March 22, 2024

Honorable Michelle L. Phillips
Secretary
New York State Public Service Commission
Three Empire State Plaza
Albany, New York 12223–0350

RE: Case 15-E-0751 Motion of the Commission in the Value of Distributed Energy Resources Incentives (Matter 17-01276)

Dear Secretary Phillips:

I would like to submit a petition to the New York State Public Service Commission (PSC) for an exemption of a cogeneration (a/k/a combined heat and power, or CHP) project from the 10-kilowatt (kW) cap for participation in the Value of Distributed Energy Resources (VDER) regulations and tariff (Matter 17-01276).

The property that is the subject of this request is 301 West 45th Street, New York, NY 10036. The property is owned by 301 W. 45 Realty LLC and self-managed by SW Management.

Granted, CHP is primarily fueled by burning natural gas, which emits greenhouse gases. Compared, however, with current grid emissions of Zone J service to New York City and Southern Westchester, CHP technology is 50 percent (%) more efficient than the generation of grid power and the independent combustion of fossil fuel for thermal energy. As confirmed by the U.S. Environmental Protection Agency (EPA), greater efficiency means fewer greenhouse gas emissions.

In addition to reducing emissions, the ability to export power into the grid serving New York City would increase power reliability for Zone J where the New York Independent System Operator (ISO) states that there is a shortage of power capacity for New York City. Furthermore, Zone J has higher emissions today due to the retirement of the two Indian Point nuclear plants that had generated 25% of power requirements with no emissions. This reverses the trend of annual reductions in statewide emissions that goes back over 20 years.

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Moreover, the "peaker rule" of New York State's Department of Environmental Conservation forces retirement of old inefficient peaker plants, which has compromised grid reliability because there is not yet an adequate replacement that involves clean power. Thus, the export of CHP power reduces economywide GHG emissions, which reduces dependence on peaker plants and contributes capacity to diminishing reliability. The CLCPA objective of 100% zero-emission electricity by 2040 will not be realized unless a technological breakthrough occurs. Nevertheless, the CLCPA objective to reduce "economy wide" emissions by 40 percent (%) by 2030 would be assisted by grid export of CHP power.

The 10-kW cap was imposed in 2017 due to the unknown impact of CHP on environmental justice. Nevertheless, NYSERDA continued to offer incentives at the time for CHP projects throughout the state. Environmental justice issues primarily exist regarding electric generation because the least efficient peaker plants have been located in close proximity to disadvantaged communities. CHP plants reduce generation of both baseload and peaker power plants through use in host buildings and as power exported to the grid.

Of course, the more power generated in a CHP facility, the more waste heat is available to satisfy a building's thermal energy load. As such, the export of surplus CHP power and the additional production of waste heat at the host building creates a unique synergy between the building and the grid. This concept is being implemented by Saint Joseph's Hospital in Syracuse, NY, where a power purchase agreement exists between the hospital and National Grid. The sale of power to National Grid benefits both the hospital and the grid economically, while society benefits from the emission of fewer GHGs into the environment. This arrangement does not appear feasible for our project, hence this petition for an exemption from the 10-kW cap for 301 West 45th Street, a 176-unit apartment building that satisfies NYSERDA criteria of affordable housing.

Since 2016 it has been apparent that the closing of Indian Point nuclear reactors would create a need for alternatives. The entire Sunday Metro section of the New York Times on February 12, 2017, was devoted to "New York 101: How New York City Gets Its Electricity." It identifies the issue affecting adequate power thus:

> The State is prioritizing projects to bring more power downstate from wind farms and hydro plants. The need is even more urgent with plans to close Indian Point as soon as 2021, as it supplies one-fourth of the power consumed in New York City and Westchester Country.

In discussing the difficulties of bringing power downstate, the article states:

> One project to bring hydropower from Quebec to New York City under Lake Champlain and the Hudson River has been in the works since 2008.

Today, four large offshore wind turbine projects and 86 solar farms recently sought "jawdropping cost increases" according to Commissioner Karen Bursen. The PSC rejected the increases and these projects are now in limbo. Additionally, the selected contracted developers of the transmission lines to bring Quebec hydro and upstate green power to New York City have also petitioned the Commission for assistance to meet significant cost increases. Decisions on the increases are pending.

At the time the New York Times article was written, it was perceived that "energy use is projected to flatten or decrease in the next decade, thanks in part to more efficient appliances and better insulated buildings." Projections, however, have radically changed due to the promotion of electrification for space heating and hot water, federal and state inducements for electric vehicles, and the increasing demand of data centers.

Energy policy experts recognize that reducing global warming and climate change requires the contribution of a broad range of technological concepts and breakthroughs. CHP pairs well with renewables and batteries to sustain power reliability and represents emission-reducing opportunities when, as projected, hydrogen emerges as a viable fuel source and carbon-capturing traps emissions. The NYISO has cautioned that to achieve "emissions-free generating with the necessary reliability service attributes," as mandated in the CLCPA by 2040, is "not yet available on a commercial scale."

Providing 301 West 45th Street with an exemption from the 10-kW cap in VDER would represent a significant step towards the encouragement of efficient energy generation and reduced emissions. These actions would help strengthen the grid when strained and during demand reduction periods of the VDER value stack.

Furthermore, granting of this petition would allow the Commission the opportunity to review future petitions for approval on a case-by-case basis. Approval of this petition to monetize the export of CHP power would motivate innovation that is currently being stifled.

Thank you for considering this petition.

Sincerely,

Lewis M. Kwit
President

Petition to the New York State Public Service Commission to Waive the 10-Kilowatt Cap for Cogeneration, as Set in PSC Case 15-E-0751 and Matter 17-01276, at 301 West 45th Street, New York, NY

Submitted by Energy Investment Systems

March 22, 2024

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Petition to the New York State Public Service Commission to Waive the 10-Kilowatt Cap for Cogeneration, as Set in PSC Case 15-E-0751 and Matter 17-01276, at 301 West 45th Street, New York, NY

Submitted by Energy Investment Systems

Summary Petition

The apartment building at 301 West 45th Street in Midtown Manhattan is implementing a 160-kilowatt (kW) cogeneration or Combined Heat and Power (CHP) project. The property has already received approval from Con Edison to export electricity to the grid through the utility's Coordinated Electric System Interconnection Review (CESIR) process. This petition seeks a Public Service Commission (the Commission, or PSC) exemption to permit the project to receive incentives through the VDER (Value of Distributed Energy Resources) tariff by circumventing its current 10-kW cap for CHP participation. [1]

The petition seeks to explain ways in which a waiver would be consistent with the policy of the Climate Leadership and Community Protection Act (CLCPA, or the Climate Act). The policy aims to reduce greenhouse gas emissions (GHGs), and supports objectives of the New York Independent System Operator (NYISO) to reduce GHGs as well as NYISO goals to assure grid reliability in New York City and Southern Westchester, which comprise NYISO Zone J.

Should the Commission grant the petition, it would not have value as a precedent; rather, it could be used to document opportunities to quantify how such efforts to export power into the grid could satisfy state emissions reduction and reliability objectives. It would also evidence an opportunity for other cogeneration projects to apply for similar exemptions that the Commission could approve or reject on a case-by-case basis.

Prior Reasoning for the VDER 10-kW Cap for CHP Projects

The VDER was developed by the Department of Public Service (DPS) and enacted by the Public Service Commission (PSC) in the Con Edison electric tariff in 2017. The regulation is intended to monetize

[1] Case 15-E-0751 (and Matter 17-01276), In the Matter of the Value of Distributed Energy Resources (filed May 22, 2018) (Staff Proposal on Value Stack Expansion), in response to Case 15-E-0751, Order on Net Metering Transition, Phase One of Value of Distributed Energy Resources and Related Matters (issued March 9, 2017) (VDER Implementation Order).

sales of electricity generated in buildings that is exported to the grid in accordance with their socioeconomic and environmental values.

The DPS has stated that expansion and modification to VDER eligibility are permitted to enable appropriate technologies to participate in VDER tariff incentives. It should be noted that CHP technology has been approved to satisfy the governing principles of VDER, however, CHP expansion has yet to take place.

The VDER ruling created the 10-kW cap due to environmental and environmental justice concerns. DPS cited the reasoning for the CHP 10-kW cap in its staff report on the Matter of the Value of Distributed Energy Resources on May 22, 2018. CHP originally fell into the category of net energy metering (NEM) with a rated capacity of up to 10 kW. As stated in the DPS matter:

> Staff considered expanding CHP eligibility beyond this very narrow class to all CHP below maximum project size, currently 5 MW, for any customer.

Staff continues by citing the reasoning for the 10-kW cap.

> While some stakeholders support this, others raise concerns that the record is not adequate to assure that the environmental impact of such resources would not unreasonably increase local pollutants in areas of environmental justice concern or similar locations.

Today, however, the environmental advantages of CHP are well known given the substantial increase in GHG emissions resulting from the closing of Indian Point's two nuclear power plants. According to NYISO, the statewide grid had decreased emissions 46 percent since 2000, however, "recent increases in the CO2 emissions rate coincide with the phased closures of Indian Point Units 2 and 3 in 2020 and 2021 respectively."

The closures increase emissions for the entire state; however, the increase is more dramatic for Zone J: Indian Point nuclear power comprised 25% of all power serving Zone J's New York City and Southern Westchester areas. The United States Environmental Protection Agency (US EPA) publishes a report called eGrid (Emissions & Generation Resource Integrated Database) that reports total output emissions rates in pounds per megawatt hour (lb./MWh) for nationwide subregions. Data shown in the reports are gathered two years prior to the report date, which means the 2022 report cites data from 2020. Indian Point 2 was shuttered at the end of April 2020 while Indian Point 3 remained active for the entire year. The report indicates that the Zone J subregion (NYC/Westchester) indicates CO2e, or

carbon dioxide and equivalents, of 636.0 lb/MWh. Emissions would obviously be lower if both Indian Point plants had operated through the entirety of 2020.

By contrast, 2022 data reported in January 2024 reveals 886.6 lb/MWh of CO2e. This is an increase in pollutants of 250 lb/MWh, which is an astounding 39% greater than 2020 emissions.

Further exacerbating downstate grid emissions, the NYISO reports that 74% of generation is comprised of power plants that can combust either oil or gas. In a comparison of the two emissions-producing fuels, oil produces a good deal more CO2e than gas when combusted to produce an equivalent heat content. Indeed, number 4 oil produces 29% more CO2e than natural gas. Furthermore, the combustion of oil, especially in peaker plants,[2] emits particulates as well as CO2e.

It is well known that CHP is far more efficient than the grid and separate combustion for thermal energy needs. As the US EPA states:

> During conventional separate power and heat generation, nearly two-thirds of energy is wasted, discharged into the atmosphere as heat during generation, transmission and distribution. By capturing and using heat that would otherwise be wasted and by avoiding distribution losses, CHP can achieve efficiencies of over 80 percent, compared to 50 percent for typical technologies (e.g., conventional electricity generation and an onsite boiler). Because of this increased efficiency, CHP systems can emit less carbon dioxide than separate heat and grid power.

See Appendix A for a more complete EPA description of CHP technology and benefits.

Environmental justice (EJ) advocates promote the elimination of peaker plants, which in New York City are most often located in EJ communities. Appendix B features an online article from Gotham 360 Innovative Energy Solutions dated November 2, 2020, which cites a Natural Resource Defense Council (NRDC) map that illustrates peaker plant locations that overlie potential environmental justice areas in New York City. Any export of more efficient CHP power into the grid reduces the need for grid-generated power, which is far less efficient. The ability of CHP plants to export power during summer heat waves when "peakers" are operating would incrementally reduce the need for peaker plant generation where CO2e emissions are directly provided in EJ areas. Peakers are also capable of burning oil, which emits hydrocarbons that can aggravate asthma conditions.

[2] Peaker plants are low-use, high-emitting power plants that grid operators call on at times of high electric demand.

EJ advocates also recognize the need for reliable power and the role that peakers now play to assure adequate capacity. Any CHP power exported into the grid also promotes reliability, which the NYISO indicates is seriously strained in the city.

The NYISO 2022 Power Trends report states:

> Reliability margins will shrink in upcoming years due primarily to the planned unavailability of simple cycle combustion turbines that are impacted by the DEC's Carbon Rule.

The NYISO 2023 Power Trends report further describes the issue of reliability:

> However, pursuant to public policies, fossil fuel generation is retiring faster than renewable resources are entering service, leading to declining reliability margins across the state but mostly in the New York City area.

Each quarter NYISO publishes a "Short-Term Assessment of Reliability," or the STAR report. In the Executive Summary of the 2023 third-quarter STAR report of October 13, 2023, the NYISO states:

> As of May 1, 2023, 1,027 MW of affected peakers have deactivated or limited their operations. An additional 590 MW of peakers are expected to become unavailable beginning May 1, 2025, all of which are in New York City. With the additional peakers unavailable, the bulk power transmission system will not be able to securely and reliably serve the forecasted demand in New York City (Zone J).

In summary, the ability of a CHP system to export power will diminish emissions in environmental justice communities as well as throughout Zone J and will enhance reliability since the grid may be unable to reliably serve forecasted demand in New York City.

Project Description

301 West 45th Street is a multifamily building with 176 rental apartments and 5 ground-floor commercial spaces. Constructed in 1965, it is named The Camelot. The building has 66 rent-regulated (stabilized) units, 38% of all apartments, thereby satisfying eligibility criteria of Con Edison's Affordable Multifamily Energy Efficiency Program (AMEEP). An eight-year-old decision by the owners to switch the building's fuel from number 4 oil to natural gas was at the root of the project.

Energy Investment Systems (EIS) has worked with the owners to facilitate switches to natural gas in many S.W. Management (SWM) properties in accordance with New York City regulations. SWM

manages the building, which is owned by SWM principals as are all other properties in its portfolio. As long-term owners/managers of affordable rental apartment buildings throughout New York City, SWM represents a valuable New York City asset.

At the beginning of the planning process, EIS identified the need to seriously upgrade the way energy was provided to the building. Building electricity in all public spaces and apartments is master metered under one Con Edison account. The commercial spaces are direct metered, which means that each store receives a separate Con Edison electric bill. Tenant electric service is included within monthly rents.

The building is centrally air-conditioned and both space heating and cooling are distributed through a hydronic two-pipe system. When EIS surveyed the building, which was constructed in 1965, and accumulated energy data, both the heating system and the absorption chiller were beyond their useful operational lives. The existing Trane chiller was original to the building and the boiler was more than 40 years old. Domestic hot water was provided by a tankless coil in the boiler. Working at 76% efficiency, the boiler produced steam that, during the heating season, went to a heat exchanger before heated water was piped throughout the building. During the cooling season, steam from the boiler was piped across the basement into the absorption chiller. The absorption chiller had a coefficient of performance of 0.50.

Although the opportunities of cogeneration were immediately obvious, a complex set of challenges was presented by the building's labyrinthian basement, which houses mechanical rooms, the building laundry room, superintendent's office, and commercial storage areas. Hallways and a variety of room functions exist throughout the basement. It required teamwork to overcome the challenges. Regardless of how creative and innovative the concept to establish a significantly energy-efficient emission-reducing plant was, its design and implementation required a multifaceted skill set. This was anchored with the recruitment of a design/build contractor, the Excel Group, and went on to encompass continuing cooperation from Con Edison, building staff and the property owner/managers.

The idea was to implement a cogeneration system that could satisfy the majority of the building's electric load, which would enhance resilience to blackouts. Because the building is master metered, it is permitted to provide electricity to the apartments. Since the building is centrally air-conditioned with thermal energy, there is an existing application for all waste heat provided during both heating and cooling seasons. During shoulder seasons, waste heat can satisfy the entire hot water load in the

building. The building's electric load is reduced since motors and pumps are not required to distribute conditioned water, which means thermal energy wasted is not significant.

Because the existing boiler and absorption chiller were beyond their useful lives and extremely inefficient, they required replacement. At one point, the superintendent cautioned that the chiller might not survive the entire 2022 summer. The overall retrofit plan called for the replacement of the existing boiler and absorption chiller with a combined heater/chiller manufactured by Broad. The space heating component has 93% efficiency and the chiller component has a coefficient of performance of 1.43. An additional, separate Lochinvar-manufactured domestic hot water heater with a rated efficiency of 97% was recommended. All of these measures have now been implemented.

The ultimate result will be to stretch the utilization of waste heat to satisfy the building's thermal loads, thus further enhancing emissions reduction. The entire effort included replacement of pumps and installation of separate heat exchangers. The building's electric room was completely upgraded and a new gas service room was constructed. Improvements continue to occur.

Rarely do all of these elements come together so neatly. The result is a realistic projection of a 90% operational efficiency rate when space conditioning for heating or cooling is required.

Although the CHP system has been installed, there is additional work to be done on technology implementation regarding installation of protective relays. A secondary chiller has been designed to receive the CHP waste heat and will be implemented together with an Energy Management System (EMS). Thus, waste heat is to be used first to satisfy initial heating and cooling loads and to satisfy domestic hot-water loads during the shoulder seasons and moderate temperatures.

The Benefits of Power Export and Exemption of the 10kW VDER CHP Cap for 301 West 45th Street

The ability of 301 West 45th Street to export surplus electricity into the Midtown Manhattan grid will provide power that is far more efficient than grid power and the independent combustion of fossil fuel to satisfy building thermal needs. The CLCPA objective to reduce economywide emissions 40% by 2030 would be assisted by the export of CHP surplus power. As a result, any power exported to the grid will be substantially more efficient than power generated by peaker plants, which are primarily located within or in close proximity to environmental justice communities.

It also seems as though CHP systems that are located within environmental justice areas are beneficial, given that they too will reduce dependency on peakers. New York City is especially cognizant of environmental concerns and has recently installed two large cogeneration systems within or in close proximity to EJ communities. The first is five 250 kW systems at 1199 Plaza, which is a New York City Housing Authority development bordering East Harlem. If CHP were harmful to EJ communities, it would not locate a 1,250-kW CHP plant in a 1,590-unit development for low-income and moderate-income New Yorkers.

The City's Department of Environmental Protection (DEP) is installing five cogeneration plants in West Harlem's wastewater treatment facility at the Hudson River. Appendix C includes the full October 2018 press release.[3] DEP estimates a nearly 50% reduction of greenhouse gas emissions from implementation projected for 2022. The plants can produce a total of 12 megawatts of power. Rory Christian, who at the time was the director of New York Clean Energy of the Environmental Defense Fund, provides a notable accolade in the release.

> As New York City transitions to a cleaner, more sustainable energy future, this effort by the Department of Environmental Protection to reduce local air pollution can significantly improve the health and well-being of New Yorkers, while limiting our dependence on fossil fuels for years to come.

The plant is now in the final stages of commissioning and is expected to be operational in a few months.

Benefits of Permitting the Waiver Petition for 301 West 45th Street

The project at 301 West 45th Street would permit the PSC to evaluate the feasibility of exporting power into the grid from a series of policy and socio-economic viewpoints. The project of 160 kW would not create a substantial benefit to the grid; however, findings could provide input as VDER transitions to the next era of grid-interactive efficient buildings.

The first task is to determine whether more efficient CHP power can be exported cost-effectively under VDER regulations. Because grid generators purchase interruptible gas, the Day-Ahead Market

[3] NYC DEP Press Release, October 2018: *$300 Million Upgrade of West Harlem's North River Wastewater Resource Recovery Facility Will Reduce Greenhouse Gas Emissions by Nearly 50 Percent*
https://www.nyc.gov/html/dep/html/press_releases/18-112pr.shtml

(DAM) prices for electricity can be significantly less than the cost to generate CHP power using firm gas. The ability to cost effectively generate power is based on the cost of purchased power and the value of waste heat. There is also a benefit of greater efficiency when the CHP generates at full capacity.

A benefit of exporting power to the building is the reduction in the independent combustion of natural gas to satisfy space heating, central air-conditioning, and domestic hot water needs. Yet, if the value of additional waste heat and the price received for exported power are less than the cost to generate power, generation for power export would not be feasible. Such a situation would stifle opportunities to help monetize the actual value of power export to both the grid and society. In this request for exemption, breaking even for costs and benefits would be appropriate for demonstration purposes.

Because 301 West 45th Street is a residential building, there will be the potential for surplus power during working hours. The building is located in a Midtown Manhattan commercial district, so the Con Edison call window for its demand response program, the Commercial System Relief Program (CSRP), is 2 PM to 6 PM. The building is located within Con Edison's Columbus Circle network, in which the call window reflects commercial demand peaks and when the Demand Reduction Value of VDER is most lucrative. Even as electric demand in the building is low, the need for central air-conditioning can be extensive. Hence, the electric need in the grid and the thermal need in the building create a synergy of opportunity, as both would be achieved by CHP power export.

The opportunity to monetize the actual value of power export beyond the 10-kW cap serves to motivate rather than stifle innovation. The trend throughout the nation is to facilitate the intertwining of electricity consumers and the grid. Historically, the enactment of Real-Time Pricing rate structures, Demand Response Programs, and Net Metering have served to strengthen grid reliability and provide additional incentives for consumers to participate in the programs. This project helps to extend this trend.

The ability to monetize the export of grid power for 301 West 45th Street benefits the grid with less polluting and more reliable power, and aids the building with more waste heat to defray the separate combustion of natural gas and protect against blackouts.[4] This would help address blackouts, such as the extensive one on July 13, 2019, which is described in Appendix D. The power export also promotes

[4] The evening of July 13, 2019, a blackout in midtown Manhattan impacted 73,000 Con Edison customers, including residents of The Camelot. It began at 7PM, shutting down Broadway theaters and Jennifer Lopez's concert in Madison Square Garden.

environmental justice, given that any time that cleaner power is added to the grid, the generation of "peaker" power is reduced. This practice at 301 West 45th Street allows the PSC to recognize the overall benefits of CHP in a residential setting that will have surplus power when valuable supply capacity is strained during summer afternoon peaks.

Prospects for the Future

Should a technical and institutional infrastructure be in place at 301 West 45th Street, additional advances could be implemented as they emerge. Linking CHP with battery storage, for example, could permit more power to be exported when the grid is strained.

It is an obvious inconsistency of VDER to cap CHP at 10 kW, which operates at efficiencies of 60% to 90% when a battery storing 30% grid efficiency is capped at 5 megawatts. Export of battery power is further compromised since the "round trip" efficiency between electricity discharged is 85-90% of the electricity charged, further minimizing efficiency.

This project can provide measurable documentation to New York State regarding the advantages of CHP in the city's strained and GHG-emitting grid. The concepts established by the US DOE's Grid-interactive Efficient Buildings further combine buildings with the grid to increase reliability and reduce emissions. Two-way communications with the grid to determine how loads are impacted by weather conditions and how buildings can automatically or predictably react would be advanced by CHP export.

CHP grid interactivity assures greater reliability of power export as it is not intermittent; it can also operate continually as opposed to batteries that are time-limited, usually to four hours. 301 West 45th Street offers a unique robust project in midtown Manhattan that can push the envelope to exemplify how the building and the grid can operate to their mutual advantage. It will also identify when more efficient and cleaner power is economically feasible for export and, of course, when it is not. The exemption will motivate the project to develop, explore and test emerging innovative solutions. CHP pairs well, for example, with renewables and batteries to sustain power reliability and represent future emission-reducing opportunities when hydrogen emerges as a viable fuel source and carbon capture traps emissions.

Finally, if the PSC approves the petition, it will permit other cogeneration systems that are much larger than this 160-kW system and could inject far more power into the grid, to prospectively do so on a case-by-case basis.

APPENDIX A: US EPA on CHP Technology and Benefits

Two online excerpts from the US EPA website are included in Appendix A: a general description of CHP technology from the Combined Heat and Power Partnership and an analysis of benefits of CHP.

EPA CHP Partnership Description of CHP Technology[5]

What Is CHP?

Combined Heat and Power: Frequently Asked Questions

CHP is a technology that produces electricity and thermal energy at high efficiencies using a range of technologies and fuels. With on-site power production, losses are minimized and heat that would otherwise be wasted is applied to facility loads in the form of process heating, steam, hot water, or even chilled water. CHP can be located at an individual facility or building or it can be a district energy, microgrid, and/or utility resource that provides power and thermal energy to multiple end-users. CHP equipment can provide resilient power 24/7 in the event of grid outages, and it can be paired with other distributed energy technologies like solar photovoltaics (PV) and energy storage.

During conventional separate power and heat generation, nearly two-thirds of energy is wasted (pdf)—discharged to the atmosphere as heat during generation, transmission, and distribution. By capturing and using heat that would otherwise be wasted and by avoiding distribution losses, CHP can achieve efficiencies of over 80 percent, compared to 50 percent for typical technologies (e.g., conventional electricity generation and an on-site boiler). Because of this increased efficiency, CHP systems can emit less carbon emissions than separate heat and grid power.

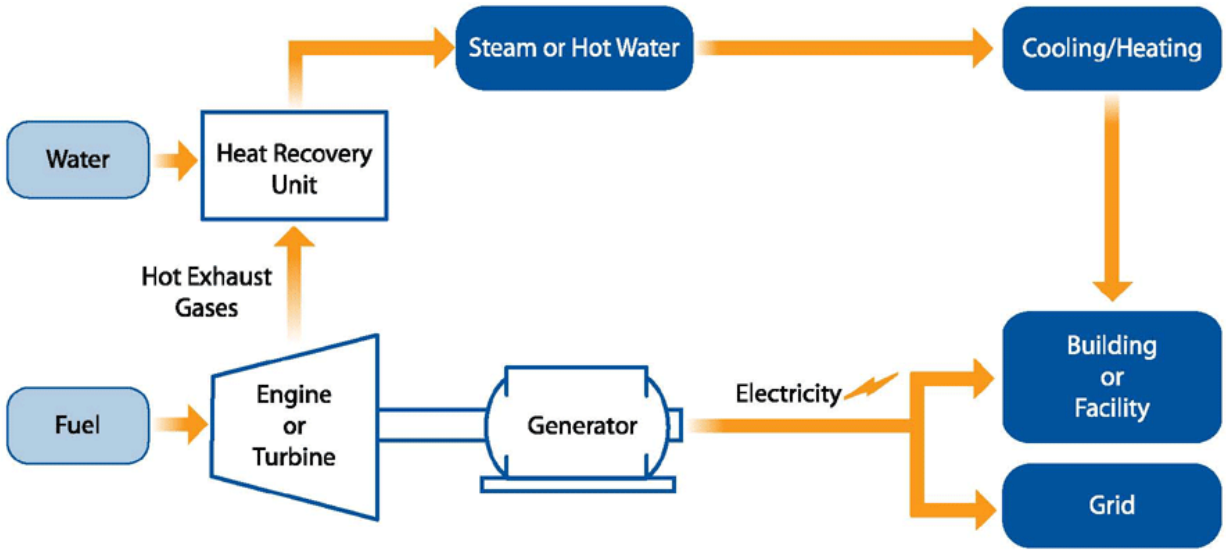
Common CHP Configurations

The two most common CHP system configurations are:

- Combustion turbine, or reciprocating engine, with heat recovery unit
- Steam boiler with steam turbine

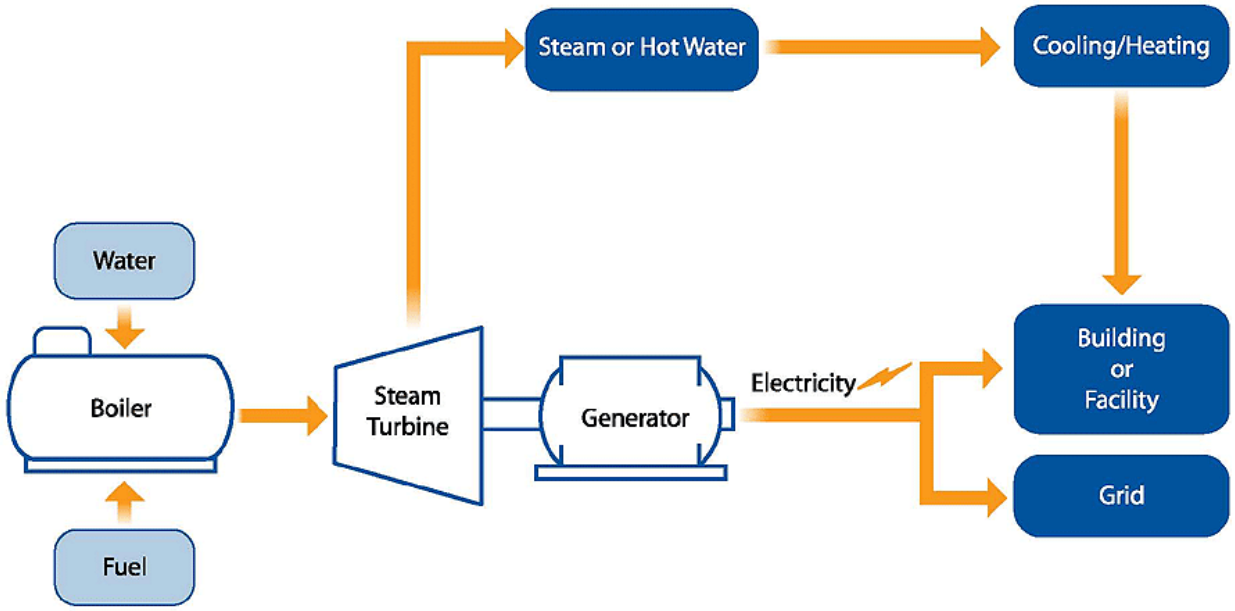
[5] https://www.epa.gov/chp/what-chp, accessed March 20, 2024.

Combustion Turbine, or Reciprocating Engine, with Heat Recovery Unit



Combustion turbine or reciprocating engine CHP systems burn fuel (natural gas, oil, or biogas) to turn generators to produce electricity and use heat recovery devices to capture the heat from the turbine or engine. This heat is converted into useful thermal energy, usually in the form of steam or hot water.

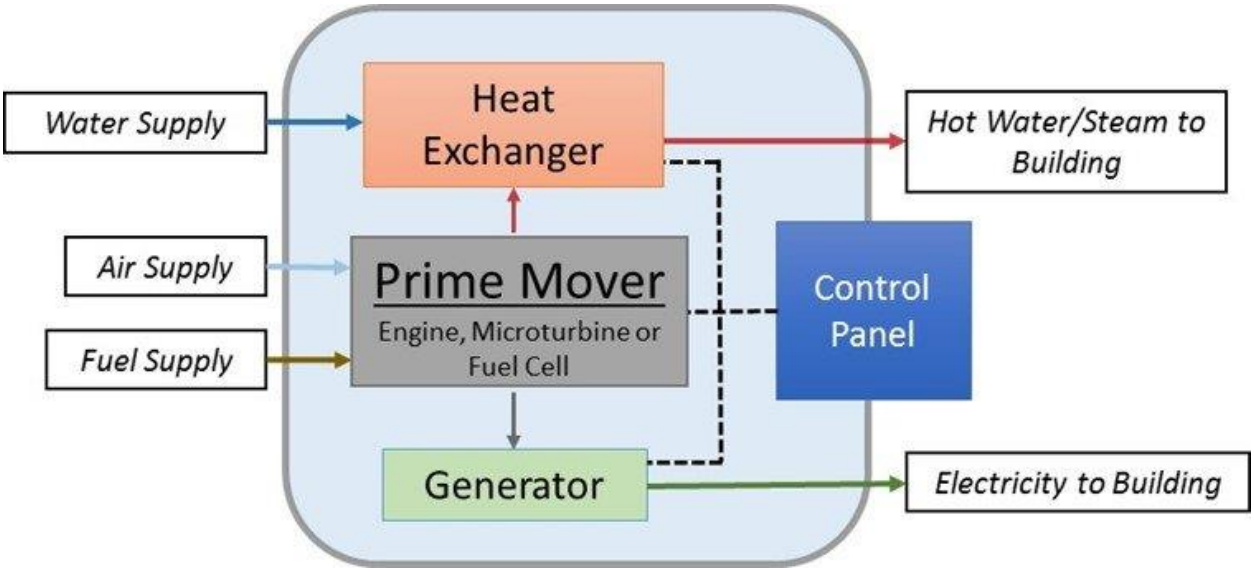
Steam Boiler with Steam Turbine



With steam turbines, the process begins by producing steam in a boiler. The steam is then used to turn a turbine to run a generator to produce electricity. The steam leaving the turbine can be used to produce useful thermal energy. These systems can use a variety of fuels, such as natural gas, oil, biomass, and coal.

Packaged CHP Systems

Increasingly, "packaged" CHP systems—standardized, factory-built, ready-to-install CHP systems—are also available. These systems can make CHP procurement and installation simpler and quicker.



Packaged systems include a prime mover (i.e., reciprocating engine, microturbine, or fuel cell), a generator, heat recovery equipment, electrical switchgear, emissions control devices, and controls, sometimes packaged in a weather-resistant sound-attenuating enclosure. These systems can be installed as single units or combined to form larger systems. Product offerings for packaged systems have been focused on relatively small (≤ 500 kW) sizes.

CHP Applications

CHP is an energy technology that has been used for more than 100 years at a wide variety of facility types, resulting in economic, environmental, and reliability/resiliency benefits [see below]. Because CHP produces both electricity and thermal energy, it is best suited for facilities that have year-round coincident power and thermal loads. The types of facilities where CHP is used successfully and where additional potential exists include:

- **Commercial buildings**—office buildings, hotels, nursing homes, retail
- **Residential**—multifamily buildings, co-ops, planned communities
- **Institutions**—colleges and universities, hospitals, prisons, military bases
- **Municipal**—district energy systems, wastewater treatment facilities, K–12 schools
- **Industrial**—chemicals, agriculture, ethanol, pulp and paper, food processing

PSC Analysis of CHP Benefits[6]

CHP offers a number of benefits compared to conventional electricity and thermal energy production, including:

Efficiency Benefits

Calculating Efficiency

Efficiency can be calculated in several ways, but the efficiency numbers that EPA cites are "total system efficiency": the total electricity and useful thermal energy output of the system divided by the fuel used to produce the electricity and useful thermal energy.

CHP needs less fuel to produce a given energy output and avoids transmission and distribution losses that occur when electricity travels over power lines.

The average efficiency of fossil-fueled power plants in the United States is 36 percent. This means that 64 percent of the energy used to produce electricity at most power plants in the United States is wasted in the form of heat discharged to the atmosphere.

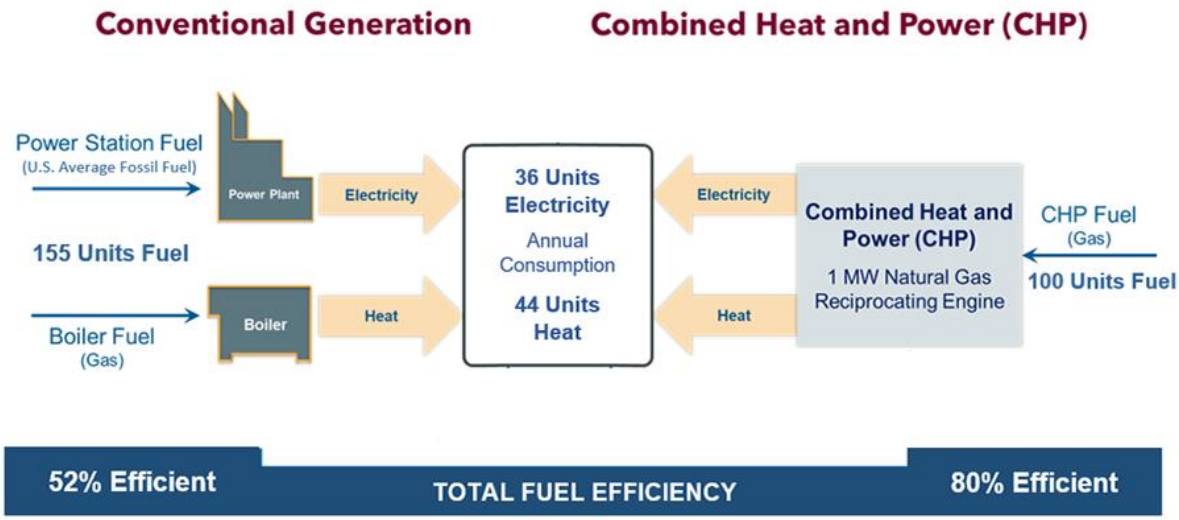
Most facilities produce heat with natural gas boilers, which are generally 75–85 percent efficient at converting fuel to thermal energy. Overall, separate heat and grid power is 50–55 percent fuel-efficient.

By recovering and using heat from on-site electricity production, CHP systems typically achieve total system efficiencies of 65 to 80 percent. Some systems achieve efficiencies approaching 90 percent.

The illustration below demonstrates the efficiency gains of a 1 MW natural-gas-fired reciprocating engine CHP system compared to conventional production of electricity and useful thermal energy (i.e., purchased grid electricity and thermal energy from an on-site boiler).

[6] https://www.epa.gov/chp/chp-benefits, accessed March 20, 2024.

Conventional Generation vs. CHP: Overall Efficiency



This is an example of a typical CHP system. To produce 80 units of electricity and useful thermal energy, the conventional system uses 155 units of energy inputs—an overall efficiency of 52 percent. However, the CHP system needs only 100 units of energy inputs to produce the 80 units of electricity and useful thermal energy, resulting in a total system efficiency of 80 percent.

A CHP system's efficiency depends on the technology used and the system design. The five most commonly installed CHP power sources (known as "prime movers") offer these efficiencies:

- Reciprocating engine: 75–80 percent
- Combustion turbine: 65–70 percent
- Steam turbine: 80 percent
- Microturbine: 60–70 percent
- Fuel cell: 55–80 percent

Avoided Transmission and Distribution Losses

By producing electricity on-site, CHP also avoids transmission and distribution losses that occur when electricity travels over power lines. Within the five major power grids in the United States, average transmission and distribution losses vary from 5.2 percent to 5.6 percent on average, with a national average of 5.3 percent (Source: eGRID). Losses can be even higher when the grid is strained and temperatures are high. By avoiding losses associated with conventional electricity supply, CHP

further reduces fuel use, helps avoid the need for new transmission and distribution infrastructure, and eases grid congestion when demand for electricity is high.

Environmental Benefits

CHP Environmental Benefits Tools and Resources

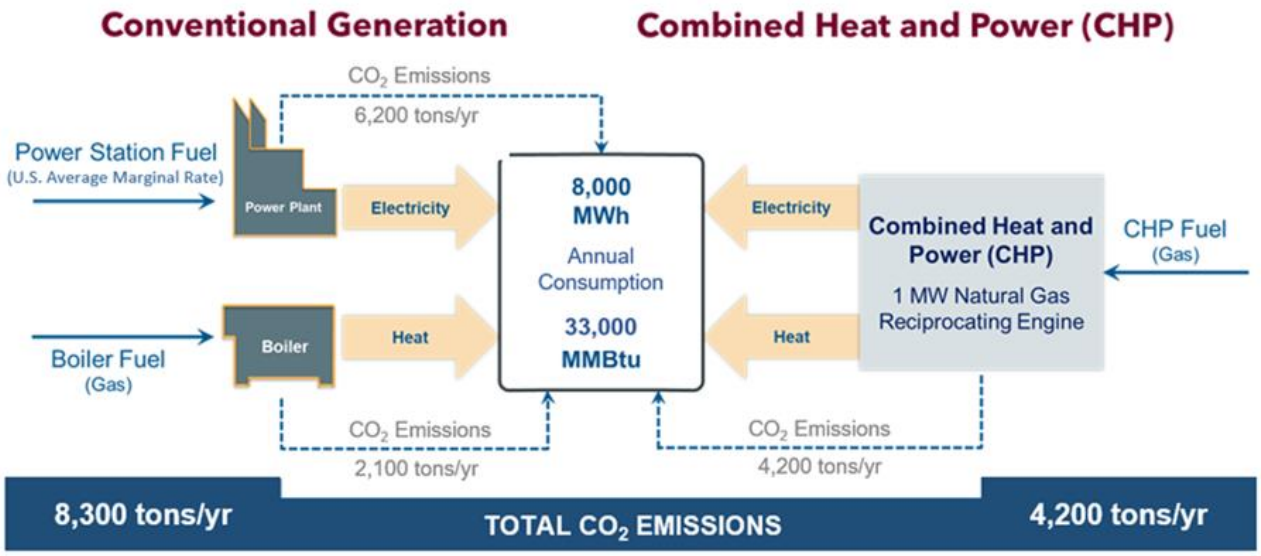
Because less fuel is burned to produce each unit of energy output and because transmission and distribution losses are avoided, CHP reduces emissions of GHGs and other air pollutants. This means it can play an important role in decarbonizing energy production.

CHP systems offer considerable environmental benefits over purchased electricity and thermal energy produced on-site. Because they capture and use heat that would otherwise be wasted from the production of electricity, they need less fuel to produce the same amount of energy.

Because less fuel is combusted, GHG emissions, such as carbon dioxide (CO_2), as well as other air pollutants like nitrogen oxides (NO_x) and sulfur dioxide (SO_2), are reduced.

The following diagram shows the magnitude of reduced CO_2 emissions of a 5 MW natural-gas-fired CHP system compared to the same energy output from conventional sources.

Conventional Generation vs. CHP: CO_2 Emissions



This diagram illustrates the CO2 emissions output from electricity and useful thermal energy generation for two systems: (1) a fossil-fuel-fired power plant and a natural gas-fired boiler and (2) a 1

MW reciprocating engine CHP system powered by natural gas. The separate heat and power system emits a total of 8,300 tons of CO2 per year (2,100 kilotons from the boiler and 6,200 kilotons from the power plant), while the CHP system, with its higher efficiency, emits 4,200 tons of CO2 per year.

Economic Benefits

Analyzing Economic Feasibility

The economic benefits of any CHP project are dependent on electricity rates, system design, equipment cost and CHP operating practices. The value of the benefits will depend on the needs and goals of the investor. A feasibility analysis is conducted to determine the technical and economic viability of a project.

CHP can offer a variety of economic benefits, including:

- **Reduced energy costs:** CHP reduces energy bills because of its high efficiency. By using waste heat recovery technology to capture wasted heat associated with electricity production, CHP systems typically achieve total system efficiencies of 60 to 80 percent, compared to 50 percent for conventional technologies (i.e., purchased utility electricity and an on-site boiler). Basically, they need less fuel for a given unit of energy output. Also, because they typically use natural gas—which is often cheaper than purchased electricity—they can help reduce electricity bills. Bills are further reduced because the CHP output reduces electricity purchases.
- **Avoided capital costs:** CHP can often reduce the cost of replacing heating equipment. Buildings can also be connected to a CHP-based district energy system that provides district heating (steam or hot water) and district cooling services (chilled water) for space heating, domestic hot water, and air conditioning. Such services avoid on-site equipment and save valuable building and rooftop space for other revenue-generating uses.
- **Protection of revenue streams:** Through on-site generation and improved reliability, CHP can allow facilities to continue operating in the event of a disaster or an interruption of grid-supplied electricity.
- **Less exposure to electricity rate increases:** Because less electricity is purchased from the grid, facilities have less exposure to rate increases. In addition, a CHP system can be configured to operate on a variety of fuel types, such as natural gas, biogas, coal, and

biomass; therefore, a facility could build in fuel switching capabilities to hedge against high fuel prices.

Reliability and Resiliency Benefits

A reliable energy supply means that electricity is available to facilities when it is needed and without interruption. A resilient facility is one that can anticipate, prepare for, respond to, and recover from energy outages caused by storms or other adverse events. Unreliable electricity service represents a quantifiable business, safety, and health risk for some companies and organizations. CHP is an on-site generation resource and can be designed to operate independently from the electric grid to enhance facility reliability. In addition to enhancing reliability, CHP systems can be designed to continue operating in the event of a disaster or grid disruption to provide power for critical functions, thereby enhancing facility resiliency.

APPENDIX B: Gotham 360 Innovative Energy Solutions, Nov. 2, 2020

The Push to Replace Peakers: The Drive to Sustainably Meet New York City's Power Demand[7]

Peaker plants are power plants which produce electricity at peak times, when the demand for power is greatest. Such times include the summer, as heat waves hit and air conditioner use increases. The need for power during these times is especially acute in large cities such as NYC.

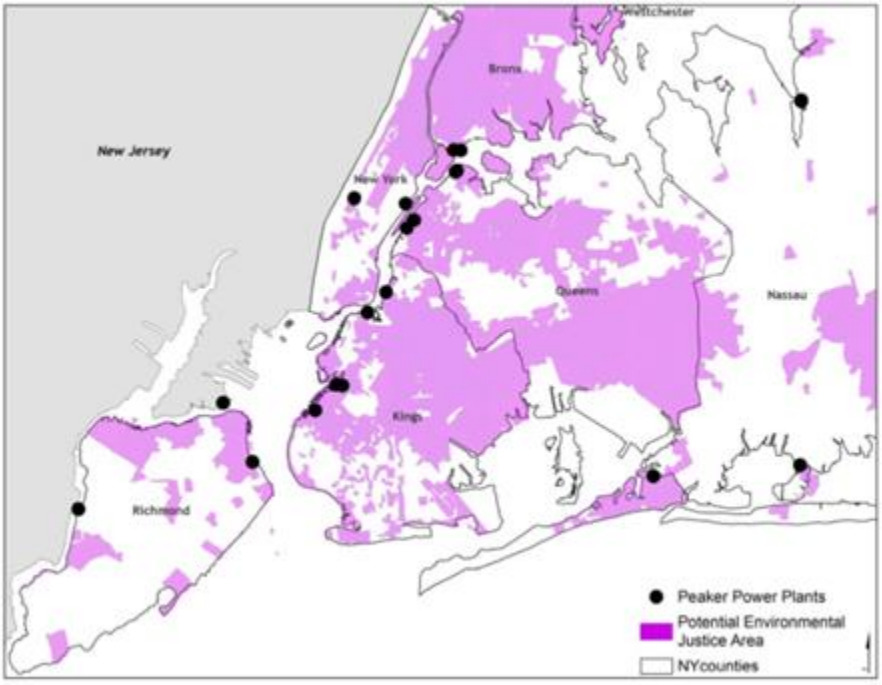
There are 16 peaker power plants currently operating in NYC, each running for approximately 90-500 hours annually. Peakers have shown to be a necessary part of NYC infrastructure, meeting the increasing demand for power and preventing widespread blackouts in the city.

However, the utility of peakers is offset by the cost – monetary and otherwise – of their use. In the past decade alone, peaker plants have cost NYC electric bill payers $4.5 billion. Other important considerations include the environmental and health effects of peaker plant use. Peakers run on fossil fuels, and many are not equipped with modern pollution control equipment. They emit more pollutants relative to the amount of electricity they generate than baseload power. These emissions yield perilous environmental effects, including acid rain and smog. In 2018, NYC peakers emitted 1,837,365 tons of carbon dioxide, 1,685 tons of nitrogen oxides, and 194 tons of sulfur oxides. To provide some perspective, the total emissions across the electric power industry in New York state in 2018 were approximately 27,936,000 metric tons of carbon dioxide, 29,000 metric tons of nitrogen oxide, and 11,000 metric tons of sulfur dioxide. Considering that peaker plants operate for just a few hours every year, the extent to which they contribute to the total amount of emissions in the state is substantial.

[7] https://www.gotham360.com, November 2, 2020.

The harmful effects of peaker plant emissions are felt most harshly by people living in areas surrounding the plants, which are generally low-income communities and communities of color. The map below depicts the intersection between peaker plant locations and environmental justice communities. This is evidenced by the prevalence of respiratory illnesses such as asthma in such areas. Additionally, research shows that the pollutants are linked to increases in the risk of developing illness or severe infection due to COVID-19.

EXHIBIT 9-5 LOCATION OF PEAKER POWER PLANTS AND POTENTIAL ENVIRONMENTAL JUSTICE AREAS IN THE GREATER NEW YORK CITY AREA.



Map overlaying peaker plant locations on potential environmental justice areas from NRDC. Also referenced in this report from Strategen.

The dire consequences for the continued usage of peaker plants have driven efforts to find alternative means of meeting the demand for energy in large cities. Environmentalists promote the utilization of renewable energy sources instead of the currently used fossil fuels as a means of producing the needed energy. Such a switch would improve air quality, and thus the health of individuals in communities currently impacted by peaker plant emissions. The transition from fossil fuels to renewable energy sources would also work towards attaining the New York State Climate Leadership and Communities Protection Act (CLCPA) goal of carbon free electricity by 2040.

One primary advocate for the adoption of new methods to meet NYC's peak energy needs is the New York City PEAK Coalition – a collaboration between the NYC Environmental Justice Alliance, New York Lawyers for the Public Interest, THE POINT CDC, UPROSE, and Clean Energy Group. Their 2020 report outlines the downfalls of NYC peaker plants and urges the adoption of a renewable alternative: solar photovoltaic energy cells and energy storage facilities. This solution is widely endorsed by numerous environmental proponents. Similar projects are being pursued elsewhere, including the Oakland Power Plant in California. Concerns arise regarding the use of solar power alone due to the fact that it is a variable energy source and cannot always be used to produce power. Energy can only be collected by solar cells while the sun shines, meaning that solar energy cannot be collected for use at night or during times when there is little sunlight. The use of batteries solves this problem, as energy can be harnessed when sunlight is abundant, with the excess stored in batteries for use when sunlight is scarce. The decreasing cost of energy storage systems makes the proposed alternative to peaker plants increasingly viable. When used in conjunction with battery storage, renewable energy sources could meet peak demand in NYC, and could even provide backup power when storms disrupt the grid. Energy storage alternatives are already being undertaken by many companies that own peaker plants, though they assert that energy storage technology is incapable of operating long enough to meet NYC's energy needs.

Implementing renewable energy solutions to meet the peak power demand will require the development of new policies, as well as the allotment of funds to carry out the projects. Provisions must be made to incentivize the use of renewable energy sources and deter that of fossil fuels. This need is reflected in recent measures taken within New York. Legislations like the CLCPA have made renewable energy sources an attractive alternative to fossil fuels by mandating that the law be contrived in a manner that relieves the burden of environmental issues on low income communities and communities of color. Additionally, New York has dedicated hundreds of millions of dollars into accelerating energy storage programs. Yet, further work needs to be done to support the use of renewables over fossil fuels. For example, imposing limits on peaker plant emissions could encourage peakers to use renewables in conjunction with their current means of power generation. Altering current regulations to allow renewable energy sources to be compensated as capacity resources would give clean energy sources an economic edge over fossil fuels. Without such initiatives, renewable energy and battery storage will continue to be at a disadvantage in the capacity market.

Many of the advocates for the new initiatives also insist that the renewable energy and storage facilities be publicly owned. All NYC peakers are owned by private firms, some of which are out-of-state. The money currently paid to such firms for the operation of fossil fuel peaker plants could instead be invested in publicly and community owned renewable energy and energy storage facilities. This would help fund local communities and meet the needs of NYC residents. Such undertakings would be a form of intersectional environmentalism which enables members of low income and Black, Indigenous, and People of Color (BIPOC) communities to take an active role in advocating for environmental causes while securing their own health and success.

Renewable energy and energy storage efforts have the potential to meet NYC's energy needs, including during peak times and in the aftermath of storms. While the decreasing cost of energy storage has advanced the adoption of such projects, more work needs to be done to improve the technology and increase the capacity and safety of batteries. Nevertheless, several arguments favor the adoption of renewable energy and energy storage as a means of powering NYC, including compliance with energy efficiency laws, benefit to public health, and supporting the development of NYC communities.

APPENDIX C: NYC DEP Press Release, Dec. 20, 2018

FOR IMMEDIATE RELEASE 18-112[8]

December 20, 2018

DEP: deppressoffice@dep.nyc.gov; (718) 595-6600

$300 Million Upgrade of West Harlem's North River Wastewater Resource Recovery Facility Will Reduce Greenhouse Gas Emissions by Nearly 50 Percent

Installation of Five Cleaner-Burning Co-Generation Engines Will Significantly Reduce Greenhouse Gas Emissions; Comparable to Taking 5,500 Vehicles off the Road or Planting Nearly 700,000 Trees

The New York City Department of Environmental Protection (DEP) today announced that work is underway on a $300 million project to install new, cleaner-burning co-generation engines at the North River Wastewater Resource Recovery Facility in west Harlem. Once that work is completed in 2022, there will be a nearly 50 percent reduction in greenhouse gas emissions. This is comparable to the air quality benefits achieved by removing 5,500 vehicles from the road or planting nearly 700,000 trees. By replacing the 10 existing engines that rely on traditional fuel oil with engines that primarily use green energy, the project will help contribute towards the City's 80 x 50 goal. In addition, over 6,500 lighting fixtures at the facility have been upgraded with energy-saving LED capability, and resiliency measures, such as floodgates and barriers, will be installed to help protect critical equipment from future storm surges and help to ensure uninterrupted service. Contrary to a stated plan, DEP will also continue a robust air monitoring program both inside and outside of the facility.

"This is another step towards achieving our city's 80 x 50 goal of reducing greenhouse gas emissions and building a fairer city for all," said **Mayor de Blasio**. "Communities across the city, as well as the environment, will benefit from more resilient and sustainable wastewater processing facilities."

"This $300 million investment in west Harlem will not only ensure that we continue to protect the health of the Hudson River, it increases the sustainability of our essential operations and improves the quality of the air we all share," said **DEP Commissioner Vincent Sapienza**. "As we continue to transition our wastewater treatment plants into resource recovery facilities, we anticipate delivering additional benefits for the environment and our neighbors and customers."

[8] https://www.nyc.gov/html/dep/html/press_releases/18-112pr.shtml, December 20, 2018.

“New York City needs bold investments that reduce carbon emissions and improve local air quality,” said **Mark Chambers, Director of the Mayor’s Office of Sustainability**. “These upgrades will minimize this facility’s carbon footprint while bolstering it against the worsening impacts of climate change.”

“At a time when Washington is turning its back on climate change, the City of New York is investing in a low-carbon future,” said **Lisette Camilo, Commissioner of the Department of Citywide Administrative Services**. “The upgrades announced today will reduce greenhouse gas emissions by nearly 50 percent and builds upon the City’s other successful investments in energy efficiency.”

“Poor air quality and extreme weather events due to climate change have the greatest impacts in New York City’ s poorest communities, exacerbating health inequities,” said **Health Commissioner Dr. Oxiris Barbot**. “Bold infrastructure improvements, like those underway at North River, will provide lasting benefits to the health of all New Yorkers.”

“Cities across the country must take bold action to reduce greenhouse gas emissions, improve air quality, and protect against storm surges,” said **Manhattan Borough President Gale Brewer**. “Investments like this one put us on track to reduce our climate footprint. On behalf of the hundreds of thousands of West Side residents these new co-generation engines will serve, I applaud the Department of Environmental Protection for taking action.”

“As our city continues to boldly address climate change, setting an example for cities across the country, investing in critical infrastructure upgrades is vital to meeting our ambitious climate and environmental justice goals,” said **Council Member Mark Levine**. “Cutting emissions by 50 percent over the next four years at the North River Wastewater Resource Recovery Facility will significantly reduce our carbon footprint while improving air quality in our neighborhoods. I’m grateful to Commissioner Sapienza for his commitment to investing in this much-needed upgrade project, and look forward to working with him anc the community to improve air quality in northern Manhattan and across the city.”

“New York City needs to lead by example in the fight against climate change, which means significantly reducing the carbon footprint of facilities it operates,” said **Council Member Costa Constantinides, Chair of the Committee on Environmental Protection**. “I am encouraged to see this work get underway and look forward to working with DEP and other agencies on incorporating cleaner, renewable energy in more New York City facilities.”

Julie Tighe, President of the New York League of Conservation Voters, said, "This North River Wastewater Resource Recovery Facility upgrade project that will cut emissions 50 percent by 2022 is a key step towards the city meeting its ambitious climate and environmental justice goals. The cleaner-burning co-generation engines and storm surge floodgates will improve air quality, enhance resiliency, and reduce the City's carbon footprint in a neighborhood that has borne the brunt of pollution. We commend Commissioner Sapienza for leading the way with this much-needed upgrade project. We look forward to working with stakeholders to ensure the air quality in the area continues to be monitored once construction is complete and that this project achieves the strongest possible air quality improvements."

"As New York City transitions to a cleaner, more sustainable energy future, this effort by the Department of Environmental Protection to reduce local air pollution can significantly improve the health and well-being of New Yorkers, while limiting our dependence on fossil fuels for years to come," said **Rory Christian, Director, New York Clean Energy at Environmental Defense Fund**.

"New York City's investment in a shifting to greener technologies at the North River Wastewater Resource Recovery Facility will reduce greenhouse gas emissions by nearly 50 percent will improve the air quality for all New Yorkers, particularly those of us who live in Northern Manhattan," said **Peggy Shepard, Co-Founder and Executive Director of WE ACT for Environmental Justice**. "And even with this significant upgrade, which notably includes energy efficiency and climate resiliency measures, the New York City Department of Environmental Protection will continue to monitor emissions from the facility to safeguard the air quality in adjacent communities."

New Yorkers produce approximately 1.3 billion gallons of wastewater every day of the year. The wastewater travels through the City' s 7,500-mile sewer system to one of 14 wastewater resource recovery facilities located across the five boroughs, where a tremendous amount of energy is required to properly treat the wastewater in order to protect public health and local waterways.

At the North River Wastewater Resource Recovery Facility (WRRF), the existing large engines burn a combination of traditional fuel oil, natural gas and recovered green energy, or digester gas, which is a byproduct of the wastewater treatment process. The engines power the primary energy consumers at the facility, the main sewage pumps and process air blowers. Those 10 engines are being replaced with five new dual-fuel cogeneration engines that primarily use digester gas, supplemented by natural gas, thus eliminating the use of traditional fuel oil at the facility.

The new cogeneration system will maximize the use of digester gas to produce up to 12 megawatts of electricity and will have the ability to take the facility off the electrical grid to ease pressure during times of high demand. The new system is expected to reduce greenhouse gas emissions by 26,000 metric tons of carbon dioxide equivalent per year, which is comparable to taking more than 5,500 cars off the road or planting nearly 700,000 trees. The City's Department of Citywide Administrative Services (DCAS) contributed funding towards the new cogeneration system. Additional supporting work includes the installation of electric motors for the main sewage pumps, replacement of the five engine driven process air blowers with nine energy efficient high-speed turbo blowers, an upgraded HVAC system, upgrades to the in-plant electrical power distribution system and an on-site electric substation to increase reliability of power distribution to Denny Farrell Riverbank State Park. In addition, the project includes upgrades to the existing fire alarm, sprinkler, and standpipe systems. The work, which is being staggered in order to ensure uninterrupted service, represents the first major upgrade to the North River facility since it went into operation in 1986.

DEP is also completing a multi-million dollar project to upgrade over 6,500 lights at the North River facility to be compatible with LED fixtures. This work reduces greenhouse gas emissions associated with the operation of the facility by over 1,000 metric tons of carbon dioxide equivalent annually, which is comparable to removing over 230 vehicles from the road or planting nearly 29,000 trees. In addition, the upgrade reduces annual operating costs by more than $300,000. DCAS also contributed funding towards the LED upgrade.

The North River WRRF experienced significant flooding during Hurricane Sandy and this project will include resiliency upgrades to harden the plant against a changing climate and future storms. This includes raising facility openings to the Hudson River and installing floodgates and barriers to protect critical equipment. This work is a part of the NYC Wastewater Resiliency Plan that calls for more than $300 million in capital protective measures for the City's wastewater pumping stations and WRRF to harden them against future storms, reduce damage and enable rapid recovery back to full service in the event of a flooding event.

The North River WRRF is built on a 28-acre reinforced concrete platform over the Hudson River and went into operation in 1986. It rests on 2,300 caissons pinned into bedrock up to 230 feet beneath the river. The roof of the building is the home of Denny Farrell Riverbank State Park, a popular recreational facility with three swimming pools, an amphitheater, an athletic center, a skating rink, a restaurant, and sports fields.

The plant provides wastewater treatment for the hundreds of thousands of people who live and work in, or visit, the west side of Manhattan, from Bank Street in Greenwich Village to Inwood Hill at the island's northern tip.

DEP manages New York City's water supply, providing approximately 1 billion gallons of high quality drinking water each day to more than 9 million residents, including 8.5 million in New York City. The water is delivered from a watershed that extends more than 125 miles from the city, comprising 19 reservoirs and three controlled lakes. Approximately 7,000 miles of water mains, tunnels and aqueducts bring water to homes and businesses throughout the five boroughs, and 7,500 miles of sewer lines and 96 pump stations take wastewater to 14 in-city treatment plants. DEP has nearly 6,000 employees, including almost 1,000 in the upstate watershed. In addition, DEP has a robust capital program, with a planned $19.4 billion in investments over the next 10 years that will create up to 3,000 construction-related jobs per year. For more information, visit nyc.gov/dep, like us on Facebook, or follow us on Twitter.

DCAS is responsible for purchasing all the energy required to run New York City's government, and for managing its energy use. Through managing the City's energy portfolio, DCAS is at the heart of New York City's efforts to reduce its carbon footprint 80 percent by 2050 and to eventually convert 100 percent of its energy use for government operations to renewable electricity. DCAS provided funding for both of these projects to help the City meet these ambitious goals.

APPENDIX D: Wikipedia on Manhattan 2019 Blackout

Manhattan blackout of July 2019[9]

The West Side of Manhattan in New York City experienced a power failure on July 13, 2019, at approximately 7 p.m. EDT. Con Edison is the energy utility serving the area, and they reported that approximately 73,000 customers were without power. Power was fully restored by midnight. The power failure occurred on the 42nd anniversary of the New York City blackout of 1977, which left nine million customers without power.[1][2][3]

Effects

The power outage commenced around 6:47 p.m. EDT, leaving 73,000 customers in Manhattan's West Side without power for about three hours. It affected six power sectors and encompassed an approximately 30-block area in Midtown Manhattan and the Upper West Side, from Times Square to 72nd Street, and from Fifth Avenue to the Hudson River.[1][4]

The Metropolitan Transportation Authority (MTA) reported that the entire New York City Subway system was affected by the outage.[1] Some subway complexes were without lights, and service was affected on several routes.[5] The MTA closed four Manhattan subway stations: 59th Street–Columbus Circle, Fifth Avenue/53rd Street, 34th Street–Hudson Yards, and 47th–50th Streets–Rockefeller Center.[6] All of the subway's numbered routes suffered extensive delays.[7] Limited service was available on the IRT Broadway–Seventh Avenue Line (1, 2, and 3 trains) on Manhattan's west side; the IRT Lexington Avenue Line (4, 5, and 6 trains) on Manhattan's east side; and on the IRT Flushing

[9] https://en.wikipedia.org/wiki/Manhattan_blackout_of_July_2019, accessed March 20, 2024.

Line (7 train) from Manhattan to Queens.[1][8] The MTA advised passengers to take buses instead in Manhattan.[9]

Areas affected by the outage included Times Square, Rockefeller Center, Radio City Music Hall, and Broadway theatres.[1][4][8] Most theaters on Broadway cancelled their shows for the evening; of the 30 shows running at the time, only the four playing on the east side of Broadway were able to perform.[10] Performances at Carnegie Hall and Lincoln Center were also cancelled. However, some performers from the canceled shows entertained audiences on the sidewalks outside the theaters. The blackout also canceled a Jennifer Lopez concert at Madison Square Garden.[1][10]

Firefighters worked to free numerous people trapped in elevators; about 750 of the 1,000 calls which the FDNY responded to were from those seeking assistance regarding elevators or fire alarms.[11][12] Drivers were stuck in a traffic jam on the West Side Highway when the streetlights went out.[7] According to New York City Department of Transportation, over 200 traffic lights stopped functioning.[3] Civilians and police officers helped to direct traffic. The roads were temporarily closed between 2nd Street and 71st Street between Fifth Avenue and the Hudson River in both directions.[7] Police directed traffic in some areas, while at other locations such as Hell's Kitchen, pedestrians took on the task.[4][11] New York Governor Andrew Cuomo brought in the New York National Guard to assist with traffic problems and safety issues.[13]

Causes

The outage was initially reported as being possibly due to a manhole explosion; the existence of the explosion was verified by New York State Assemblywoman Linda Rosenthal. The New York City Fire Department, the New York City Police Department, and the NYC Emergency Management agency were dispatched to 65th Street and West End Avenue in response to the incident.[8]

In the early stages of the incident, Con Edison attributed the outage to a mechanical failure that it felt could be resolved relatively quickly, but did not give an estimate on when power would be restored.[1] According to the New York City Fire Department, the blackout was caused by a transformer fire at West 64th Street and West End Avenue.[14][4][15]

However, Con Edison later said that the power failure originated at a substation on West 49th Street. Gov. Cuomo further specified that an explosion and resulting fire at the substation caused damage to other substations. New York Mayor Bill de Blasio initially said via Twitter that a "manhole fire" was the

cause, though he later stated that the outage was due to a transformer fire, and that no foul play was suspected.[5]

John McAvoy, Con Edison's chairman and CEO, said that although mechanical failure was likely the cause of the outage, a full investigation would be required for a definitive answer.[1] McAvoy further stated that "excessive load" due to summertime energy demand was not likely a contributing factor to the blackout.[5]

Restoration of service

At around 10:00 p.m. EDT, July 13, 2019, power was partially restored to Times Square and Hell's Kitchen.[16] By 10:30 p.m., five of the six electric networks were restored.[16] Shortly before midnight, power was fully restored to all six sectors.[1][16]

By 1:30 a.m. on July 14, 2019, multiple lanes between Fifth Avenue and the Hudson River were open.[17] By 2:00 a.m., subway lines through Midtown Manhattan, namely the IND Eighth Avenue Line (A, C, and E trains), IND Sixth Avenue Line (D, F, and M trains), and the IRT lines (1, 2, 3, 4, 5, 6 and 7 trains), had resumed service in both directions.[17]

Aftermath

No injuries or fatalities were reported during the outage.[13]

Governor Cuomo was critical of the power failure, calling it "unacceptable" due to the breadth of the outages, as well as in light of previous problems with power substations. He called for an investigation by New York's Department of Public Service to identify the cause of the outages, and to "prevent an incident of this magnitude from happening again".[1][5]

However, Cuomo praised the response of the city's population, saying via Twitter, "When things are at their worst, New Yorkers are at their best, and they were at their best tonight."[13]

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