New York State Peaker Power Plants

Energy Storage Replacement Opportunities

Across New York, 50 oil- and gas-fired peaker power plants and peaking units at larger plants help meet statewide peak electric demand. These include both combustion turbines designed to ramp quickly to meet peak demand, and aging steam turbines now used infrequently to meet peak needs. More than a third of New York's peaker plants burn primarily oil, and three-quarters are over 30 years old—resulting in numerous inefficient plants with high rates of greenhouse gas and criteria pollutant emissions for every unit of electricity generated. Some of these plants are in very urban areas: ten plants have more than a million people living within three miles. One-third of the plants are located in areas the state considers to be environmental justice communities, where vulnerable populations typically already experience high levels of health and environmental burdens. New York has set energy storage targets and recently designed peaker plant emission reduction targets, providing an opportunity to replace inefficient, high-emitting peaker plants in vulnerable communities throughout the state with energy storage and solar.

New York State Policy and Regulatory Environment

New York has enacted a suite of policy targets to support clean energy adoption and emission reductions that could facilitate replacement of peakers with solar, storage, demand response and other clean energy alternatives. Key targets include:

- **2023-2025:** Limits for emission rates of nitrogen oxides from peaker plants.
- **2025:** Deployment of 6 GW of distributed solar and 1,500 MW energy storage.
- **2030:** Deployment of 3,000 MW of energy storage; 70 percent of electricity to be sourced from renewable resources.

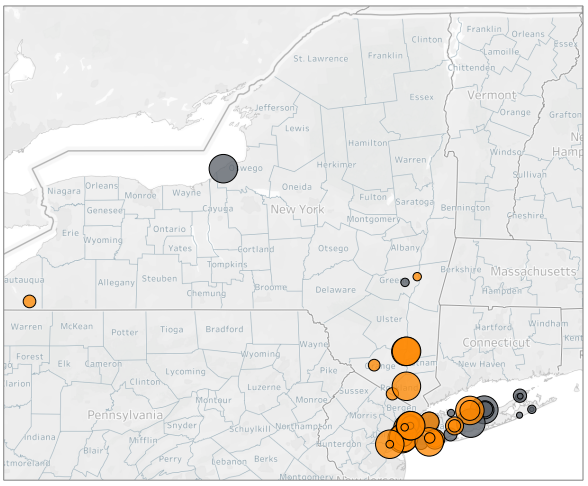

Figure 1: Peaker plants across New York

- **2040:** Carbon-neutral electricity.
- **2050:** Full carbon neutrality; greenhouse gas emission reductions 85 percent below 1990 levels.

Since 2014, New York has also been developing its Reforming the Energy Vision initiative to encourage distributed resources and increase grid resilience. The New York grid is operated by the New York Independent System operator, which identifies resource needs in load zones across the state. The downstate region, in particular New York City and Long Island, is import-constrained and requires local resources to meet the local load. Energy storage may be particularly valuable in this region to help alleviate peak demand as well as incorporate variable generation from distributed solar and offshore wind projects.

New York State Peaker Plants

Peak electricity demand in New York is partially met by 50 gas turbines, internal combustion engines, and underutilized aging steam plants, including both stand-alone units and units located at larger facilities. Features of these plants sug-

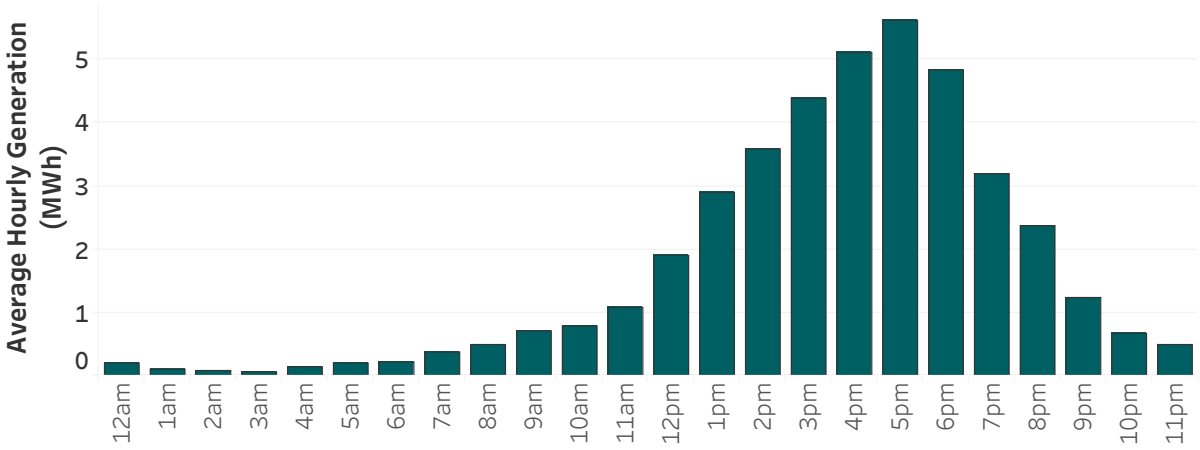

Figure 2: Average hourly generation from the Gowanus Gas Turbines facility. The plant typically meets peak afternoon loads, runs an average of 4.8 hours each start up, and has a capacity factor of 0.2 percent. Batteries can serve a similar grid role.

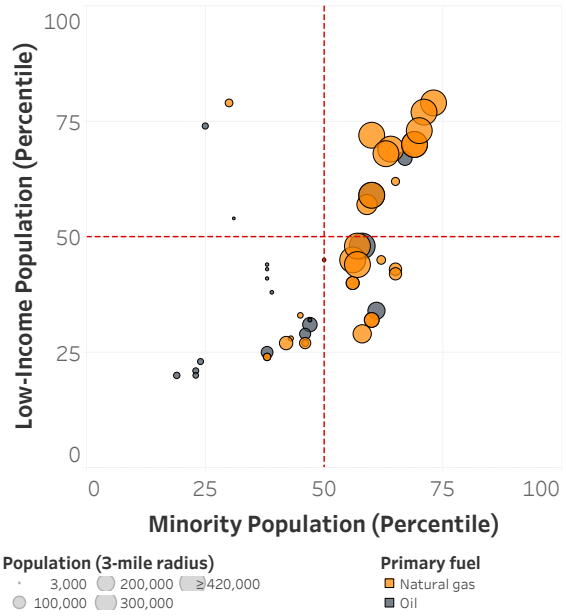

Figure 3: Demographic distribution of New York peaker plants. Bubbles reflect population size. Axes mark state percentiles for low-income (double federal poverty limit) and minority populations living within three miles of each facility.

gest that many would be good targets for replacement with energy storage, including:

- **Aging:** 39 (78 percent) are over 30 years old.
- **Inefficient:** 32 plants (64 percent), particularly the older ones, are less efficient than the national average for similar plants.
- **Short runtimes:** 15 (of the 40 plants for which we have data) run for less than five hours every time they are started up, which can likely be met with standalone batteries or solar+storage (see **Figure 2**).
- **Infrequently used:** Half of the plants operate at a capacity factor of 1 percent or less—that is, they generate 1 percent of the electricity that they would if they were running constantly at full power year-round.

The Gowanus Gas Turbines plant has proposed repowering its facility with natural gas, which may provide a decision-making opportunity to consider solar+storage alternatives. The Ravenswood Generating Station recently proposed adding a 300 MW storage system to its facility to help meet peak demand.

Nearby Populations

Ten of the New York peaker plants each have more than a million people living within a three-mile radius. The most urban plants tend to also be in relatively low-income, minority communities, due to both the location of some facilities in low-income, environmentally overburdened communities of color—such as two plants in the Bronx—as well as the demographics of New York City as compared to upstate New York (see **Figure 3**). Sixteen units across 15 facilities

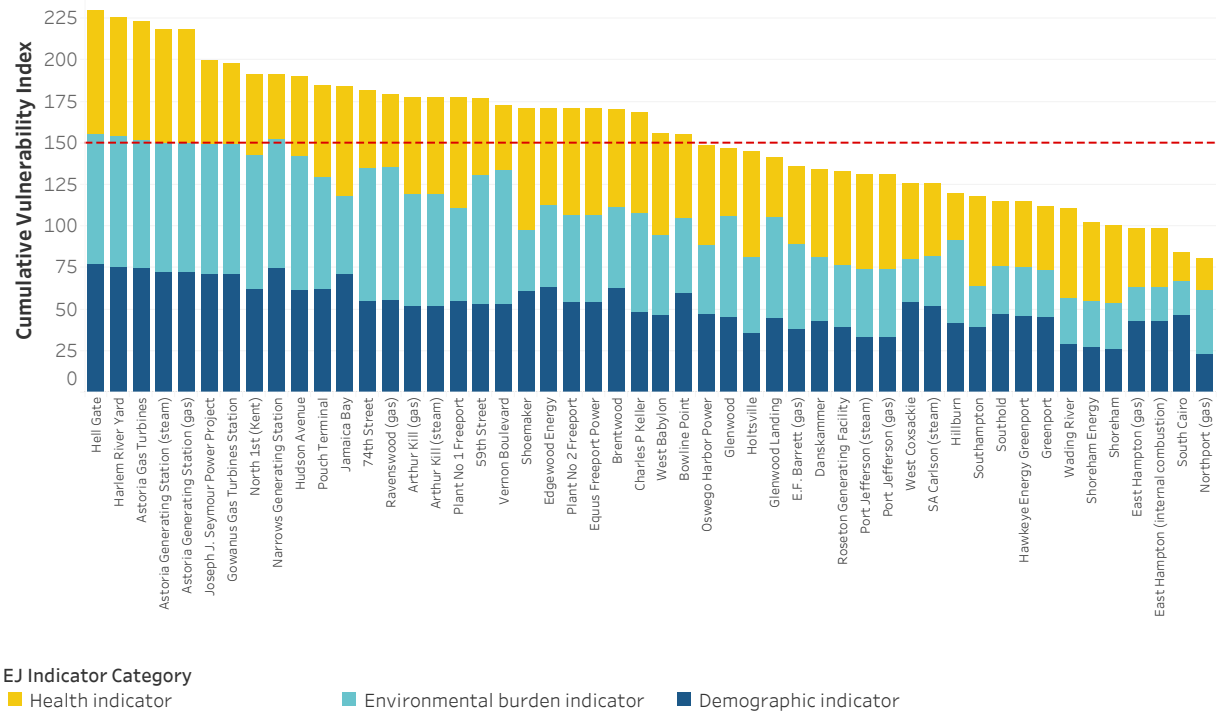

Figure 4: The cumulative vulnerability index reflects a set of environmental, human health and demographic indicators for populations living within three miles of each plant. The score is based on a comparison of indicators to statewide values: if a plant ranked at the median percentile for all indicators, it would score 150, which is indicated by the red dashed line.

are located within state-defined environmental justice areas, characterized as communities with 51.1 percent or more of the population reporting as non-white in urban areas (more than 33.8 percent in rural areas) and/or 23.59 percent or more of the population in households with incomes below the federal poverty level. Many communities also have high cumulative environmental health burdens from numerous sources. We developed a cumulative vulnerability index that integrates data on health burdens (asthma, heart attacks, premature birth rates); environmental burdens (ozone, particulate matter, toxics, traffic proximity, lead paint, and hazardous facilities); and demographic indicators (low-income, minority, linguistically isolated, and non-high school-educated populations). The cumulative vulnerability index for populations living within three miles of each facility is shown in **Figure 4**. The two Bronx plants—Hell Gate and Harlem River Yard—rank higher than all other facilities on this index.

Emissions and the Environment

Twenty of the New York peaker plants and units primarily burn oil and the remainder chiefly use natural gas, although many burn both. Carbon dioxide and nitrogen oxides emission rates—pollution per unit of electricity generated—tend to be high from both sets of facilities, which is likely a function of both the age of the facilities and the fuels used. The majority of plants are located in the New York and Long Island areas, which are considered to be in non-attainment for federal ozone standards. The operation of these plants on hot summer days to meet air conditioning demands can exacerbate these poor air quality conditions. **Figure 5** shows the daily generation from New York City peaker plants (for those we had data for) along with temperature in Central Park, illustrating that these plants typically operate simultaneously on hot summer days.

The New York Department of Environmental Conservation recently developed standards to reduce emissions of nitrogen oxides (an ozone precursor) from peaker power plants by 2023-2025,

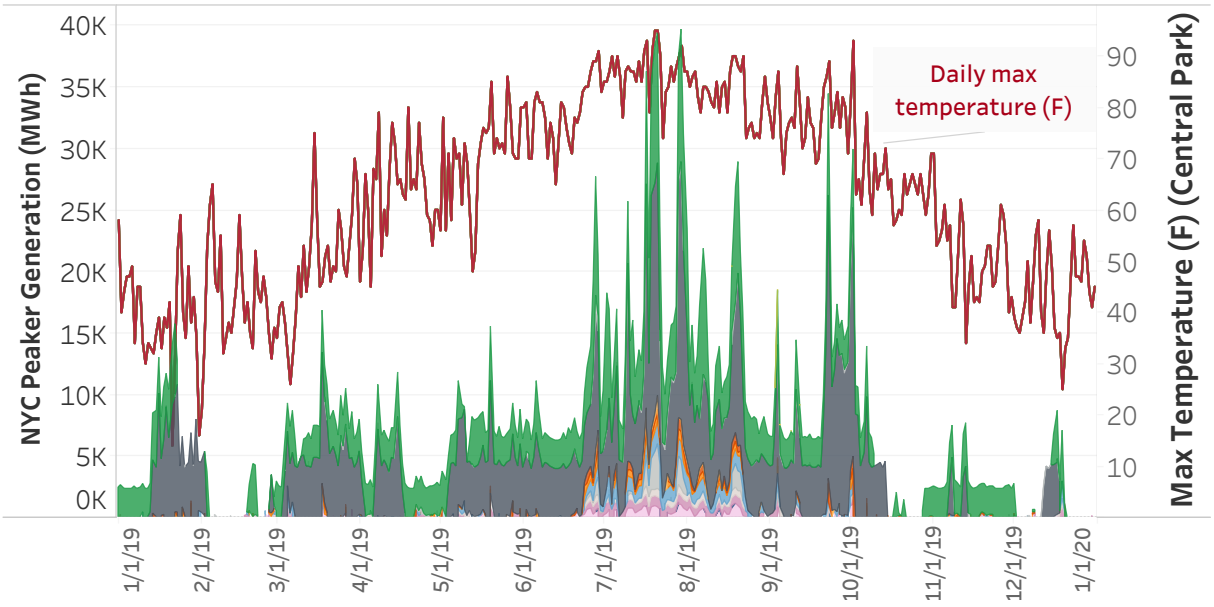

Figure 5: New York City peaker plants typically run simultaneously on hot summer days. Each color represents electricity generation from a New York City-based peaker plant in 2019. The red line indicates the temperature in Central Park.

which will force many plants to retire, upgrade or repower in the coming years. These standards provide an opportunity to replace the state's most polluting peaker plants with alternatives such as energy storage.

Summary

The majority of New York's peaker plants are located in densely urban areas in New York City and Manhattan, a region that is in non-attainment for federal ozone standards. These include old, inefficient and oil-burning units near populations that experience high cumulative environmental health and socioeconomic burdens. The state's new emission reduction standards for nitrogen oxides, along with its energy storage deployment goals, provide a clear opportunity to target inefficient and polluting facilities for replacement with cleaner alternatives, particularly in urban areas. In the attached table, we provide operational, environmental and demographic data for New York peakers and nearby populations. Indicators such as nearby population, emission rates, heat rate (a measure of efficiency), operation on poor air quality days, capacity factor, typical run hours, and location in an environmental justice community or in an import-constrained load zones downstate can help inform whether a given plant might be a good target for replacement with storage, solar+storage, demand response, or other clean energy alternatives. These data should be accompanied by engagement with affected communities to determine replacement priorities and strategies.

New York State peaker plant operational and demographic data.
For methods see: www.psehealthyenergy.org.

	Plant description						Operation and emissions						Demographics (3-mile radius)			
Name[1] (EIA ID)	**Status**	**County**	**Fuel**[2]	**MW**[3]	**Load zone**[4]	**Age**[5]	**Capacity factor**[6]	**Run hours/ start**[7]	**Heat rate**[8] MMBtu/ MWh	**CO_2 rate**[9] tons/ MWh	**NO_x rate**[10] lbs/MWh	**% MWh high ozone days**[11]	**Pop.**	**% non-white** (percentile)[12]	**% low-income** (percentile)[13]	**CVI**[14]
59th Street (2503)	Operating	New York	Natural gas	17	J	51	0.05%	3.2	15.7	1.7	16.9	0%	1,207,344	45% (57)	24% (44)	176
74th Street (2504)	Operating	New York	Oil	37	J	52	0.07%	5.1	15.9	2.1	11.9	0%	1,193,966	46% (58)	26% (48)	181
Arthur Kill GT[15] (2490)	Operating	Richmond	Natural gas	18	J	50	0.3%	5.6	15.7	1.4	5.03	6%	106,582	43% (56)	22% (40)	177
Arthur Kill ST[16] (2490)	Operating	Richmond	Natural gas	878	J	61	13.8%	271	10.5	0.6	0.7	5%	106,582	43% (56)	22% (40)	177

[1]*Indicates plant is in a state EJ area.
[2]Primary fuel; many plants burn both oil and natural gas.
[3]Installed nameplate capacity (plant size).
[4]Load zone within NYISO territory; zones G-K are import constrained.
[5]Age of oldest unit in 2020.
[6]Percent of time running as compared to running all year at full capacity for 2016-2018; plants with very low capacity factors may have higher discrepancies in NO_x and CO_2 values reported.
[7]Average number of hours plant runs each time it is turned on. Steam plants are slower to ramp up so tend to run longer.
[8]Heat rates are energy burned per unit of electricity generated; high heat rates reflect low efficiency.
[9]Direct carbon dioxide emissions per unit of electricity generated; does not include upstream emissions.
[10]Nitrogen oxides (NO_x) emitted per unit of electricity generated; NO_x contributes to ozone and particulate matter formation.
[11]Percent of generation on days nearby monitors record exceedances of federal ozone standards.
[12]Percentile minority population indicates percent of census tracts across the state with lower fraction of non-white populations.
[13]Percentile low-income population indicates percent of census tracts across the state with lower fraction of households below double the federal poverty limit.
[14]Cumulative Vulnerability Index combines state percentiles for demographic, health and environmental exposure indicators. A median on all values would score 150.
[15]Gas turbine unit at 896 MW gas peaker plant.
[16]Steam turbine unit at 896 MW gas peaker plant.

Astoria Gas Turbines* [17] (55243)	Operating; proposed repower on hold?	Queens	Natural gas	527	J	50	0.7%	2.8	14.8	0.9	7.3	8%	998,335	73% (70)	43% (73)	223
Astoria Generating Station* GT [18] (8906)	Operating	Queens	Natural gas	15	J	53	0.7%	3.6	12.2	1.0	6.6	11%	1,065,712	69% (69)	41% (70)	218
Astoria Generating Station* ST [19] (8906)	Operating	Queens	Natural gas	943	J	66	10.9%	495	12.1	0.7	0.7	4%	1,065,712	69% (69)	41% (70)	218
Bowline Point (2625)	Operating	Rockland	Natural gas	1242	G	48	9.9%	109	10.2	0.6	1.2	2%	47,063	53% (62)	25% (45)	155
Brentwood* (7912)	Operating	Suffolk	Natural gas	47	K	19	13.7%	7.1	9.6	0.6	0.1	4%	93,391	60% (65)	23% (42)	169
Charles P Keller (2695)	Operating	Nassau	Natural gas	34	K	78	0.1%	NA	67.0	4.5	188	NA	209,836	46% (58)	16% (29)	168
Danskammer (2480)	Operating	Orange	Natural gas	537	G	69	0.5%	16.5	12.1	0.7	1.4	2%	19,461	29% (45)	18% (33)	133
East Hampton GT [20] (2512)	Operating	Suffolk	Oil	21	K	50	4.8%	8.7	14.8	1.2	8.0	18%	8,285	30% (47)	18% (32)	98
East Hampton IC [21] (2512)	Operating	Suffolk	Oil	6	K	58	3.2%	NA	10.6	0.9	14.2	NA	8,285	30% (47)	18% (32)	98
Edgewood Energy* (55786)	Operating	Suffolk	Natural gas	100	K	18	11.3%	7.3	10.1	0.6	0.1	3%	95,918	61% (65)	24% (43)	170
E.F. Barrett* GT [22] (2511)	Operating	Nassau	Natural gas	293	K	50	4.8%	4.9	16.2	1.0	3.7	7%	112,543	25% (42)	16% (27)	135
Equus Freeport Power (56032)	Operating	Nassau	Natural gas	120	K	16	8.1%	7.0	10.0	0.6	0.1	4%	136,266	50% (60)	18% (32)	170

[17] Recently retired 128 MW unit.
[18] Gas turbine unit at 958 MW gas peaker plant.
[19] Steam turbine unit at 958 MW gas peaker plant.
[20] Gas turbine at 27 MW gas peaker plant.
[21] Internal combustion unit at 27 MW gas peaker plant.
[22] Gas turbine unit at 669 MW gas peaker plant.

Glenwood (2514)	Operating	Nassau	Oil	110	K	48	0.3%	3.6	13.6	1.1	7.2	6%	77,361	30% (46)	16% (29)	146
Glenwood Landing (7869)	Operating	Nassau	Natural gas	122	K	53	12.5%	7.9	10.0	0.6	0.1	5%	79,693	30% (46)	16% (27)	141
Gowanus Gas Turbines* (2494)	Operating; proposed repower	Kings	Natural gas	640	J	49	0.2%	4.8	16.2	1.4	5.9	3%	831,440	57% (63)	40% (68)	197
Greenport (2681)	Operating	Suffolk	Oil	10	K	63	0.03%	NA	10.9	0.9	38	NA	6,961	21% (38)	22% (41)	112
Harlem River Yard (7914)	Operating	Bronx	Natural gas	94	J	19	4.8%	5.8	10.2	0.6	0.1	8%	1,227,259	74% (71)	47% (77)	225
Hawkeye Energy Greenport (55969)	Operating	Suffolk	Oil	54	K	17	3.5%	7.2	10.0	0.8	0.3	22%	6,647	22% (38)	23% (43)	114
Hell Gate (7913)	Operating	Bronx	Natural gas	94	J	19	4.8%	5.6	10.2	0.6	0.1	8%	1,160,176	78% (73)	49% (79)	228
Hillburn* (2628)	Operating	Rockland	Natural gas	47	G	49	0.1%	1.8	20.3	1.2	12.04	0%	27,821	29% (46)	15% (27)	119
Holtsville (8007)	Operating	Suffolk	Oil	567	K	46	0.6%	3.7	16.6	1.3	11.1	9%	86,798	21% (38)	14% (25)	144
Hudson Avenue (2496)	Operating	Kings	Oil	49	J	50	0.3%	4.5	18.6	1.4	23.8	10%	1,150,937	50% (60)	33% (59)	190
Jamaica Bay* (56141)	Operating	Queens	Oil	61	K	17	1.6%	NA	11.1	0.9	9.3	NA	126,711	65% (67)	39% (67)	183
Joseph J. Seymour Power Project (23rd and 3rd)* (7910)	Operating	Kings	Natural gas	94	J	19	14.0%	9.8	10.2	0.6	0.1	4%	909,470	58% (64)	40% (69)	199
Narrows Generating Station* (2499)	Operating; proposed retirement	Kings	Natural gas	352	J	48	1.8%	8.0	15.8	1.0	5.3	7%	555,435	51% (60)	43% (72)	191
North 1st (Kent)*(7915)	Operating	Kings	Natural gas	47	J	19	12.0%	8.4	10.0	0.6	0.1	6%	1,209,568	50% (60)	33% (59)	190

Northport GT[23] (2516)	Operating	Suffolk	Oil	16	K	53	0.1%	2.2	23.9	1.9	28.7	7%	25,768	8% (19)	12% (20)	80
Oswego Harbor Power* (2594)	Operating	Oswego	Oil	1804	C	72	0.3%	21	11.8	0.9	2.2	0%	23,694	12% (25)	44% (74)	148
Plant No 1 Freeport* (2678)	Operating	Nassau	Oil	11	K	79	0.1%	NA	14.3	1.1	45.2	NA	185,261	53% (61)	19% (34)	177
Plant No 2 Freeport (2679)	Operating	Nassau	Natural gas	79	K	47	6.3%	8.8	10.0	0.6	0.2	5%	136,266	50% (60)	18% (32)	170
Port Jefferson GT[24] (2517)	Operating	Suffolk	Natural gas	122	K	54	6.0%	5.4	9.8	0.6	0.2	14%	34,448	21% (38)	14% (24)	130
Port Jefferson ST[25] (2517)	Operating	Suffolk	Natural gas	376	K	72	9.8%	106	10.7	0.7	0.8	14%	34,448	21% (38)	14% (24)	130
Pouch Terminal (8053)	Operating	Richmond	Natural gas	47	J	19	14.8%	9.2	10.0	0.6	0.1	6%	255,079	47% (59)	32% (57)	183
Ravenswood GT*[26] (2500)	Operating; proposed battery expansion	Queens	Natural gas	458	J	53	0.2%	2.9	16.8	1.0	1.6	4%	1,232,618	45% (57)	26% (48)	178
Roseton Generating Facility (8006)	Operating	Orange	Natural gas	1242	G	46	3.7%	21.6	10.3	0.7	1.6	1%	16,333	27% (43)	16% (28)	132
SA Carlson ST[27] (2682)	Operating	Chau-tauqua	Natural gas	49	A	69	8.2%	NA	NA	NA	NA	NA	37,736	15% (30)	49% (79)	125
Shoemaker (2632)	Operating	Orange	Natural gas	42	G	49	0.1%	2.8	20.3	1.2	15.1	0%	40,982	61% (65)	35% (62)	171
Shoreham (2518)	Operating	Suffolk	Oil	72	K	54	0.4%	NA	15.3	1.2	13.9	NA	19,969	11% (23)	12% (20)	100
Shoreham Energy (55787)	Operating	Suffolk	Oil	100	K	18	0.7%	4.5	10.1	0.8	0.5	7%	22,068	10% (23)	12% (21)	102

[23]Gas turbine unit at 1,564 MW gas plant.
[24]Gas turbine unit at 498 MW gas plant.
[25]Steam turbine unit at 498 MW gas plant.
[26]Gas turbine unit at 2,600 MW gas plant; recently retired 65 MW unit.
[27]Steam turbine unit at 96 MW gas plant.

South Cairo (2485)	Operating	Greene	Oil	22	G	50	0.07%	NA	17.1	1.4	11.2	NA	4,801	16% (31)	30% (54)	84
Southampton (2519)	Operating	Suffolk	Oil	12	K	57	1.3%	NA	26.3	2.1	23.5	NA	8,506	23% (39)	21% (38)	114
Southold (2520)	Operating	Suffolk	Oil	14	K	56	0.7%	NA	32.5	2.6	28.8	NA	7,406	22% (38)	24% (44)	115
Vernon Boulevard (7909)	Operating	Queens	Natural gas	94	J	19	7.1%	6.3	9.6	0.6	0.1	6%	1,264,532	43% (56)	25% (45)	172
Wading River (7146)	Operating	Suffolk	Oil	239	K	31	0.9%	4.6	13.1	1.1	3.8	6%	22,954	11% (24)	13% (23)	110
West Babylon (2521)	Operating	Suffolk	Oil	52	K	49	0.5%	3.2	14.5	1.2	8,.2	1%	130,952	31% (47)	17% (31)	155
West Coxsackie (2487)	Operating	Greene	Natural gas	22	G	51	0.3%	NA	13.9	0.8	4.7	NA	7,478	34% (50)	25% (45)	125