2030*		
CO_2	$125	$134	$142	2,656,627	$377,241,034
NO_X	$15,321	$16,416	$17,510	1,655	$28,985,794
SO_2	$105,060	$109,437	$120,381	171	$20,557,762
Total					**$426,784,590**

2.4.3 Non-quantified Benefits

Job Creation: Retirement of fossil fuel resources and installation of local renewable generation has obvious environmental benefits such as pollution reduction and a resulting improvement in human health, but renewable energy development also results in economic stimulus from money invested in communities for local generation projects and the creation of sustainable jobs. Locally-sited resources are necessary to maintain reliability in New York City due to transmission constraints, so these positive economic impacts will be locally experienced as well.

The growing renewable energy industry is already a major U.S. employer, with clean energy workers outnumbering fossil fuel workers three to one.[85] On average more jobs are created for each unit of electricity generated from renewable sources than from fossil fuels.[86] Clean energy jobs are widely

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[81] NY Department of Environmental Conservation, 2020. *Establishing a Value of Carbon: Guidelines for use by State Agencies.*

[82] U.S Environmental Protection Agency, The Social Cost of Carbon, https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html

[83] Key drivers of the $1,116 million in emission savings by 2035 (NPV) include the 2% discount rate used by the NY DEC Guidelines to calculate the present value of carbon. The quantity of pollutants emitted by the peaker fleet was taken from EPA reports at the unit level for the last three years. For units where information was unavailable Strategen approximated the amount of pollutants based on the heat rate of the units, energy generated and/or proxies from units with similar turbine technology, age and fuel.

[84] Emission Cost per Ton at 3% discount rate for SO_X and NO_X, and at 2% for CO_2 in 2020 dollars, based on 2017 to 2019 emissions.

[85] Forbes, 2019. *Renewable Energy Job Boom Creates Economic Opportunity as Coal Industry Slumps*. Accessed Nov 2020. https://www.forbes.com/sites/energyinnovation/2019/04/22/renewable-energy-job-boom-creating-economic-opportunity-as-coal-industry-slumps/?sh=2f5787533665

[86] Union of Concerned Scientists, 2017. *Benefits of Renewable Energy Use.* Accessed Nov 2020. https://www.ucsusa.org/resources/benefits-renewable-energy-use

available to individuals with varied educational backgrounds and pay wages higher than the national average.[87] In addition to jobs directly created by the development and maintenance of renewable energy resources, growth in this industry can create a positive ripple effect as other industries in the renewable supply chain benefit.

As explained before, the use of distributed resources like rooftop solar and behind-the-meter storage is an option that could bring additional benefits for NYC, including the creation of more quality jobs for each unit of electricity capacity in the city. On average, residential solar development creates 38.7 jobs per MW and a commercial solar creates 21.9 jobs per MW.[88] Recent announcements by the Cuomo administration have estimated that clean energy investment could lead to more than 150,000 jobs in the state.[89] Similar estimates for energy storage are not available, but expert advisors to the PEAK Coalition estimate that adding energy storage will increase the jobs per MW of solar by 20% for residential and 10% for commercial, resulting in 46.4 jobs for residential and 24.1 jobs for commercial.

Resiliency: Around the world, billions of dollars are lost each year due to business interruption and damage to physical buildings and equipment from power outages. These costs are typically borne by building owners, insurers, and the local, state, or federal government. When properly planned and sized, renewable plus storage systems can decrease a building's exposure to the risk of losses. A case study for buildings in NYC by MDPI and NREL demonstrated how implementing renewables plus storage in place of traditional backup diesel generators can double the amount of outage survivability. For a superstorm Sandy-type event, results indicate that insurance premium reductions could support up to 4% of the capital cost of the system, and potential exists to prevent up to $2.5 billion in business interruption losses with increased renewable plus storage deployment. [90]

Energy storage also improves the reliability of the grid and can be sited and operated to provide essential functions like micro-gridding and islanding. A microgrid is a small, self-contained electric grid which has the ability to disconnect from the centralized grid and operate autonomously. The ability to island allows microgrids to be essential energy resiliency safety nets during times when regional blackouts occur as they continue to provide power when the grid is down. Essential buildings like hospitals, military bases, and universities could benefit from the resiliency that storage and renewables provide during emergencies.

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[87] *Ibid.*

[88] The Solar Foundation, 2018. *National Solar Jobs Census 2018.* The jobs per MW calculation include all the projected workers that 50% of their

[89] NY Governor's Office, pressroom. *Governor Announces PSC Approval of Major Transmission Line Project from Oneida County to Albany County*. (Jan 21, 2021).

[90] Multidisciplinary Digital Publishing Institute (MDPI), 2018. *Quantifying and Monetizing Renewable Energy Resiliency.*

3. How to Enable a Clean Energy Vision

Taken as a whole, the resource deployments outlined in the previous section represent a significant step forward from "business as usual" resource development. Achieving these goals is feasible but will require concerted policy action and collaboration from policymakers and stakeholders in the city and across the state. The below section outlines some of these key policy actors and the actions they can take to help advance this vision.

3.1 Principles for a Transition

In 2020, the NYC Environmental Justice Alliance published the *NYC Climate Justice Agenda* calling for community-based renewable energy programs, replacing peaker power plants, generating clean energy jobs and preparing more adequately for natural disasters, among other climate justice objectives. The agenda highlights that "achieving true climate justice requires more than drawing down emissions and creating jobs – it also requires supporting the health and resilience of every community in our city and honoring the rights of communities to articulate their own climate solutions". [91] Inspired by this agenda, the following paragraphs state three principles to guide the energy transition in the City.

3.1.1 Prioritize Community and Stakeholder Engagement and Buy-in

Historically, power generation has been often built with little to no involvement from local communities. More recently, this has created significant challenges for resource development, as communities are belatedly made aware of the local impacts of new fossil fueled energy resources. In some cases, grassroots and local organizations have come together to successfully oppose siting or re-permitting of assets. For example, in Southern California, local community and environmental groups successfully opposed the construction of a new peaker plant in Oxnard, where the local utility finally agreed to serve residents using local solar and storage resources. However, the lack of community engagement in the resource development process was a root cause of project delays, cost uplifts and trust loss between the utility and its customers. In order to avoid similar issues in the future, it is vital that the clean energy transition be centered on community engagement and stakeholder buy-in.

3.1.2 Leverage and Enable Market Participants and Developers

New York State will need to add about 520 MW of distributed solar each year in order to meet its goal of 6 GW by 2025. Our analysis found that procuring this capacity with a geographic focus on NYC could bring the largest benefits for historically disadvantaged communities and for the environment as a whole. To do so, state and city officials need to engage with market participants and developers to overcome procurement barriers and meet the State's ambitious goal.

Rooftop solar in NYC is lagging behind penetration needed to meet climate goals. This is due to the fact that solar infrastructure is prohibitively expensive for many New Yorkers, especially renters who will not recoup the costs of system installation. To overcome this, it is vital to create market opportunities and incentives for developers to invest in rooftop solar in NYC just like they would invest in a concentrated solar farm. In 2019, Blackstone Group invested $10 million on a 3.9 MW rooftop system with $2.3 million provided by NYSERDA's NY-SUN incentive program. Large-scale rooftop and community solar systems such as this can be crucial to meet the city's climate and energy goals, and to overcome the cost barriers to distributed solar development in the city.

State energy agencies and financing programs could also create opportunities to share savings and benefits of rooftop solar among stakeholders, since these are not always passed on to consumers.

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[91] NYC Environmental Justice Alliance, 2020. NYC Climate Justice Agenda 2020: A critical decade for climate, equity and health

For example, renters at properties covered by Blackstone's project will not see any benefit associated with the utility cost savings. Steps need to be taken to ensure that these projects are helpful to all.

3.1.3 Provide Transparency and Accountability

Opacity in the regulatory process has allowed industrial players to control the energy industry while ratepayers and average citizens have not had access to voice their concerns. People find it hard to see or understand where their money goes or choose where their energy comes from. Additionally, disadvantaged communities are more likely to be impacted by these decisions. Creating a more transparent and accountable regulatory process including public review and oversight will empower communities to avoid costly and dirty energy sources such as natural gas peaker energy.

3.2 Policy Recommendations

This section outlines specific policy actions that should be taken by NYISO, NYSERDA, the NY PSC, and New York City leaders to help enable this vision.

3.2.1 Wholesale Market Design

Recommendation 1: NYISO must aggressively pursue fair compensation of storage and other clean energy resources that will be needed for New York's clean energy transition.

As a general principle, wholesale markets should provide appropriate compensation to viable business models and to energy resources that recognize their unique characteristics and value propositions. The capacity market is needed to ensure the reliability of the grid, and so it needs be reformed to allow and incentivize the participation of clean energy resources, in line with the state's decarbonization goals. Current capacity market rules attribute a lower value to variable energy resources, like solar and wind, to reflect the probability that they will be generating power during times of peak demand. Subsequently, the ability of these resources to replace thermal plants is limited in part by this lower capacity value. Although co-located or aggregated energy storage may be able to increase the value, these resources may also face challenges under current wholesale market rules.[92]

NYISO has been working with FERC to modify rules for the NYISO capacity market that would allow participation from storage and other resources that are currently ineligible. However, this process has experienced challenges associated with federal policies. New York should continue to drive this process forward with FERC but cannot let federal policies prevent New York's own clean energy goals. As necessary, New York may need to contemplate what options it has to advance these market structures independently.

Recommendation 2: Enable wholesale markets to support fair compensation of DERs by aggressively pursuing implementation of FERC Order 841, bolstering locational valuation of energy resources, and allowing energy storage and other DERs to participate and receive compensation as demand response resources.

New York must aggressively establish and implement wholesale market rules that enable participation and revenue streams for DERs. FERC has established rules for wholesale participation by aggregated DERs in its recent ruling Order 841. Although Order 841 provides guidance to its implementation, the development of specific rules and participation mechanisms are left to be determined by individual jurisdictional system operators. Wholesale participation from DERs will be instrumental in enabling an accurate view of resource capacity, especially for constrained urban areas like New York City, that may be more reliant on DERs, as development of DERs will support local reliability concerns and load pocket constraints. Furthermore, the successful establishment of

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[92] Clean Energy States Alliance, 2017. *Northeast Offshore Wind Regional Market Characterization.*

these programs will advance resource competition on an even playing field to help minimize overall capacity costs and customer rate impacts.

Building upon the current Locational System Relief Value within the Value of DERs tariff, New York must continue to develop an accurate, location-based measure of DER value. Particularly in light of the unique constraints within New York City's electrical grid, a deeper understanding of locational values can assist in making smarter investments, setting more equitable rates, and optimizing programs for energy efficiency, demand response, and renewable and storage deployment.

Finally, many DERs and particularly distributed storage can help to reduce customer energy demand similar to demand response programs. DERs should have opportunity to participate in these types programs to help meet peak energy needs and should be allowed to collect revenue streams for the value and services that they provide.

Recommendation 3: Consider a "clean capacity standard" that would help provide benchmarks and milestones for reducing dependence on fossil-based capacity.

A clean capacity standard could enable a transition plan toward the larger goals of New York State and New York City. Such a standard could establish goals and targets for a transition towards clean capacity – i.e., capacity that comes from non-emitting resources. Clear benchmarks and milestones would help to provide market certainty and help LSEs better manage responsible transformations from their existing fossil-based generation portfolios. In this way, setting a clean capacity target will serve as an additional mechanism for accelerating an orderly transition from traditional fossil resources over a known period of time. This clean capacity requirement could also apply to any localized capacity needs. For example, Zone J (New York City) has its own Installed Reserve Margin ("IRM") requirements that exceed those found in upstate regions.

3.2.2 State Policy

Recommendation 1: Continue to advance energy efficiency, storage, and distributed and community solar resources in New York City / Zone J.

Development of local clean resources will be foundational in a transition away from existing fossil assets. NYSERDA and NY-SUN programs are proactively incenting clean energy development, although there are opportunities for deeper funding commitments and consistent improvements to program models. In particular, there have been challenges with the adoption of clean energy resources in New York City, and NYSERDA must develop specific plans to target the unique challenges associated with resource development in this highly urban area.

For example, solar development in New York City has lagged significantly behind solar development in the rest of the state. NYSERDA should work with community groups to understand the challenges to program participation and build a toolkit to support engagement from New York City's underserved communities.

Recommendation 2: Allow distributed and community solar to count towards renewable energy credit (REC) obligations and establish a certification process that enables participation from small-scale projects.

Currently, New York's REC rules only apply to utility-scale solar. However, particularly for New York City, the ability to count the generation of distributed resources will be important to achieve clean energy targets. Moreover, additional revenue streams from RECs will help distributed solar to establish viable and cost-effective business models and will encourage investment in local community resources by solar developers. To support participation from community members, any certification process established by NYSERDA and the NY PSC should not be administratively burdensome, so as to avoid creating a barrier to entry.

Recommendation 3: Partner with developers to identify, reduce, and remove barriers to utility-scale resource development of offshore wind in New York City / Zone J.

Offshore wind has a higher capacity factor and greater peak coincidence than other variable renewables and can therefore be a particularly effective resource in New York's electricity generation portfolio. New York is pursuing an aggressive but appropriate timeline for offshore wind development. Subsequently, timely deployments of offshore wind and the ability to interconnect into New York City will be critical for meeting these timelines. In addition to efforts like the National Offshore Wind Research and Development Consortium, NYSERDA, Department of Environmental Conservation, Department of State, and other state and local entities should continue to collaborate with offshore wind developers to better understand barriers to utility-scale resource development and identify opportunities for increased collaboration, which could include additional efforts to develop complementary port infrastructure and coordinate public-private partnerships.

Recommendation 4: NYSERDA or another appropriate state entity, such as NYPA, should consider procurement of energy storage resources towards the state's targets given the lack of success of recent utility procurements.

Despite state mandates, the majority of New York LSEs have yet to make significant progress on their storage targets. Moreover, preliminary analysis by New York state energy planning agencies has shown that the potential need for storage could significantly exceed existing mandates. With this potential need to scale deployments in mind, it may be appropriate for NYSERDA or another appropriate state entity, such as NYPA, to consider a greater role in procurement of energy storage resources. In particular, NYPA or NYSERDA may be better positioned to address the challenge of limited access to land for resource development.

3.2.3 Local Community and City Policy

There are several important actions that can be taken locally to enable further clean energy development.

Recommendation 1: New York City should prioritize land use for clean energy development and remove barriers in zoning, permitting, siting and interconnection.

Due to physical and economic constraints of developing within the city, difficult trade-offs will need to be made with other land uses, such as transportation and public infrastructure. The city will also need to enable developers to access physical pieces of land at the market level as well as redeveloping city-owned land.

Reducing "soft costs" in permitting and zoning is necessary to foster development of storage and renewable energy development in the city. Furthermore, installation rules by NYC Fire Department should evolve to augment eligible sites for aggregated energy storage assets, such as community energy storage and VPPs. Additionally, energy storage projects are only permitted in residential districts with a permit but are allowed "as of right" within certain commercial and manufacturing districts. Expanding these siting and permitting options will enable greater energy storage penetration.

Recommendation 2: City leaders should partner with NYSERDA and other energy agencies to ensure successful implementation of customer-focused policy goals, such as the State's EE targets.

New York City leaders will be an invaluable partner in outreach and engagement by representing their constituents and communicating any challenges in accessing resources, funding, etc. Particularly in light of the lag in DER development in the city, local awareness and engagement will be crucial in ensuring all New Yorkers are empowered in their energy choices.

Recommendation 3: Expand forums for collaboration and partnership between key stakeholders – including community members, regulators, and policymakers – to discuss challenges and opportunities for energy storage, energy efficiency, and other clean energy resources going forward. Although numerous opportunities for stakeholder collaboration are already in place, gaps still remain in harmonizing existing efforts and identifying additional needs.

Conclusion

This report details a community-focused option to retire fossil fueled power plants in New York City. Using an analysis of hourly generation profiles over several years, this report shows the amounts of solar, wind, energy efficiency and energy storage needed to meet this goal and provide a safe and clean environment for all New Yorkers.

The 2030 peaker retirement scenario finds that roughly 4,200 MW of storage capacity will be needed to supplement renewable energy and energy efficiency growth consistent with CLCPA and NYISO targets. As a result, this report outlines some recommendations to enable growth of energy storage as well as distributed renewable energy resources.

First, the NYISO capacity market must be reformed to fairly compensate and incentivize energy storage and distributed energy resources in recognition of the unique role they play. In addition, a "clean capacity standard" should be considered to provide benchmarks for reducing reliance on fossil powered energy and provide market certainty to storage developers.

Secondly, New York State and NYSERDA have opportunities to facilitate the clean energy transition in New York City. Allowing distributed solar to count towards Renewable Energy Credits will help New York to achieve clean energy goals and the additional revenue will incentivize new developments. NYSERDA should also consider investing in storage projects directly in order to meet state targets that are not being met by LSEs.

Lastly, it is essential for the City to take steps to enable clean energy development. The City should prioritize land use for clean energy and storage capabilities and remove zoning barriers that increase soft costs of development. They should also partner with NYSERDA on specific policy goals and create a forum to engage with community leaders, policymakers, and stakeholders. Lastly, the City should create a clear vision and plan to meet its ambitious goals and give certainty to other actors in the process.

Though this analysis was conducted specifically for New York City, many of these findings and recommendations apply in other large cities in the US. San Francisco, Los Angeles, Philadelphia, and many other cities also have climate action plans and enabling local generation and storage is certain to be a major factor in their transitions as well.

In conclusion, this report indicates that a reform of New York energy policy is needed in order to meet the goals and targets of in the CLCPA. Additionally, this report shows that it is technologically feasible to retire all peaker power plants in New York City and replace them with renewable energy and storage.

ABOUT THE PEAK COALITION MEMBERS

Clean Energy Group

Clean Energy Group (CEG) is a national, nonprofit advocacy organization working on innovative policy, technology, and finance strategies in the areas of clean energy and climate change. Since 1998, CEG has promoted effective clean energy policies, developed new finance tools, and fostered public-private partnerships to advance clean energy markets that will benefit all sectors of society for a just transition. CEG serves as a leading national proponent of battery storage and solar to replace fossil-fueled power plants, providing economic analysis on the economics of peaker plant replacement. Over the past several years, CEG's Resilient Power Project has been primarily focused on supporting solar-plus-storage development in disadvantaged communities, supporting solar-plus-storage projects in more than 60 communities nationwide. CEG has also worked on state energy storage policy and large-scale battery storage deployments. www.cleanegroup.org

New York Lawyers for the Public Interest

New York Lawyers for the Public Interest (NYLPI) is a not-for-profit law firm founded in 1976 to help protect civil rights and achieve lived equality for communities in need. NYLPI combines the power of law, organizing, and the private bar to make lasting change where it's needed most. Staff attorneys, community organizers and advocates provide direct representation, advocacy and assistance to low-income New Yorkers in the areas of disability justice, environmental justice, health justice, immigrant justice, and community justice. NYLPI has used its legal and policy expertise in tandem with organizing and community partnerships for over two decades to address disproportionate environmental burdens in New York City's low-income communities of color. NYLPI brought a challenge to the development and siting of new peaker plants in the early 2000s, and is currently deeply engaged in local climate and renewable energy policy with a focus on environmental justice. www.nylpi.org

NYC Environmental Justice Alliance

Founded in 1991, the New York City Environmental Justice Alliance (NYC-EJA) is a nonprofit citywide network linking grassroots organizations from low-income communities of color in their struggle for environmental justice. NYC-EJA integrates groundbreaking research, robust advocacy campaigns, policy analysis, and technical assistance for our members and allies. Many of NYC-EJA's campaigns focus on energy-related advocacy and planning by providing support to the local struggles of our members who are advocating for the displacement of polluting infrastructure from their communities. NYC-EJA also works with its members to concurrently develop renewable energy opportunities that optimize local health and economic benefits. NYC-EJA is committed to advancing energy resilience and just transitions in the energy sector through our leadership in power building efforts at both City and State levels. www.nyc-eja.org

THE POINT CDC

THE POINT CDC is dedicated to youth development and the cultural and economic revitalization of the Hunts Point Peninsula of the South Bronx. After Superstorm Sandy, THE POINT mobilized elected officials, businesses, labor groups, and residents to inform the creation of the Hunts Point Lifelines Plan focused on building climate resilience. This input led Lifelines to receive a $20 million Rebuild by Design award from HUD and $25 million from the City towards the development of renewable, resilient energy systems and stormwater management infrastructure in Hunts Point. Additionally, THE POINT is currently in the pre-development stage for what will be one of the largest community solar projects in New York State with support from the New York State Energy Research Development Authority (NYSERDA).
www.thepoint.org

UPROSE

Founded in 1966, UPROSE is Brooklyn's oldest Latino community-based organization. UPROSE is an intergenerational, multi-racial, women of color-led, and nationally recognized organization that promotes sustainability and resiliency in the Sunset Park neighborhood through community organizing, education, indigenous and youth leadership development, and cultural/artistic expression. In the aftermath of Superstorm Sandy, UPROSE has established the Climate Justice Center, focused on engaging community residents and local businesses to generate grassroots-led climate adaptation and community resiliency planning. UPROSE is working to operationalize the Green Resilient Industrial District (GRID), a comprehensive community-led proposal and model for a Just Transition, to move away from an extractive economy dependent on fossil fuels to a regenerative economy centering frontline communities. For years, UPROSE has advocated against the siting and continued investment in polluting infrastructure, pushing for the development of community-led renewable energy solutions such as Sunset Park Solar—New York's first community solar cooperative.
www.uprose.org

THE FOSSIL FUEL END GAME

The PEAK Coalition—UPROSE, THE POINT CDC, New York City Environmental Justice Alliance (NYC-EJA), New York Lawyers for the Public Interest (NYLPI), and Clean Energy Group (CEG)—has come together to end the long-standing pollution burden from power plants on the city's most climate-vulnerable people. This Coalition will lead the first comprehensive effort in the US to reduce the negative and racially disproportionate health impacts of a city's peaker plants by replacing them with renewable energy and storage solutions. Our collaboration brings technical, legal, public health, and planning expertise to support organizing and advocacy led by communities harmed by peaker plant emissions. Together with communities, we are advocating for a system of localized renewable energy generation and battery storage to replace peaker plants, reduce greenhouse gas (GHG) emissions, lower energy bills and make the electricity system more resilient in the face of increased storms and climate impacts.

More information about the PEAK Coalition can be found here:

www.peakcoalition.org

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