STATE OF NEW YORK

PUBLIC SERVICE COMMISSION

Proceeding on the Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard	**Case 15-E-0302**

NEW YORK ENERGY & CLIMATE ADVOCATES

POST-CONFERENCE COMMENTS ON ZERO EMISSIONS TECHNICAL CONFERENCE

I. Introduction

New York Energy & Climate Advocates (NYECA) is a non-profit, volunteer-based organization of scientists, engineers, environmentalists, business professionals, and advocates for social justice who understand the reality of climate change and the moral imperative for timely action employing effective solutions that work in the real world. In the past, we provided technical comments in case 15-E-0302 relating to implementation of New York's Clean Energy Standard and a petition by parties for a zero-emissions program. Since then, we provided substantive testimony responding to questions contained in the May 18, 2023 *Order Initiating Process Regarding Zero Emissions Target* and subsequent October 20, 2023 *Notice Seeking Further Comment* issued by the New York State Public Service Commission (the "Commission") regarding technologies and actions for achieving the 2040 zero-emission target for electricity set forth in the Climate Leadership and Community Protection Act (CLCPA).[1] NYECA also submitted topics and questions for consideration by Department of Public Service (DPS) staff pursuant to the October 20, 2023 *Notice Scheduling Technical Conference* regarding the zero-emission target, and we attended the technical conference held December 11-12, 2023 in Albany.

[1] *Comments of New York Energy & Climate Advocates Responding to New York State Public Service Commission Order Initiating Process Regarding Zero Emission Target,* New York Energy & Climate Advocates, New York Public Service Commission Docket# 15-E-0302, August 16, 2023.
https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={F02D008A-0000-CC14-8D5C-F572D9D2EA12} ;
New York Energy & Climate Advocates Response to Notice Seeking Further Comment, New York Energy & Climate Advocates, New York Public Service Commission Docket# 15-E-0302, February 20, 2024.
https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={5038C88D-0000-CF10-9004-80A527680CD8}

NYECA commends the Commission and DPS staff for hosting the December technical conference, an important first step to developing an effective programmatic strategy for meeting the CLCPA's goal of zero-emission electricity. We welcome the opportunity to provide the following post-conference comments.

II. Establishing The Need for Substantial Firm Zero-Emission Capacity

The technical conference hosted by DPS was useful in showing definitively that existing carbon-free resources, along with additional renewables and battery storage, will not meet the 2040 goal of carbon-free electricity. This was discussed by the conference's first panel in the context of characterizing a "gap" corresponding to unserved demand as more intermittent renewables and storage are deployed.

Assessing how big a "gap" might be in a system dominated by intermittent renewables is difficult. Aside from trying to predict the weather, it requires knowledge of future conditions on a macroscopic and microscopic level: growth in demand, the efficacy and distribution of storage, transmission and interconnection improvements needed to prevent curtailment, and the availability of renewable energy from outside the state. Each of these factors can dramatically alter size of the gap in both of its dimensions: magnitude and duration. Further, while some generalized models may imply that creating a grid based on intermittent sources is only difficult when trying to meet the last few percentages of demand, empirical evidence—as seen in California and Germany—reveals the opposite: that complications in the real world accrue much sooner.

Most revealing was information presented by Dr. Lindsay Anderson, Chair of Environmental Engineering and interim Director of the Cornell Energy Systems Institute, who discussed the results of a spatiotemporal analysis of New York's electric grid based on resources identified in the Climate Action Council's Scoping Plan.[2] Unlike simplistic "copper plate" studies to date, the Cornell analysis actually modeled real-time grid performance statewide and regionally for various physical distributions of generation, storage, and transmission.[3] Dr. Anderson explained that significant gaps of load shedding (unmet demand) occur in all scenarios regardless of how much solar, wind, and

[2] M. Vivienna Lie, Vivek Srikrishnan, Kenji Doering, Elnaz Kabir, Scott Steinschneider, C. Lindsay Anderson, *Heterogeneous Vulnerability of Zero-Carbon Power Grids under Climate-Technological Changes,* September 15, 2023. https://doi.org/10.48550/arXiv.2307.15079

[3] By "copper-plate" studies, we mean over-simplified analyses that treat the electric grid as a single large conductive metal plate in which electricity can flow unimpeded as if generators, storage, and loads that may be distributed over hundreds of miles were located right next to each other.

battery resources are added to the system and regardless of how those resources are distributed. Stating that "building more renewables and adding more storage is not going to solve the problem," Anderson predicted that even with planned transmission improvements, unless significant Firm Zero-Emission Capacity (FZEC) is deployed, New York will experience conditions where load shedding is necessary downstate even as upstate renewables are curtailed.

What the Cornell report says about the Integration Analysis prepared by the New York State Energy Research and Development Authority (NYSERDA) and Energy & Environmental Economics (E3) is particularly telling:

> **Merely increasing wind and solar capacity is ineffective in improving reliability due to transmission congestion and spatiotemporal variations in vulnerabilities. This underscores the importance of considering spatiotemporal dynamics and operational constraints when making decisions regarding additional investments in renewable resources.**[4]
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> …
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> Congestion prevents the transfer of power from upstream zones to where it is demanded. As a result, although the maximum FZEC [Firm Zero-Emission Capacity] requirement identified without zonal analysis is 27 GW over the 22-year analysis period…the actual need is likely as high as 37 GW when zonal requirements are included. Recall that in [the scoping plan] 18-23 GW FZEC is estimated to ensure grid reliability. **The more detailed study presented here indicates that the FZEC need is 61-105% more than the scoping plan estimate.** These findings underscore the importance of modeling energy systems with spatiotemporal co-variability and incorporating grid topology and operational constraints.[5]
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> …
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> **The findings highlight the importance of considering system operation constraints. Neglecting these constraints can lead to a significant underestimation of system vulnerabilities, particularly for evaluating load shedding quantity and load shedding hours.** This aligns with the expected outcome, as disregarding transmission line constraints and the power flow relationship with phase angle essentially eliminates the grid's topological structure, allowing power to be delivered anywhere in the grid.[6] (emphasis added)

By not adequately considering spatiotemporal factors, operational constraints and grid topology, the Scoping Plan's Integration Analysis significantly underestimates the magnitude of firm, zero-emission capacity required. Taking these factors into account, the Cornell study predicts a gap of up to 37 GW, which more closely approximates levels identified by another panelist, Zachary Smith, Vice President of System and Resource Planning for the New York Independent System

[4] Heterogenous Vulnerabilities report, page 1 (abstract).
[5] Heterogenous Vulnerabilities report, page 8.
[6] Heterogenous Vulnerabilities report, Supplemental Information, page 14.

Operator (NYISO). As Smith discussed, scenarios modeled in NYISO's 2021-2040 Outlook report predict a need for 27 GW to 45 GW of additional firm, zero-emission capacity.[7]

While spatiotemporal analysis certainly underscores the importance of transmission, it is also important to recognize the practical limitations of transmission in addressing the problem New York faces. For example, much attention has been given to two projects for bringing electricity downstate: Champlain Hudson Power Express (CHPE) and Clean Path New York (CPNY). Yet together these add up to merely 2,550 MW of total transmission capacity. Currently, the downstate region includes 21,690 MW of generation capacity from oil- and gas-fired power plants.[8] So unless new firm zero-emission generation capacity is built downstate to replace those dispatchable fossil fuel sources, that much transmission capacity (and more with electrification of buildings and transportation) will be needed to ensure access to clean electricity from somewhere else. The eventual construction of offshore wind downstate does not alter this since New York City will still need electricity when the wind stops blowing and batteries are depleted.

Equally important is the frequency and duration of times that firm zero-emission capacity must be called upon to meet demand. Based on NYSERDA's Integration Analysis, new firm zero-emission resources might supply less than 2% of annual load, mostly during wind lulls for a few days in the winter.[9] However, Cornell's spatiotemporal analysis predicts that firm capacity could be needed throughout much of the winter and summer seasons. The DPS should explore this further, especially since it affects the types of firm zero-emission generation that can actually do this. For example, renewable natural gas (RNG) and green hydrogen have been proposed as potential firm resources. However, both are limited by their respective fuel supplies. The use of RNG is inherently constrained by limited volumes of biogas. Likewise, green hydrogen relies on stored hydrogen reserves, and if derived from solar and wind, will be subject to the availability of intermittent generation to maintain those reserves.[10]

A valuable point was also made by another panelist, Diedre Altobell of Consolidated Edison. Discussing "N-1-1" contingency, Altobell explained that the grid must be able to recover from conditions in which the two largest components of the system are lost. Since intermittent generators

[7] NYISO, *2021-2040 System & Resource Outlook (The Outlook),* September 22, 2022. https://www.nyiso.com/documents/20142/33384099/2021-2040-Outlook-Report.pdf
[8] NYISO, 2023 Power Trends—A Balanced Approach to a Clean and Reliable Grid, revised August 14, 2023. https://www.nyiso.com/documents/20142/33384099/2021-2040-Outlook-Report.pdf
[9] NYSERDA's Integration Analysis for the Scoping Plan adopted in 2022 predicts DEFR generation providing between 3482 GWh and 4329 GWh annually, corresponding to between 1.3% and 1.7% of predicted state load. Revisions to the Integration Analysis since then reduce this to between 1.1% and 1.3% of total load.
[10] This is also why hydrogen from electrolysis is more appropriately considered energy storage.

cannot be counted on for this purpose, even more firm capacity will be needed to ensure that this important criterion for reliability and resiliency is met. Related to this is the subject of reserve margins, which we discuss in section VII of these comments.

Perhaps the most telling remark from the first panel was by Zack Smith of NYISO who said:

> "What drives the timing of the need for these additional [firm zero-emission] resources? We see that it is demand coupled with the pace of fossil fuel retirement. …anytime that a gap starts to occur in the level of demand and the amount of generation that we have available between nuclear, hydro, and fossil.
> If those add up to less than the demand, then that is when we see the need for additional [firm zero-emission] resources."

The salient take-away message from this is that **a reliable grid requires firm capacity, whether baseload or dispatchable, that can meet demand irrespective of how much other intermittent generation (solar and wind) may also be present in the system.** To meet the CLCPA's goal of carbon-free electricity, this basically means that any retired fossil fuel capacity must be replaced— watt for watt— by an equal amount of firm zero-emission capacity. Since essentially the same amount of firm zero-emission capacity is needed *regardless* of how much solar and wind is installed, this leads to the logical question of whether a more efficient system-level architecture is possible by optimizing the use of firm capacity and relying less on intermittent sources. We discuss this next.

III. The Elephant in the Room – What the "Gap" Characterization Misses

Although the conference's gap discussion was useful in understanding flaws in NYSERDA's analysis, it would be a mistake to characterize the task facing New York as one of filling the "gap" between future demand and a hypothetical scenario that maximizes renewable generation.

The CLCPA does not require that New York maximize the buildout of energy sources defined as "renewable." The only statewide renewable mandate in the CLCPA is for New York to receive 70% of its electricity from renewable sources in the year 2030. Other than securing 8,000 MW of distributed solar by 2025 and 9,000 MW of offshore wind by 2035, the CLCPA has no arbitrary quota for statewide generation from renewables either before or after the year 2030. In fact, according to NYSERDA's own analysis, even if all of the renewable resources needed to meet the

CLCPA's 2030 goal were to remain operational, with load growth this arguably "required" amount of renewable generation in 2030 would correspond to less than half of demand in 2040.[11]

Yet despite flexibility that is clearly available under the law to pursue a diverse set of zero-emission resources, all four illustrative scenarios modeled by NYSERDA in its Integration Analysis for the Scoping Plan conform to a paradigm that focuses on a dramatic expansion of intermittent generation (solar and wind) and runs new firm zero-emission generators only as a last resort. In fact, NYSERDA's nearly-identical scenarios suggest that almost 90% of electricity demand could be met by renewables in 2040, increasing to 95% in 2050. Even more concerning from a technical standpoint, NYSERDA suggests that nearly 70% and 80% of electricity demand could be met with intermittent generation by 2040 and 2050 respectively, even as electricity demand doubles.[12]

As discussed in past comments to the Climate Action Council and the Commission by our organization and others with energy expertise, substantial research confirms that this is the most infeasible, inefficient, and costly path forward.[13] Solar and wind are useful during the early stages of decarbonization when integrating intermittent resources into the grid does not require major system upgrades. However, as those resources are called upon to serve a larger percentage of total generation, the system-level challenges of maintaining reliability when electricity production is governed by the weather instead of real-time demand become formidable barriers. It is an approach that demands an excessive buildout of underperforming low-capacity-factor generation, tremendous battery storage, extensive transmission, and substantial energy imported from elsewhere. As discussed, it also requires building and maintaining duplicative "backup" capacity for when intermittent resources are unavailable and batteries are depleted. Such a land-consuming, materially-intensive, and ecologically invasive approach that relies heavily on overseas manufacturing cannot be described as "green" or sustainable.

However, aside from environmental harm and the logistical difficulties involved, it is important to recognize that the above approach also **directly jeopardizes the end goal of grid**

[11] Scenario 3 of NYSERDA's Integration Analysis (Sept 15, 2023 revision), estimates a statewide electricity load of 170,078 GWh in 2030 and 255,693 GWh in 2040. 70% of 178,985 GWh is 119,055 GWh, which is about 47% of 255,693 GWh.

[12] Scenario 3 of NYSERDA's Integration Analysis (Sept 15, 2023 revision), estimates 177,743 GWh of electricity from wind and solar and a statewide load of 255,693 GWh in 2040, corresponding to 69.5% of electricity served by solar and wind. The same analysis estimates 241,780 GWH of electricity from wind and solar and a statewide load of 310,050 GWh in 2050, corresponding to 78.0% of electricity served by solar and wind.

[13] See New York Energy & Climate Advocates, *Comments on Draft Scoping Plan*, July 1, 2022. https://www.dropbox.com/scl/fi/htf1xnzrbfolthvt33jk0/NYECA-Scoping-Plan-comments_7-1-22r-Schue_Rodberg.pdf?dl=0&rlkey=qgvwl6o7o7mk8ti5dhxtt34lx

decarbonization. Placing undue emphasis on intermittent resources will create a dependency on dispatchable gas for backup in the near-term, which will be difficult to shed later. Because it requires greater use of fast-ramping simple-cycle generators ("peakers") or forces power plants to run in "hot-standby," this pairing is also highly inefficient, causing more gas to be burned for the amount of electricity produced. Furthermore, as more renewables are deployed in the future, allowing intermittent capacity to distort price signals during periods of maximum generation could hinder the viability of zero-emission baseload generators that, if lost, will result in even larger "gaps" that gas would need to fill.

We understand that groups aligned with the solar and wind industry are urging the state to ignore the CLCPA's zero-emission mandate and focus only on the 2030 "renewable" goal. However, this is profoundly irresponsible advice. Unless steps are taken to coordinate actions required to meet the 2030 renewable goal with actions needed to achieve zero-emissions, the state will find itself with a grid architecture that locks in fossil fuels for electricity long after 2040, regardless of what is written in the CLCPA.

Notwithstanding politics, the real world offers a good indicator of what works and what does not. Places that have significantly decarbonized their grids, like France and Ontario, did so not by abandoning high-capacity-factor firm generation, but by embracing it. Meanwhile, governments with ideological bias, like Germany and California, remain far from their climate goals despite having invested billions over decades on solar and wind. Perhaps the most poignant example of contrasting success and failure is New York itself. Thanks to firm, high-capacity-factor hydropower and nuclear, upstate New York already enjoys an extremely low-carbon grid. Meanwhile, the downstate region is powered almost entirely by fossil fuels, a fact exacerbated by the closure of Indian Point.

Fortunately, although the four scenarios originally considered by NYSERDA are not credible pathways to success, the agency's analysis did not end with them. During review of the draft Scoping Plan, valuable comments were received from energy experts and labor questioning the state's failure to consider alternatives. Consequently, NYSERDA presented useful information to the Climate Action Council in November 2022 on advanced nuclear technology, which was also included in Appendix G of the final document. NYSERDA reported that by adding just 4 GW of new nuclear, New York could avoid 12 GW of intermittent generation and 5 GW of storage and backup generation, while saving money and conserving land.[14] Based on annual energy generation alone, 4

[14] Climate Action Council Scoping Plan, December 2022, page 92.
https://climate.ny.gov/resources/scoping-plan/-/media/project/climate/files/Appendix-G.pdf

GW of additional nuclear could alleviate 200 square miles of solar panels or more than 2500 large 5MW land-based wind turbines sprawled across upstate New York.[15] Accounting for "firming" technologies needed to convert intermittent solar or wind to useful electricity (batteries with additional generation to overcome round-trip losses, extensive transmission, and firm backup capacity), the benefits of nuclear would be even greater. Significantly, in a 2020 study of the Pacific Northwest region, E3—the same consultant that has worked with NYSERDA—found that 6.5 GW of firm nuclear power (existing and new) could avoid 91 GW of non-firm resources (solar, wind, and batteries) while saving almost $8 billion.[16] Other states are taking a leadership role in advanced nuclear power.[17] New York ought to be among them.

Meeting the CLCPA's aggressive decarbonization goals is possible. However, doing so will not be achieved if New York is constrained by ideology that shuns baseload power and inherently reliable technology. Instead of conceding to a paradigm not even mandated by the CLCPA, the Commission should encourage and develop programs that support an effective balance of firm and intermittent generation, including new high-capacity-factor resources. To realistically achieve the goal of zero-emission electricity, firm zero-emission capacity should be deployed not merely as ***"backup"*** for intermittent generation. Rather, firm zero-emission capacity should serve a meaningful portion of demand—the ***"backbone"*** of an inherently reliable, carbon-free network. The most effective pathway to grid decarbonization will be one that focuses on the salient goal of grid decarbonization using whatever mix of technologies are most effective.

IV. Zero-Emission Technology Attributes

As discussed during the technical conference, the attributes of zero-emission resources vary, and attention to the capabilities and limitations of various resources that comprise a system is

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[15] Assuming a nuclear capacity factor of 93% and a solar capacity factor of 20%, 4 GW of nuclear corresponds to annual energy of 93/20 x 4 GW = 18.6 GW. At a density of 5-7 acres/MW, this corresponds to 145-203 square miles. Assuming a wind capacity factor of 29%, this corresponds to a 93/29 x 4 GW = 13GW, o wind farm consisting of over 2566 wind turbines, each with a nameplate capacity of 5 MW.

[16] *Pacific Northwest Zero-Emitting Resources Study*, Energy & Environmental Economics, January 13, 2020. https://www.ethree.com/wp-content/uploads/2020/02/E3-Pacific-Northwest-Zero-Emitting-Resources-Study-Jan-2020.pdf ; see also *E3 Examines Role of Nuclear Power in a Deeply Decarbonized Pacific Northwest*, News: Resource Planning, Energy & Environmental Economics, March 9, 2020. https://www.ethree.com/e3-examines-role-of-nuclear-power-in-a-deeply-decarbonized-pacific-northwest/

[17] Martucci, *As states increasingly look to advanced nuclear, Wyoming, Virginia and Michigan lead the way*, Utility Dive, April 17, 2024. https://www.utilitydive.com/news/states-advanced-nuclear-smr-reactors-wyoming-virginia-michigan-lead/71342

essential to ensuring system-wide reliability. Importantly, even within a resource category, the performance attributes of generators vary depending on their design and location in the system.

Although we respect the expertise of NYISO in understanding and managing the New York grid, we find that the table of resource attributes that NYISO presented during the conference is not fully representative of features associated with certain technologies and could lend itself to misinterpretation.[18] For example, NYISO appears to divide traditional and new nuclear power plants into two groups, which it defines as "nuclear" and "modular nuclear." We suggest that "legacy nuclear" and "advanced nuclear" would be better descriptions since the term "advanced nuclear" encompasses the new technologies and modern features that such reactors incorporate.[19] Furthermore, while modularity is common in new reactors designs, it is not a distinguishing factor for the performance attributes identified.

While it is true that existing Generation II nuclear power plants in New York and most of the United States were built to operate as baseload resources, this is not the case everywhere. In France and Germany, many nuclear reactors were specifically designed as load-following facilities and operated as such. In fact, existing nuclear power plants in France continue to function in the grid very much like large load-following fossil fuel power plants do in the United States today. Depending on the particular technology, several advanced reactor designs can also be described as dispatchable, or even fast ramping. For example, the Westinghouse AP1000 is a fully-approved 1,100 MW Generation III+ advanced nuclear reactor currently being deployed around the world, including the United States, Europe, and China.[20] During the nuclear panel discussion of the technical conference, Rita Baranwall of Westinghouse explained that the AP1000 can ramp 1 MW per second or 60 MW per minute in response to load. Furthermore, others like TerraPower's Natrium reactor with thermal

[18] This chart appears originally in Figure 39 of NYISO's 2023-2032 Comprehensive Reliability Plan (November 28, 2023). https://www.nyiso.com/documents/20142/2248481/2023-2032-Comprehensive-Reliability-Plan.pdf

[19] 42 U.S. Code § 16271 defines "advanced nuclear reactor" as: (A) a nuclear fission reactor, including a prototype plant (as defined in sections 50.2 and 52.1 of title 10, Code of Federal Regulations (or successor regulations), with significant improvements compared to reactors operating on December 27, 2020, including improvements such as (i) additional inherent safety features; (ii) lower waste yields; (iii) improved fuel and material performance; (iv) increased tolerance to loss of fuel cooling; (v) enhanced reliability or improved resilience; (vi) increased proliferation resistance; (vii) increased thermal efficiency; (viii) reduced consumption of cooling water and other environmental impacts; (ix) the ability to integrate into electric applications and nonelectric applications; (x) modular sizes to allow for deployment that corresponds with the demand for electricity or process heat; and (xi) operational flexibility to respond to changes in demand for electricity or process heat and to complement integration with intermittent renewable energy or energy storage; (B) a fusion reactor; and (C) a radioisotope power system that utilizes heat from radioactive decay to generate energy.

[20] Westinghouse is also developing the AP300, which a smaller-scale 300 MW SMR version of the AP1000. https://www.westinghousenuclear.com/energy-systems/ap300-smr

storage, now under construction in Kemmerer, Wyoming, are being designed for even greater ramping flexibility to support more intermittent generation on the grid.[21] We encourage NYISO to revise its chart to reflect these capabilities. We also encourage DPS to review the November 2023 testimony titled "Nuclear is a Dispatchable Energy Source" submitted in this docket by Nuclear New York.[22]

Conversely, we notice that NYISO's table generally characterizes fossil fuel and hydrogen combustion power plants as having flexible, quick-start, and multi-start capability. However, the extent to which this is true depends on the plant. Smaller simple-cycle peakers having greater flexibility than larger more efficient, but-less responsive, combined cycle facilities. NYISO's reference to its 2023-2032 Comprehensive Reliability Plan only partially addresses this. For thermal plants—whether they are fossil fuel, hydrogen combustion, or nuclear—these performance attributes depend largely on the individual design, a fact not fully captured in the chart presented or the report referenced. NYISO also describes solar and wind as flexible, quick-start, and multi-start facilities. However, since solar and wind are inherently intermittent resources that depend on the weather or time of day, these descriptions are confusing. Needless to say, the start-up time for a solar panel at 8pm in the evening is 12 hours—or longer if it is raining the next day.

Regarding other technologies, NYISO accurately identifies both batteries and pumped storage as energy-limited, but describes hydrogen as non-energy limited. Fundamentally, hydrogen produced by electrolysis is a form of storage and therefore relies on energy reserves of finite size, along with generation to maintain those reserves. In the case of "green" hydrogen derived from solar or wind, this generation is likely to be limited and sporadic. As previously discussed, NYSERDA's Integration Analysis underestimates the amount of firm generation required to back up a grid dominated by intermittent renewables. But even in doing so, it assumes that half of the hydrogen consumed in-state would need to be imported from elsewhere. It is therefore appropriate to consider hydrogen energy-limited. That said, producing hydrogen from a firm zero-emission source like nuclear power would make those limitations stemming from generation uncertainty less severe.

NYISO identifies all zero-emission resources (except demand response) as having dynamic reactive control capability. However, this is not an inherent feature of every resource. Synchronous

[21] TerraPower: A Nuclear Innovation Company https://www.terrapower.com/ ;
Natrium https://natriumpower.com/

[22] Detering, *Nuclear is a Dispatchable Energy Source*, Nuclear New York, NYS-DPS docket #150-E-0302, Nov 2023. https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7BA0F5C88B-0000-C521-AAAD-996DCC98AF0F%7D

spinning generators can affect and influence reactive power by their operation, but providing adequate dynamic reactive control may require additional equipment, especially if there are large amounts of intermittent generators in the system.[23]Although not mentioned by NYISO, the inertia-maintaining benefits of spinning generators are also very important to grid-stability and system-wide reliability. DPS staff made this point during the conference as well.

V. Application and Viability of Zero-Emission Technologies

As discussed during the conference, achieving the state's goal of zero-emission electricity will require a balance of resources with different attributes. Some resources are valuable because they can assist in reducing demand or improving the profile of demand, while others are essential to reliability by providing guaranteed generation when other resources are not available. Although both contribute to meeting the zero-emission goal, it is important to understand the difference.

Demand-side resources and virtual power plants: The technical conference's third panel on demand-side resources and virtual power plants helped to understand some of the latest techniques and federal programs that are available. However, the concept of demand response is not new. Relatively simple and effective forms of it have been available to commercial and residential customers in several states for years.[24] A common example of this is where a utility is be given permission to occasionally shut off electricity to a residential hot water heater in return for a discount that appears on the customer's monthly bill. Taking this to another level, the panel discussed sophisticated techniques involving remote monitoring and control of multiple loads, sometimes in combination with other on-site resources like storage. We support these investments as ways to improve reliability and system-level efficiency. Nevertheless, it is important to understand that while such mechanisms can help, there is a limit to their benefit. During the conference, it was said that California demand response efforts have been successful in shifting demand by about an hour. There are also limits to which customers will tolerate losing control of their own appliances and electricity service. Given that customer needs vary, this is also reason to question the viability and equity of implementing demand response as an "opt-out" rather than "opt-in" feature, as one panelist suggested.

[23] ZDDQ Electric is one example. https://www.zddqelectric.com/

[24] Residential Demand Response Programs: https://clearlyenergy.com/residential-demand-response-programs

Similarly, we support the integration of demand response with distributed resources of generation and storage, a concept that has been marketed as a "virtual power plant." However, it would be a mistake to think this creates something greater than the sum of its parts. A "virtual power plant" is *equal* to the sum of its parts. Intermittent generation, distributed storage, and demand respond can help meet demand, and they can collectively help more than individually. However, individually or collectively, they do not provide a guarantee of load-serving capacity whenever power may be needed and for however long it may be needed. Ultimately, as one participant in the conference said, a "virtual power plant" is not an actual power plant, and therefore cannot be considered a dispatchable emission-free resource (DEFR).

Long-range energy storage: The technical conference's fourth panel on long-duration energy storage was useful in identifying potential technologies and creating a dialogue regarding what the term "long-duration energy storage" actually means. Although panelists described forms of storage ranging from 8 hours to 100 hours, it was apparent from the panel's interaction with DPS staff that only long-term storage systems on the order of 100 hours might be sufficient to alleviate the need for dispatchable firm generation to cover gaps in a hypothetical grid dominated by intermittent generation. It was also clear from the discussion that while small amounts of long-duration storage may be achievable in the foreseeable future, scalable high-capacity long-duration storage corresponding to tens of gigawatts at 100 hours is not.

Methane: The second day of the conference was dedicated to generation technologies, the first of these being methane. Emily Grubert, associate professor of sustainable energy policy at Notre Dame, emphasized the importance of understanding full lifecycle emissions, including the embedded fossil-fuel component of biogenic sources. She pointed out that carbon capture and sequestration (CCS) does not capture all carbon dioxide emissions, and that it actually magnifies upstream greenhouse gas emissions since the technology requires more fossil fuels per watt-hour of electricity. Questioning the concept of negative emissions, she also pointed out that obtaining methane for biogas or RNG from agricultural operations, landfills, and wastewater treatment plants involve facilities that are specifically designed to maximize methane production, and therefore any greenhouse gas reductions attributed to those facilities must be fairly compared to emissions otherwise produced. Panelists agreed that while RNG can be of potential benefit, limited supplies and refining expense will limit its applicability. While acknowledging the potential of biodiesel in dualfuel plants and peakers, the panelists generally agreed that energy requirements and cost of creating synthetic methane are prohibitive for large-scale use.

Grubert expressed caution regarding assumptions about the ability to effectively maintain infrastructure that will ostensibly have limited use in the future, suggesting that storage of fuel onsite may be more effective than pipelines. It was also discussed that CCS requires a pipeline for removing carbon dioxide, and will be geographically and geologically limited to areas where that carbon dioxide can be sequestered or used. The panel also discussed the higher combustion emission rates and difficulty of preventing onsite leakage from-simple cycle turbines and reciprocating engines, especially if subjected to frequent starts and stops in response to intermittent generation.

Hydrogen: Although identified as "generation" technology during the conference, hydrogen is more appropriately considered a form of storage—an energy carrier whose use is limited by how much of it can be produced from other forms of actual generation. From a practical standpoint, hydrogen will also be limited by the feasibility and cost of related facilities and infrastructure. Pursuing a plan focused predominantly on intermittent generation, New York would likely require 37 GW or more capacity from new or repurposed hydrogen-consuming power plants (combustion turbines or fuel cells). This is in addition to an entirely new network of leak-proof, thick-steel hydrogen-grade pipelines and compressor stations to deliver hydrogen to power plants around the state (400 miles of pipeline according to the state's Scoping Plan). Large hydrogen-storage facilities would have to be built as well. (The Scoping Plan suggests using underground salt caverns, but does not indicate a volume.) Finally, large banks of electrolyzers would be needed to make hydrogen from electricity. If powered by a firm, continuously running zero-emission generator (like a nuclear power plant), less electrolyzers would be necessary since they could operate around the clock.[25] On the other hand, if powered by electricity from excess solar and wind that would otherwise be curtailed, many more would be required, each operating on an extremely intermittent basis.

Whether or not NYSERDA's assumptions about requiring only a small amount of energy from new firm sources are credible, using hydrogen as backup generation within a system dominated by intermittent solar and wind presents major challenges. If that backup generation is only rarely needed, the complexity and expense associated with deploying the previously-mentioned facilities

[25] NYSERDA's Integration Analysis (Sept 2023) predicts that 33 TBtu of hydrogen will be needed annually in 2040, and the energy content of hydrogen is 33.3 kWh/kg. This corresponds to 290,431,599 kg. It takes about 50-55 kWh of electricity to make 1 kg of hydrogen. Therefore, 290,431,599 kg of hydrogen can be made with 14,522 – 15,974 GWh of electricity. Assuming a capacity factor of 93%, this amount of hydrogen could be produced with a 1.8 – 2 GW nuclear power plant.

and infrastructure will likely be impractical. However, in the much more likely case that firm power is needed to compensate for intermittency far more than NYSERDA predicts, the state will not have the resources to produce or procure, and to store, the much larger volumes of hydrogen required. When asked about hydrogen production, panelists agreed that the dedicated resources of nuclear power would be the most effective. One even implied that building a dedicated hydrogen pipeline into the downstate region could be more affordable than electric transmission. Yet, while all of the panelists were enthusiastic about hydrogen, there was little discussion regarding what scale of facilities and infrastructure are feasible. We agree with panelists that there is a role for hydrogen in decarbonizing New York's electric grid, however the extent of that role warrants further study.

Advanced nuclear power: Rita Baranwal is a Senior Vice President at Westinghouse and former Assistant Secretary for Nuclear Energy at the Department of Energy. She began her testimony on the nuclear panel of the conference by discussing how New York's upstate reactors provide 27 million megawatt-hours of electricity annually—nearly half of the state's carbon-free electricity—while sustaining 25,000 direct and indirect jobs. She stated that the cheapest way of limiting carbon emissions is by maintaining existing nuclear power plants, but that the only clear path to zero emissions will also require investment in new nuclear, which is why policy initiatives should include both. She highlighted the benefits of nuclear technology for flexible grid operation, hydrogen production, desalinization, process heat, district heating, and the creation of life-saving medical isotopes. She also discussed specific capabilities of the company's AP1000 reactor, AP300 small modular reactor, and eVinci micro-reactor.

Julie Kozeracki, with the Department of Energy's loan program office, is the principal author of DOE's Advanced Nuclear Liftoff report, which addresses the economics and financing of new nuclear power and calls for over 200 GW of additional nuclear capacity in the United States.[26] As a panelist, she discussed the critical need for expanding nuclear along with renewables to achieve deep decarbonization as demand doubles or triples due to building electrification, electric vehicles, and growth in data centers. Nuclear power has upfront costs; however, as she explained, it is an investment justified by the reliability, system-level attributes, and 80 years or more of long-term operation provided. Kozeracki discussed federal assistance that is available, including partnering

[26] DOE, *The Pathway to Advanced Nuclear Commercial Liftoff*. https://liftoff.energy.gov/advanced-nuclear/ : Full report here: https://liftoff.energy.gov/wp-content/uploads/2023/05/20230320-Liftoff-Advanced-Nuclear-vPUB-0329-Update.pdf

opportunities, tax credits, and low-cost loans that pair well with state funding. She also discussed lessons learned from first-of-a-kind construction relating to initial design, workforce, and supply chains that will make n^{th}-of-a-kind deployment cheaper and faster in the future.

Significantly, all of the members of the nuclear panel challenged the paradigm of firm reliable generation serving only as "backup" for unreliable intermittent generation. As they discussed, credible models show that the most achievable and affordable means of decarbonization is with clean, firm generation serving at least 20% to 40% of demand. Although it was confirmed that Westinghouse advanced nuclear reactors are capable of load-following without degradation or accelerated aging, Kozeracki pointed out that over-maneuvering nuclear plants to work around extremely intermittent solar and wind is not the highest and best use of the technology, and that simply curtailing intermittent generation when necessary makes more sense. She also encouraged activists to examine the environmental impacts and unrealistic assumptions associated with attempting to rely too heavily on solar and wind. Referring to the state's increased dependence on fossil fuels following the closure of Indian Point, she said, "New York has a really stark example of what happens when you don't value nuclear's proposition for a resilient decarbonized grid."

Notwithstanding events of the past, New York should move forward in a positive direction. As a high-capacity-factor source of zero-emission electricity that is not dependent on the weather or time of day, nuclear power reduces the need for sprawling intermittent generation, large amounts of energy storage, and what will otherwise be a web of high-voltage power lines across the state. Moreover, as a firm resource, nuclear power is inherently reliable, obviating the need for additional backup generation. Reliability is further enhanced by the fact that nuclear plants require only occasional refueling. All of these are factors that dramatically reduce physical footprint, material extraction, and infrastructure impacts upon the environment compared to any other alternative—which in turn conserves farmland, natural habitat, and wildlife.

With respect to deployment, advanced reactors can be co-located with existing nuclear facilities that already have a trained workforce and infrastructure, installed in place of polluting fossil fuel power plants, or built elsewhere that communities would enjoy the benefits of clean, reliable energy and high-wage jobs. Because of their small size and inherit safety features, SMRs can be sited with even greater flexibility, making them ideal candidates for behind-the-meter loads such as data centers or industry. If New York is serious about achieving its goal of zero-emission electricity while ensuring ample reliable energy for a healthy economy, it will invest in advanced nuclear power.

Building upon prudent leadership shown by the Commission in convening the zero-emission technical conference, we recommend that DPS perform a detailed analysis of new scenarios involving different types and combinations of intermittent and firm zero-emission resources to meet the state's goal of zero-emission electricity in 2040 and the years that follow. Importantly, this analysis should explore new firm zero-emission resources, including nuclear power, that can serve not only as "backup" to intermittent generation, but in a baseload or load-following capacity. Although the analysis may consider, it should not assume a renewable buildout exceeding that which is required to comply with the CLCPA (70% in the year 2030 and 9 GW of offshore wind by 2035). The analysis should consider a variety of scenarios that focus on system-level efficiency, the optimization of installed capacity, and the minimization of additional support infrastructure. The analysis should also consider feasibility, supply chains and system-wide costs of implementation.

VI. Ensuring a Just Transition and Environmental Justice

The second panel of the conference discussed the importance of a just transition and environmental justice. John Murphy, representing the United Association of Plumbers and Pipefitters, testified on the alignment of technologies capable of closing the gap and meeting the needs for reliable energy with today's workforce. As he explained, nuclear power, hydrogen, and other thermal technologies involve the same highly-skilled, highly unionized workers (welders, pipefitters, millwrights, boilermakers) currently employed in the energy sector. However, he also expressed concern for the future of those quality jobs under a plan based on installing solar panels, wind turbines, and batteries manufactured overseas. As he remarked:

> …Developing new dispatchable zero-emission resources will be critical in helping New York meet its climate goals. While the state has created an extensive program to support renewable sources, it has not developed a similar system for alternative clean energy projects. Like other forms of energy, zero-emission sources require public subsidies, especially in the early stages to become feasible. Investment advisors will always suggest diversifying retirement savings to mitigate risks—Don't put all of your eggs in one basket. Diverting billions in subsidies to primarily renewable sources is putting New Yorkers at risk.
>
> A review of energy programs for the federal government and other states indicates that some of the most promising alternative clean sources include advanced nuclear systems, carbon capture and sequestration, bioenergy, hydrogen power and enhanced geothermal systems. These programs outside of New York are utilizing an all-of-the-above strategy, investing substantial resources in both renewable and zero-emission

options. But unlike most renewable plants, alternative clean sources typically require industrial processes that are supported by a large skilled workforce. These would be high quality union jobs capable of sustaining healthy middle-class communities while returning greater tax revenue to state and local governments.

Utilizing an all-of-the-above energy strategy provides real solutions that will reduce emissions and lower cost while preserving and creating high-skilled middle-class union jobs. Building and upgrading clean power generating facilities creates an environment of job certainty that's necessary to allow building trades unions to recruit from underserved communities most affected by climate change into pre-apprenticeship programs, and having that pipeline of work will allow us to train the clean energy workforce of tomorrow...

Significantly, Murphy also clearly stated early in his testimony that "Any future clean energy programs, policies, and initiatives need to include **<u>new</u> and existing nuclear generation**." Nuclear power is "Made-in-America." It has the most unionized and highest paid workforce of any energy sector.[27] A fossil fuel worker transitioning to nuclear sector experiences upward career mobility. One that takes a job installing solar panels from China does not.

With respect to environmental justice, the most "unjust" transition is the transition that does not occur. Members of the second panel agreed that disadvantaged communities bear the brunt of harm caused by society's dependence on fossil fuels, and that failure or delay in reducing emissions will harm them the most. Yet, by focusing on the buildout of intermittent resources that can only partially reduce emissions, disadvantaged communities are put at greatest risk. The tragedy of a grid architecture that relies on 37 GW of dispatchable emission-free capacity to back up solar and wind is that when that backup generation does not materialize, New York will have to retain 37 gigawatts of fossil fuel capacity—essentially the state's entire fossil fuel fleet. Moreover, when those fossil fuel plants are needed a lot more than NYSERDA's rosy estimates predict and are forced to operate under conditions that make them less efficient, New York could find that it has made little real progress in curbing emissions. New York will not avoid the costly mistakes of California and Germany by following in their footsteps.

Ultimately, overcoming racial and socio-economic prejudice that has historically harmed environmental justice communities will require tackling *technology* prejudice that contributes to misguided policy and hinders progress. As John Murphy pointed out, when Indian Point closed, a thousand highly skilled permanent jobs were lost and the amount of fossil fuels burned for electricity

[27] U.S. DOE, *Pathways to Commercial Liftoff: Advanced Nuclear* (previously cited)
U.S. Energy and Employment Jobs Report (USEER)
https://www.energy.gov/policy/us-energy-employment-jobs-reportuseer

downstate skyrocketed.[28] Moreover, New York became responsible for over 10 million tons of avoidable greenhouse gas emissions entering the atmosphere every year, along with co-pollutants that disproportionately impact disadvantaged communities.[29] Those are emissions that will continue to be produced until and unless New York fully decarbonizes its grid. Losing nuclear power was an environmental justice failure that the state should take care not to repeat.

Importantly, attention to environmental justice also requires reliable, affordable electricity. Low-income New Yorkers will suffer most from the lack of electricity or heat when service is lost, and may live in areas where losing electricity threatens public safety. They will also have difficulty affording energy made expensive by a system that is unnecessarily complex and inefficient. According to NYISO, losing downstate nuclear resulted in thinner reliability margins and higher electric bills. By encouraging a balanced portfolio of zero-emission resources, the Commission can ensure reliability while controlling cost.

Finally, the Commission should recognize that not all injustice is downstate. Many upstate communities believe they have been discriminated against by a heavy-handed set of dictates associated with CLCPA implementation. These grievances include a dissolution of "home rule" and local laws that can be overridden by the Office of Renewable Energy Siting (ORES); lack of meaningful public input or attention to the negative environmental, agricultural, and community impacts of large-scale renewables; the deprivation of fair property tax revenue for towns that are required to host such projects; and the increased use of eminent domain in the building of transmission to support them.[30] Many towns stand to lose a significant amount of rural land to

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[28] From 2019 to 2022, fossil fuel generation grew from 45 TWh to 60 TWh even as reliance on imported electricity rose. Notably, this occurred during the COVID pandemic when demand was down.

[29] Natural gas CO_2 emissions coefficient is 116.65 lb/million BTU;
https://www.eia.gov/environment/emissions/co2_vol_mass.php ;
Average NGCC heat rate (2021) is 7580 BTU/kWh ; https://www.eia.gov/electricity/annual/html/epa_08_02.html
1 ton/2000 lb x 116.65 lb/ 1,000,000 BTU x 7580 BTU/kWh x 1,000,000 kWh/GWh = 442.1 tons CO_2/GWh
Therefore, Indian Point avoided 16,695 GWh x 442.1 tons CO_2/GWh = 7.38 million tons CO_2 annually compared to NGCC. Depending on lifecycle methane leakage rate, total greenhouse gas emissions could be double this amount.

[30] In 2021, the NYS Department of Tax and Finance (DTF) prepared a statewide appraisal model for solar and wind projects that was intended to supersede local appraisal methods, and that dramatically reduced revenue to towns and school boards in communities where solar and wind projects are sited. Several towns challenged the model on grounds that it violated the State Administrative Procedures Act (SAPA). Validating their complaint, a temporary restraining order was issued by the court. (*Town of Blenheim, et. al. v. NYS Tax and Finance*, Index No. 903157-22, Albany Co.) In response to this and depriving towns of due process, a provision was then added to a state budget bill during the 2023 NYS legislative session to specifically exempt appraisal models and discount rates from SAPA, allow DTF to summarily adopt the state's solar and wind appraisal model, and void the case in litigation. The "RAPID" Act, passed as part of the budget during the 2024 session, provides additional authority for using eminent domain and eliminating conservation easements for transmission to support projects approved through the expedited ORES process.

sprawling industrial-scale solar or wind projects that their residents strongly oppose. As expressed by a spokesperson for one such group during Q&A with the panel, there is growing animosity among upstate residents that the community protection part of the state's Climate Leadership and *Community Protection* Act does not apply to them. The Commission can address this by encourage less intrusive, zero-emission alternatives that will reduce the magnitude of these impacts and conserve upstate resources.

VII. Other Issues Affecting the Zero-Emission Goal

Although the zero-emission technical conference was a useful step toward greater awareness on actions necessary to attain a zero-emission grid, a few important topics were not addressed. We discuss some of those here.

Impact of "Renewable" Goal on Zero-Emission Goal: Our concerns regarding a preference for intermittent resources over reliable zero-emission generation are discussed in Section III of these comments. Although we find the CLCPA's "renewable" goal orthogonal to the meaningful purpose of greenhouse gas reduction, it is not necessarily a barrier to achieving a zero-emission grid since the CLCPA only mandates that New York receive 70% of its electricity from renewables in the year 2030. This provides flexibility for other existing zero-emission generators to continue providing firm electricity essential to a reliable grid, and it allows for the further expansion of new, firm, inherently reliable zero-emission resources beyond 2030. We do recognize, however, that actions taken in the near term to implement the 2030 goal could hinder, or make more difficult and costly, the ultimate goal of zero-emission electricity.

This a particular threat if almost all new renewables deployed in the state are intermittent generators (solar and wind). To limit future dependency on fossil fuels that will be difficult to shed later, the Commission should provide greater support for the development of renewable resources like hydropower that are inherently reliable, provided they can be developed in an ecologically-responsible manner. An example of this (also referenced in prior comments) is expansion of the Green Island Hydroelectric Power Station on the Hudson River north of Albany. Since 2009, a proposal has existed to expand the current 6 MW facility to 48 MW by replacing four old turbines with eight modern ones. In addition to offering a reliable source of carbon-free electricity in proximity to the state's capital, the proposal includes a public park and fish-exclusion technology that would make the facility more ecologically friendly than today.[31] Yet, for lack of state-level support, progress has languished. The fact that a beneficial, shovel-ready project like this remains stagnant years after CLCPA adoption while projects that challenge grid reliability are expedited is indicative of a process in need of reform.

In addition, the Commission should carefully examine how growth in intermittent generation could undermine the goal of 100% carbon-free electricity in the future, and especially after 2030. Proper system-level planning will be necessary to ensure that actions ostensibly taken to reduce greenhouse gas emission do not have the unintended consequence of locking in fossil fuels. This evaluation should consider realistic forecasts of demand; the type, scale, and location of additional renewables proposed; and the interaction between intermittent generation and storage, firm zero-emission generation, and existing fossil fuel resources. If the Commission finds that the 2030 goal threatens eventual realization of a zero-emission grid, then corrective action should be taken—for example, by establishing a more flexible renewable target or one focused more broadly on zero-emission resources instead of myopically on "renewables."

Imported Electricity: Another issue that can significantly impact the magnitude and duration of necessary firm generation is interconnectivity with neighboring jurisdictions. NYSERDA makes extremely generous assumptions about the availability of imports, including exchanges of clean imported and exported electricity to meet real-time demand, access to significant dedicated sources of hydropower and wind outside New York, and access to green hydrogen produced elsewhere to satisfy half of the state's needs.[32] Notably, since every state cannot expect to receive clean energy from somewhere else to make up for its own shortfall, this weakens claims that New York's plan will be a model for others to follow.

NYSERDA's Integration Analysis appears to suggest that by 2040 approximately 12 to 13 TWh of demand will be met by unspecified renewable imports, and that this amount of electricity would be balanced on an annual basis by an equal amount of renewable exports, supposedly when not needed in-state.[33] However, weather patterns and the availability of sunshine and wind often correlate regionally, meaning that neighboring states are likely to experience a surplus or dearth of

[31] Village of Green Island, *Expansion Plans, Project Renderings, Modernizing Hudson River Hydropower.* https://villageofgreenisland.com/gipa/expansion-plans/

[32] See prior discussion o hydrogen in Section V of these comments.

[33] For the purpose of this discussion, we presume that in 2040, any imported electricity serving in-state demand is from zero-emission sources, consistent with requirements of the CLCPA. See further discussion in NYECA answers to question pursuant to the PSC's May 18, 2023 *Order Initiating Process Regarding Zero Emissions Target* and October 20, 2023 *Notice Seeking Further Comment.*

electricity from renewables at the same time New York does. In fact, NYISO warns of this in its Phase II Climate Change Impact and Resilience Study: [34]

> The variability of meteorological conditions that govern the output from wind and solar resources presents a fundamental challenge to relying on those resources to meet electricity demand. In scenarios involving [Loss of Load Occurrences], or requiring substantial contributions from [dispatchable emission-free] resources, periods of reduced output from wind and solar resources are the primary driver of challenging system reliability conditions, particularly during extended wind lull events…**Importantly, further increasing the nameplate capacity of such resources is of limited value, since when output is low, it is low for all similar resources across regions or the whole state.** (emphasis added)

NYSERDA does not explain how it concludes that New York will be able to freely exchange 13 TWh of surplus carbon-free electricity produced in-state at times when it is not needed for 13 TWh of carbon-free electricity from elsewhere when it is. Nor has relevant information, such as the projected capacity and timing of such imports and exports been disclosed. While California remains far from achieving its renewable goals, it was forced to curtail 2.4 TWh of renewable generation in 2022 (mostly solar) due to congestion and an inability to serve outside markets.[35] This represents over two weeks of New York City's average electric load. Yet all four of NYSERDA's scenarios assume no curtailment whatsoever. Significantly, 13 TWh is over three times the energy that NYSERDA predicts will be needed from dispatchable emission-free resources. Unrealistic assumptions about clean energy exchange with other jurisdictions are likely to have skewed NYSERDA's modeling. We strongly encourage DPS to investigate this further, as it directly impacts how much and how often the state will need firm zero-emission capacity to ensure reliability.

Additionally, the NYSERDA's Integration Analysis assumes significant dedicated capacity from wind sources outside of New York, about 6 GW in 2040. Yet based on NYSERDA's predictions of energy generation, those sources would have a capacity factor of 45%, which is impossible unless nearly all are offshore wind turbines. Considering that many of New York's neighbors are inland and that those with coastline are unlikely to dedicate their own offshore resources for another state, we find this capacity factor assumption astonishing. It is also important to recognize that New York's contract with Quebec for CHPE hydropower is not a guarantee of service.

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[34] Analysis Group for NYISO, *Climate Change Impact and Resilience Study – Phase II: An Assessment of Climate Change Impacts on Power System Reliability in New York State, Final Report,* September 2020. https://www.nyiso.com/documents/20142/16884550/NYISO-Climate-Impact-Study-Phase-2-Report.pdf

[35] *Solar and Wind Power Curtailments are Rising in California,* U.S. Energy Information Administration, October 30, 2023. https://www.eia.gov/todayinenergy/detail.php?id=60822#

In the future, if both Quebec and Manhattan require more electricity in winter, New York City residents who have converted to heat pumps could be left in the cold.

Again, DPS should carefully examine any assumptions regarding the availability of imported electricity, as this will directly impact how much and what kind of firm zero-emission capacity New York must plan for to maintain reliability while achieving the CLCPA's goal of carbon-free electricity. The fact that NYSERDA's modeling relies so heavily on the assumed availability of imports, as well as the assumed flexibility of energy exchange with neighboring jurisdictions, underscores the vulnerability of its decarbonization strategy.

Behind-the-Meter Resources: Although they were a subject of recent questions by the Commission to parties in this proceeding, behind-the-meter resources were not discussed in a meaningful way during the technical conference. Behind-the-meter generation can play a useful role in meeting CLCPA goals, both in achieving the goal of zero-emission electricity as well as decarbonizing other sectors. For example, future small modular reactors could provide electricity for dedicated loads and process heat for difficult-to-decarbonize industries. In fact, this is what Dow is planning at its Seadrift chemical plant in Texas which will deploy four 80 MW Xe-100 pebble-bed reactors from X-Energy to create heat and power, replacing fossil fuel combustion to fully decarbonize the facility.[36] Experiencing rapid growth with the emergence of Artificial Intelligence, data centers—which require large amounts of continuous reliable electricity—are another application for carbon-free nuclear energy in a behind-the-meter or dedicated power setting. Recently Oklo, a developer of advanced micro-reactors, signed an agreement with Equinix to provide up to 500MW of power for its expanding data center operations.[37] Microsoft and Amazon are pursuing opportunities to co-locate data centers with nuclear facilities as well.[38]

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[36] *DOW and X-Energy advance efforts to deploy first advanced small modular nuclear reactor at industrial site under DOE's advance reactor demonstration program,* DOW press release. https://corporate.dow.com/en-us/news/press-releases/dow-x-energy-collaborate-on-smr-nuclear.html ; see also: https://x-energy.com/seadrift

[37] Swinhoe, *Equinix signs deal to procure up to 500MW of nuclear power from Oklo reactors – makes $25m pre-payment: Equinix makes first SMR deal for a colocation company,* Data Center Dynamics, April 5, 2024. https://www.datacenterdynamics.com/en/news/equinix-signs-deal-to-procure-up-to-500mw-of-nuclear-power-from-oklo-smrs-makes-25m-pre-payment/

[38] Swinhoe, AWS acquires Talen's nuclear data center campus in Pennsylvania: Cloud company pays $650 million – plans 960MW campus, Data Center Dynamics, March 4, 2024.
https://www.datacenterdynamics.com/en/news/aws-acquires-talens-nuclear-data-center-campus-in-pennsylvania/ ;
Moss, *Microsoft & OpenAI consider $100bn, 5GW 'Stargate' AI data center – report: Enormous supercomputer could launch in 2028,* Data Center Dynamics, March 29, 2024.
https://www.datacenterdynamics.com/en/news/microsoft-openai-consider-100bn-5gw-stargate-ai-data-center-report/

The Commission should work with and support industry to develop similar opportunities in New York. For example, Micron is planning to build a very large manufacturing complex upstate. It is reported that the facility will require an average of 928 MW of electricity, comparable to the output of a gigawatt nuclear reactor that operates 24/7. In fact, Micron would consume more electricity than the entire state of Vermont.[39] This is in *addition* to requiring heat, which the plant currently expects to provide with natural gas. Regardless of how renewable energy certificates or other creative offsets might be manipulated to create the appearance of relying on renewables only, such a manufacturing facility in reality will require continuous, reliable electricity and heat that cannot come from solar, wind, or excess hydropower alone.[40] To avoid an otherwise inevitable increase in fossil fuel consumption resulting from this business venture—which is important to the region's economy—it would be helpful to consider how advanced nuclear could be used in a behind-the-meter configuration for onsite power and heat.

This said, it will also be important to ensure that behind-the-meter applications comply with the CLCPA's zero-emission mandate. We recognize that certain loads like hospitals and emergency shelters may need to have emergency fossil fuel generators onsite in case the external grid loses power. Since the emergency conditions for which they are intended are rare, resulting greenhouse gas emissions from such generators are de minimis. However, if fossil fuels are burned behind-the-meter during normal operation, emissions can be significant. For example, concerns have been raised that crypto-currency operators could try to escape CLCPA compliance by using behind-the-meter electricity from fossil fuels to run energy-intensive blockchain algorithms. With growth in cryptocurrency, data centers, and other industries seeking to provide their own power, this could become a significant loophole that undermines greenhouse gas reduction unless firm, carbon-free sources of behind-the-meter power are encouraged.[41]

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[39] Tim Knauss, *How would Micron's electricity-hogging plan here live with NY's war on fossil fuels?* Syracuse.com , February 28, 2023. https://www.syracuse.com/news/2023/02/how-would-microns-electricity-hogging-plant-here-live-with-nys-war-on-fossil-fuels.html ;
Molly Burke, *Semiconductor manufacturing expected to strain NY electrical grid,* Times Union, February 26, 2024. https://www.timesunion.com/state/article/globalfoundries-project-brings-load-new-york-s-18677537.php

[40] The NYPA RechargeNY program provides for the low-cost allocation of hydropower capacity to qualifying businesses as an incentive for economic development. As of March 2023, the GlobalFoundries Micron project had been recommended for 60 MW of hydropower capacity. https://www.nypa.gov/services/incentives-and-grants/recharge-ny

[41] Buckley, *IEA Study Sees AI, Cryptocurrency Doubling Data Center Energy Consumption by 2026,* Data Center Frontier, March 8, 2024. https://www.datacenterfrontier.com/energy/article/33038469/iea-study-sees-ai-cryptocurrency-doubling-data-center-energy-consumption-by-2026

Inasmuch as the state counts behind-the-meter residential solar as contributing to the state's 2030 renewable energy goal, it must count behind-the-meter resources that are *not* renewable or zero-emission *against* the 2030 and 2040 mandates, respectively. To be clear, we do not support discriminating against businesses based on the amount of energy they use. However, the Commission should exercise its full authority to ensure that behind-the-meter applications, regardless of their business interest, achieve compliance with the CLCPA's mandate of zero-emission electricity. The Commission should evaluate what kind of regulatory framework will be needed to ensure that such operations are covered and develop programs to implement that regulatory structure.

Reserve Margins: NYISO describes the purpose of the New York Installed Capacity (ICAP) Market as serving "to maintain reliability of the bulk power system by procuring sufficient resource capacity to meet expected maximum energy needs *plus an Installed Reserve Margin (IRM).*"[42] Presently this reserve margin is driven by the need to ensure reliability in the face of uncertainty in supplies of electricity that are predominantly baseload or dispatchable, and thus inherently reliable. To achieve system-wide reliability today, NYISO targets a IRM of about 20%.[43] However, it is unclear what margins are needed to ensure the reliability of a grid dominated by intermittent generators in which supply is inherently uncertain. Nor is it apparent how a capacity market can be structured to support the very large capacity of backup generation that such a grid would require. The need for capacity payments to safeguard the system could swell with cost passed on to consumers. Likewise, transmission congestion contracts could be impacted.[44]

NYSERDA and NYISO do not appear to address these concerns in their estimates of required facilities. However, doing so will likely result in the need for even more zero-emission firm generation, storage, and infrastructure than estimated thus far. There may also be a new temporal component of uncertainty associated with storage and dispatchable firm resources that are fuel-limited like hydrogen or renewable natural gas. We recommend that the Commission and NYISO evaluate these issues to determine what kinds of reserve margins, programs, and market structures are needed and their feasible to ensure reliability as the grid change. This information will be important as decisions are made regarding future architecture and components of the system.

[42] NYISO, Installed Capacity Market (ICAP) https://www.nyiso.com/installed-capacity-market ; https://www.nyiso.com/documents/20142/34827341/Installed-Capacity-ICAP-Market.pdf
[43] NYSIO, *How the Installed Reserve Margin Supports Reliability in New York,* April 27, 2023. https://www.nyiso.com/-/how-the-installed-reserve-margin-supports-reliability-in-new-york
[44] NYISO, Transmission Congestion Contracts (TCC) https://www.nyiso.com/transmission-congestion-contracts-tcc

In conclusion, our organization again wishes to thank the Commission and DPS staff for hosting a zero emissions technical conference, an important first step to developing an effective strategy for meeting the CLCPA's goal of zero-emission electricity.

We are available to discuss these matters at any time.

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Respectfully submitted,

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