Power Generation Advisory Panel Peaking Power Plants

I am submitting these comments in response to the January 11, 2021 Generation Advisory Panel meeting discussion of peaking power plants. Although the peaking plants are alleged to be a primary driver of the environmental burden in neighboring environmental justice communities that is unlikely to be the case. Combine that with the enormous costs of energy storage and the difficulty siting enough renewables within the city to replace these plants that means that resolving the peak load problem is more difficult than suggested by many of the panel members and could affect reliability and affordability.

I am a retired electric utility meteorologist with nearly 40 years-experience analyzing the effects of meteorology on electric operations. I have been involved with peaking power plants in particular for over 20 years both from a compliance reporting standpoint and evaluation of impacts and options for these sources. This background served me well preparing these comments. The opinions expressed in my comments do not reflect the position of any of my previous employers or any other company I have been associated with, these comments are mine alone.

Background

Last summer in response to the PEAK Coalition report "Dirty Energy, Big Money" and the Physicians, Scientists, and Engineers (PSE) for Healthy Energy report Opportunities for Replacing Peaker Plants with Energy Storage in New York State, I prepared three analyses of the claims in the reports as summarized here. The first analysis provided information on the primary air quality problem associated with these facilities, the organizations behind the report, the State's response to date, the underlying issue of environmental justice and addressed the motivation for the analysis. The second analysis addressed the rationale and feasibility of the proposed plan relative to environmental effects, affordability, and reliability. Finally, I discussed the Opportunities for Replacing Peaker Plants with Energy Storage in New York State report that provided technical information used by the PEAK Coalition.

In brief, peaking power plants are used to ensure that there is sufficient electricity at the time it is needed most. The problem is that the hot, humid periods that create the need for the most power also are conducive to the formation of ozone. In order to meet this reliability requirement ~ 100 simple cycle turbines were built in New York City in the early 1970's that were cheap and functional but, compared to today's standards, emitted a lot of nitrogen oxides that are a precursor to ozone. The Peak Coalition report claims that peaking units operate when energy load spikes, are mostly old, and have high costs. However, they expand the definition of peaking units to just about every facility in the City including units that are new, have low emission rates, and have lower costs than claimed. Environmental Justice advocates claim that the expanded definition peaking power plants are dangers to neighboring environmental justice communities. However, my analyses found that the alleged impacts of the existing peaking power plants over-estimate impact on local communities relative to other sources.

There is a category of existing simple cycle peaking turbines in New York City that are old, inefficient and much dirtier than a new facility and clearly should be replaced. However, they reliably produce affordable power when needed most. PSE and the PEAK Coalition advocate a solar plus energy storage approach and that has become the preferred approach of the majority of the Power Generation Advisory Panel members. It is not clear, however, if that is a viable option.

Public Health Impacts

The primary public health reference in the PEAK Coalition report was the New York City Department of Health and Mental Hygiene's (DOHMH) Air Pollution and the Health of New Yorkers report. The PEAK coalition description of air quality public health impacts quotes the conclusion from the DOHMOH report: "Each year, PM2.5 pollution in [New York City] causes more than 3,000 deaths, 2,000 hospital admissions for lung and heart conditions, and approximately 6,000 emergency department visits for asthma in children and adults." These conclusions are for average air pollution levels in New York City as a whole over the period 2005-2007.

The DOHMOH report specified four scenarios for comparisons (DOHMOH Figure 4) and calculated health events that it attributed to citywide PM2.5 (DOHMOH Table 5). Based on their results the report notes that:

> Even a feasible, modest reduction (10%) in PM2.5 concentrations could prevent more than 300 premature deaths, 200 hospital admissions and 600 emergency department visits. Achieving the PlaNYC goal of "cleanest air of any big city" would result in even more substantial public health benefits.

It is important to note how air quality has improved since the time of this analysis. The NYS DEC air quality monitoring system has operated a PM2.5 monitor at the Botanical Garden in New York city since 1999 so I compared the data from that site for the same period as this analysis relative to the most recent data available (Data from Figure 4. Baseline annual average PM2.5 levels in New York City). The Botanical Garden site had an annual average PM2.5 level of 13 $\mu g/m^3$ for the same period as the report's 13.9 $\mu g/m^3$ "current conditions" city-wide average (my estimate based on their graph). The important thing to note is that the latest available average (2016-2018) for a comparable three-year average at the Botanical Garden is 8.1 $\mu g/m^3$ which represents a 38% decrease. That is substantially lower than the PlaNYC goal of "cleanest air of any big city" scenario at an estimated city-wide average of 10.9 $\mu g/m^3$.

In order to convince me that the PM2.5 health impacts claimed by MOHDOH and many others are correct I need to see confirmation with observed data. The DOHMOH report claims that in 2005-2007 that PM2.5 concentrations led to, for example, 3,200 premature mortality events. There was a 38% decrease in PM2.5 between 2005-2007 to 2016-2018 so to verify these claims the DOHMOH should present numbers demonstrating the improvements resulting from this improvement. There is the thing though. The percentage of people with asthma in the United States from 2001 to 2018 is not showing a decrease at the same time ambient levels of all air pollutants are going down substantially. While correlation does not necessarily mean causation, no correlation with a purported cause indicates a bet on a dead horse.

I don't think that the PSE approach made a convincing case that the peaking power plants are a primary driver of environmental burdens on neighboring communities. Their vulnerability index lists other factors but makes no attempt to attribute impacts to each factor. The ultimate problem with this approach is that the peak unit justification relies on environmental burdens from ozone and particulate matter air quality impacts. However, ozone is a secondary air pollutant and the vast majority of ambient PM2.5 from power plants is also a secondary pollutant. As a result, there is enough of a lag between the time emissions are released and creation of either ozone or PM2.5 that the impact is felt further away than the immediate neighborhood. That means that the accused peaking power plants do not create the air quality impact problems alleged to occur to the environmental justice communities located near the plants. In fact, because NOx scavenges ozone, the peaker plants reduce local ozone if they have any effect at all.

Peaking Power Plant Status

By definition, for EPA reporting purposes 40 CFR Part 75 §72.2, a combustion unit is a peaking unit if it has an average annual capacity factor of 10.0 percent or less over the past three years and an annual capacity factor of 20.0 percent or less in each of those three years. As noted previously the utility industry considers the combustion turbines built expressly for peak periods as the New York City "peakers". PSE chose to select peaking power plants based on the following criteria: fuel type: oil & natural gas; Capacity: ≥ 5 MW; capacity factor: ≤15% (3-yr. avg.); unit technology type: simple cycle combustion turbine, steam turbine & internal combustion; application: entire peaker plants & peaking units at larger plants; and status: existing and proposed units.

TABLE 1: Peaker Power Plants Operating in New York City[4]

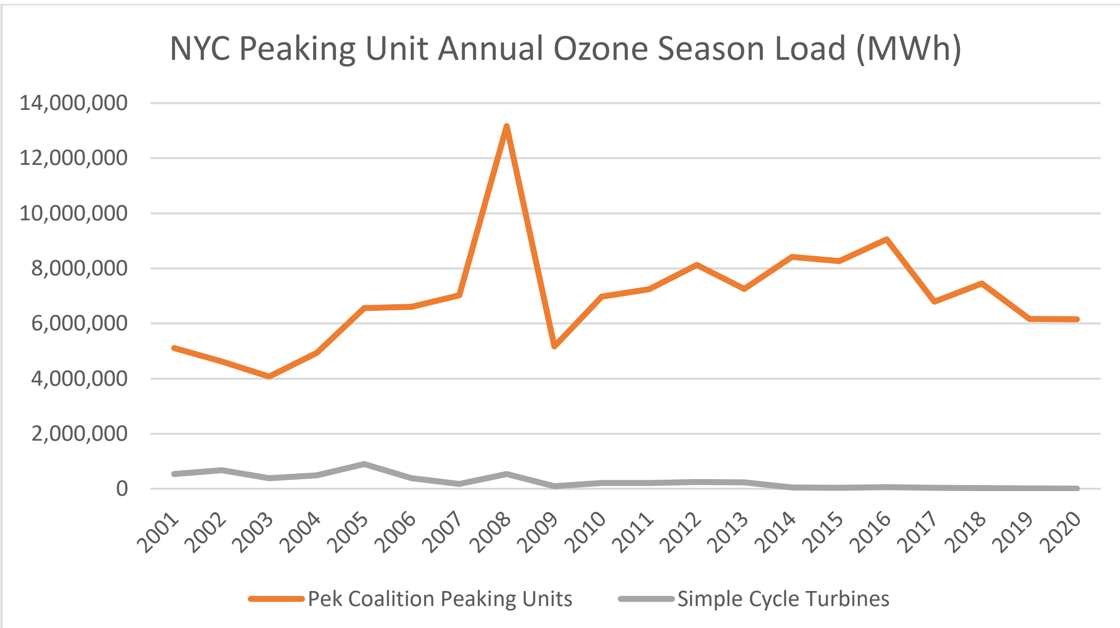
Plant Name	Parent Company	Location	Name Plate Capacity (MW)	Online Date
59 St.	Consolidated Edison Inc.	Manhattan	17	1969
74 St.	Consolidated Edison Inc.	Manhattan	37	1968
Arthur Kill	NRG Energy Inc.	Staten Island	878	1959
Astoria	ArcLight Capital Holdings LLC	Queens	572	1954
Astoria GT	NRG Energy Inc.	Queens	558	1970
Bayswater Plant	Long Island Power Authority	Queens	61	2002
East River	Consolidated Edison Inc.	Manhattan	370	1955
Gowanus	ArcLight Capital Holdings LLC	Brooklyn	640	1971
Harlem River	New York Power Authority	Bronx	94	2001
Hellgate	New York Power Authority	Bronx	94	2001
Hudson Ave.	Consolidated Edison Inc.	Brooklyn	49	1970
Jamaica Bay	Long Island Power Authority	Queens	61	2003
Joseph J. Seymour	New York Power Authority	Brooklyn	94	2001
Kent	New York Power Authority	Brooklyn	47	2001
Narrows	ArcLight Capital Holdings LLC	Brooklyn	352	1972
Pouch	New York Power Authority	Staten Island	47	2001
Ravenswood	LS Power Group	Queens	1,827	1969
Vernon Blvd.	New York Power Authority	Queens	94	2001

Source: NYISO Gold Book 2019

3 Caroline Spivack, "Bronx's Asthma Alley Protests Plans to Extend Power Plant Permits," *City Limits*, November 12, 2015, *https://citylimits.org/2015/11/12/bronxs-asthma-alley-protests-plans-to-extend-power-plant-permit.*

4 Name plate capacity refers to the maximum power a plant could potentially generate, which is typically higher than actual operational generating capacity. Online date refers to the oldest peaker unit currently in operation. A power plant with multiple peaking units may have some newer units as well.

There is another nuance to the peaking units story. Because the primary environmental concern with the combustion turbines that run so little is ozone attainment, they only are required to report data during the Ozone Season (May 1 to September 30). The NYC Peaking Unit Annual Ozone Season Load graph shows the trend of the simple cycle combustion turbine peaking unit and the Peak Coalition peaking unit ozone season load. Since 2001, the simple cycle turbines load trend is down and in 2020 the ozone season total energy produced was only 8,155 MWh compared to a peak over this period of 897,939 MWh in 2005. On the other hand, the Peak Coalition peaking units have only been trending down since 2017. Over that short a period the effects of weather may be the primary driver of any load changes.



There are issues with the Peak Coalition definition of peaking units. Ss far as I can tell the list of units that they describe as peaking units includes boilers used for electric power, boilers used for steam, and recently built combined cycle combustion turbines as well as the 100 or so peaking turbines that industry considers peaking units. The Peak Coalition definition includes units that do not necessarily exist solely to address peak load problems but also have other uses. Obviously if the steam units are eliminated there are ramifications beyond the peak power issue.

Table 1[1] categorizes the units as simple cycle turbines (the industry "peakers"), all the other turbines, boilers that provide electricity and steam boilers that provide steam. In the last 20 years a number of combined cycle combustion turbines that are more efficient than the simple cycle turbines and the boilers have been put online. In 2020, that category provided the most energy of any of the units considered displacing most of the simple cycle turbine output and a big chunk of the boilers producing electricity. As shown in the table, in 2020 the "peakers" only generated 8,155 MWh and emitted 6,927 tons of CO2 and 28 tons of NOx. The combined cycle turbines produced 3,968,562 MWh, 1,772,752 tons of CO2 and 103 tons of NOx and the both boiler categoriess produced 2,172,185 MWh in 2020, 1,654,514 tons of CO2 and 752 tons of NOx in the 2020 Ozone Season.

[1] Note that the 2002, 2004, and 2006 data are omitted solely to make the table fit into the space available.

Table 1: New York City Ozone Season Load, CO2 Mass, and NOx Mass Trends

		2001	2003	2005	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Load	Simple Cycle Turbines	538,904	390,715	897,939	177,171	532,228	90,941	216,358	208,051	244,666	237,990	45,808	32,700	56,028	33,723	25,295	11,048	8,155
	Other Turbines	9,690	521,570	1,409,012	2,999,164	5,741,137	2,510,343	2,885,816	3,772,504	4,382,293	3,795,669	4,373,802	4,385,558	4,385,027	3,985,922	4,488,145	4,091,060	3,968,562
	Boilers	4,563,297	3,160,488	4,254,628	3,850,010	6,890,664	2,566,443	3,879,922	3,258,632	3,502,612	3,217,214	3,997,197	3,852,060	4,608,836	2,773,712	2,941,056	2,059,191	2,172,185
	Steam Boilers	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	5,111,891	4,072,772	6,561,578	7,026,345	13,164,029	5,167,727	6,982,096	7,239,186	8,129,571	7,250,872	8,416,807	8,270,319	9,049,891	6,793,358	7,454,496	6,161,299	6,148,903
CO2	Simple Cycle Turbines	524,758	350,950	735,361	149,034	449,920	61,208	181,542	168,287	202,345	197,188	37,266	34,132	39,403	23,080	17,814	8,874	6,927
	Other Turbines	10,012	318,512	704,704	1,299,654	2,457,958	1,005,631	1,212,936	1,594,006	1,879,609	1,653,056	1,850,660	1,910,778	1,891,502	1,729,529	1,999,096	1,835,389	1,772,753
	Boilers	2,769,684	2,181,414	3,170,630	2,569,718	4,496,989	1,668,934	2,454,589	2,071,699	2,172,426	1,989,062	2,466,566	2,372,996	2,840,760	1,758,937	1,899,668	1,319,745	1,410,911
	Steam Boilers	850,909	733,279	818,072	656,387	1,074,362	409,983	543,943	394,020	443,104	452,737	303,649	279,643	327,524	194,110	304,037	257,764	243,603
	Total	4,155,363	3,584,155	5,428,766	4,674,793	8,479,228	3,145,757	4,393,010	4,228,012	4,697,485	4,292,042	4,658,141	4,597,548	5,099,189	3,705,656	4,220,616	3,421,773	3,434,194
NOx	Simple Cycle Turbines	1,874	1,338	2,784	549	1,562	229	626	637	798	729	142	135	157	99	73	36	28
	Other Turbines	38	63	75	96	205	68	97	117	127	127	108	118	114	115	107	113	103
	Boilers	2,583	1,843	2,339	1,347	2,089	756	1,214	1,014	1,017	948	1,195	1,079	1,455	679	789	415	498
	Steam Boilers	1,627	1,200	1,097	802	1,327	535	664	463	410	466	284	259	303	167	252	264	255
	Total	6,123	4,443	6,295	2,793	5,183	1,588	2,601	2,230	2,351	2,270	1,729	1,591	2,028	1,060	1,221	827	884

Alternatives

I don't think that many of the members of the power generation advisory panel really understand the electric system. Although the simple cycle turbine peaking units have run less and less recently, completely eliminating them is still a significant undertaking. Nonetheless, last year the Department of Environmental Conservation promulgated a new regulation that will shut them down on a schedule based on complete assurance that equally reliable options are available. In order to eliminate all the units in the Peak Coalition report is a much more difficult problem. Unfortunately, to the ill-informed it is a simply a matter of political will.

The apparent preferred option is to use energy storage ultimately powered using renewables. In December 2020, 74 Power Global and Con Edison announced the signing of a seven-year dispatch rights agreement for the development of a 100-megawatt battery storage project, the East River Energy Storage System, in Astoria, Queens. The NRG Astoria Gas Turbine facility presently consists of 24 16MW simple cycle turbines is also located at the same location. The East River Energy Storage System is rated to provide 4 hours at 100 MW capacity or 400 MWh. On the other hand, those 24 16MW turbines can run all day if the need arises to produce 9,216 MWh or 23 times more energy.

Unfortunately, that is not the end of the bad news for energy storage. Last year I estimated the energy storage requirements of the CLCPA based on a NREL report Life Prediction Model for Grid-Connected Li-ion Battery Energy Storage System that describes an analysis of the life expectancy of lithium-ion energy storage systems. The abstract of the report notes that "The lifetime of these batteries will vary depending on their thermal environment and how they are charged and discharged. To optimal utilization of a battery over its lifetime requires characterization of its performance degradation under different storage and cycling conditions." The report concludes: *"Without active thermal management, 7 years lifetime is possible provided the battery is cycled within a restricted 47% DOD operating range. With active thermal management, 10 years lifetime is possible provided the battery is cycled within a restricted 54% operating range."* If you use the 54% limit the 400 MWh of energy goes down to 216 MWh and the existing turbines can produce over 42 times as much energy in a day.

The mantra of the environmental justice advocates on the power generation advisory panel is that "smart planning" and renewables will be sufficient to replace fossil generation peaking plants. In the absence of what is exactly meant by "smart planning" I assume that it will be similar to the New York Power Authority agreement to "assess how NYPA can transition its natural gas fired 'peaker' plants, six located in New York City and one on Long Island with a total capacity of 461 megawatts, to utilize clean energy technologies, such as battery storage and low to zero carbon emission resources and technologies, while continuing to meet the unique electricity reliability and resiliency requirements of New York City." Beyond the press release however, is a major technological challenge that if done wrong will threaten reliability.

Moreover, the costs for this technology seem to be an afterthought. The Energy Information Administration says the average utility scale battery system runs around $1.5 million per MWh of storage capacity. That works out to $600 million for the East River Energy Storage System. NYC currently peaks at around 13,000 MW– just to keep the city running. I get the impression that one aspect of "smart" planning is to shave peaks but the CLCPA targets will require electrification across all sectors. I don't think that any peak shaving programs can do much to reduce the current summer peak and the peak will certainly shift to the winter when peak shaving and shifting of heating is unrealistic. Assuming the same peak level and that the daily total peak above the baseline requires 104,000 MWhr, that means that 481 East River Energy Storage Systems operating at the NREL 54% limit would be needed to cover the peak at a cost of $289 billion. Throw in the fact that the life expectancy is ten years and I submit this unaffordable especially to those already having trouble paying their utility bills.

New York City Solar

Even if you have enough energy storage, the mandates of the CLCPA require the use of solar and wind resources to provide that energy. There are specific in-city generation requirements for New York City that have been implemented to ensure there is no repeat of blackouts that were caused by issues with the transmission and generation system. It is not clear to me how this will be handled within the CLCPA construct but there is a clear need for in-city generation. Clearly massive wind turbines are a non-starter within NYC so that leaves solar. The problem is that a 1 MW solar PV power plant will require between 2.5 acres and 4 acres if all the space needed for accessories are required. Assuming that panels generate five times their capacity a day 43.2 MW of solar panels can generate the 216 MWh of energy available from the East River Energy Storage System and that means a solar array of between 108 and 173 acres. To get the 104,000 MWh needed for the entire NYC peak between 10 and 16 square miles of solar panels will be needed.

Conclusion

There are significant implementation issues trying to meet the CLCPA mandates in New York City. Energy storage at the scale needed for any meaningful support to the NYC peak load problem has never been attempted. The in-city generation requirements have to be reconciled with what could actually be available from solar within the City. Even if the technological problems are resolved, all indications are that the costs will be enormous. Importantly, I have only described the over-arching issues. I am sure that there are many more details to be reconciled to make this viable. In order for the Power Generation Advisory Panel to understand the provisions in place to prevent blackouts I recommend that the New York State Reliability Council provide a briefing to the membership.

I have previously shown that the Peak Coalition analysis of peaking plants misses the point of peaking plants and their environmental impacts. Their definition includes facilities that provide services other than peaking services. The primary air quality health impacts are from ozone and inhalable particulates. Both are secondary pollutants that are not directly emitted by the peaking power plants so do not affect local communities as alleged. While nothing detracts from the need to retire the old, inefficient simple cycle turbines, replacing all the facilities targeted by the Peak Coalition with energy storage and renewables is a mis-placed effort until replacement technologies that can maintain current levels of affordability and reliability are commercially available. At this time that is simply not the case.

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