New York Energy and Climate Advocates
310 W. 86th St. #6B, New York, NY 10024

New York State Senate and Assembly
Submitted by electronic mail to wamchair@nyassembly.gov and financechair@nysenate.gov

January 28, 2022

RE: Written Comments for February 1st Environmental Conservation Budget Hearing

Dear members of the State Senate and Assembly,

Please accept the following comments on behalf of New York Energy & Climate Advocates as part of the 2022 Budget Hearing process. These are being submitted pursuant to our previously submitted request to speak at the upcoming February 1st hearing.

Several elements of the Transportation, Economic Development, and Environmental Conservation budget bill (A.9008) seek to address aspects of CLCPA implementation by discouraging gas service to buildings, encouraging electrification, and requiring that new building have zero "on-site" GHG emissions by 2027. Similarly, the Executive's education, labor, and family assistance bill (A.9006) calls for the transition to zero-emission school buses by certain dates.

Our organization supports beneficial electrification initiatives, and we recognize such efforts as important in meeting statewide greenhouse gas reduction goals. However, according to projections by NYISO and NYSERDA, the widespread electrification of heating systems, transportation, and industrial processes will require that New York generate significantly *more* electricity than we do today, perhaps twice as much. Therefore, unless the state develops a credible plan for generating that electricity—reliably, when it is needed—then this year's budget, and future budgets, are likely to spend a lot of money on efforts that are inadequate to address the climate crisis, that will increase cost to New Yorker ratepayers and taxpayers, and that could threaten the provision of reliable energy necessary for New York economically prosper in the future.

We believe that the draft scoping plan that has been put forth by the New York State Climate Action Council, and which referencing analysis by NYSERDA, is seriously flawed. Further, because the draft plan does not constitute a realistic implementation strategy for meeting electricity demand with carbon-free sources, it condemns New York to a future that remains substantially dependent on fossil fuels.

In addition to twice the amount of offshore wind identified in the CLCPA, the draft plan recommends astronomical levels of *onshore* wind and solar. Based on NYSERDA's proposed annual generation from solar, many hundreds of square miles of fields, forest, and farmland would need to be converted to glass, steel, and copper—an area roughly the size of Albany sacrificed each and every year for decades. Furthermore, despite the fact that not a single wind turbine has been installed in New York in the past

three years, NYSERDA proposes to erect thousands across upstate New York in the next two decades. To save energy from wind and solar for when it is actually needed, New York would also require a hundred times more storage than the biggest battery in the world. This is in addition to massive amounts of costly transmission infrastructure.

Upstate communities, agriculture lands, and the integrity of connected natural ecosystems would be adversely impacted by the Council's proposed plan. Yet, even *if* one assumes an implausible scenario in which upstate communities tolerate such a massive industrial buildout and New York ratepayers and taxpayers accept the cost, it would still be inadequate to meet our energy needs. Analysts admit that ensuring reliability when the weather doesn't cooperate and batteries are depleted would require "firm" backup generation approaching the entire capacity of gas plants in the state. In the real world, it is not difficult to see where such a strategy—one based on an inefficient Rube-Goldberg scheme of overbuilt, underperforming sources—will lead. As in California and Germany, it leads to skyrocketing electric rates, grid instability, ongoing dependence on fossil fuels, and little progress on climate change.

If New York hopes for a different outcome, it must take a different approach. Rather than only considering firm carbon-free capacity as backup to an overbuilt network of intermittent sources, the state would be in a far better position to achieve its climate and energy goals by making optimal use of firm generation that is also capable of supplying baseload power.

Along with a *rational* deployment of renewables, reliable energy-dense **nuclear power** can effectively tackle climate change, conserve land, and meet the needs of a global economy. Capable of producing electricity around the clock or as needed, nuclear is both compact and carbon-free. In fact, the U.N. Economic Commission for Europe recently determined that nuclear power has the lowest total carbon footprint of any energy source—including wind and solar—as well as the lowest lifecycle land use, mineral, and metal requirements of carbon-free technologies. Moreover, the United Nations Intergovernmental Panel on Climate Change includes nuclear in every viable pathway to avoiding the worst impacts of global warming.

Importantly, nuclear power is also scalable. France decarbonized its grid in a little over a decade with nuclear, and President Macron recently pledged support for a new generation of advanced reactors. Likewise, here in the United States, companies like NuScale and TerraPower are designing passively-safe, modular plants that can respond rapidly to changes in load—a good match for renewables, peaking, or baseload generation. The Biden administration, along with legislators on both sides of the aisle, now acknowledge the role that nuclear power—existing and next generation technology—must play if we are to successfully decarbonize our energy system. Highlighting that enthusiasm, U.S. Energy Secretary Jennifer Granholm recently said, "We are very bullish on advanced nuclear reactors...Nuclear is dispatchable, clean baseload power, so we want to be able to bring more on."

Significantly, the Empire State and especially upstate New York has been an historic leader in nuclear research and power generation—from Knolls Atomic Power Laboratory in Schenectady to the four reliable reactors on Lake Ontario which produce much of our state's electricity. We have the skills, manpower, and New York spirit of innovation to build upon that foundation. Moreover, doing so would create quality union jobs, strengthen our economy, and ensure that the state makes good on its climate commitments.

Yet despite generating nearly all of our non-hydro carbon-free electricity, nuclear power in New York has not received the informed attention that it deserves. Nuclear expertise has been conspicuously absent from the state's Climate Action Council and its subcommittees. Similarly, the Public Service Commission has revised the state's Clean Energy Standard to address the CLCPA interim objective of 70% renewables; however, it has remained silent with respect to the legislation's mandate for carbon-free electricity by 2040, essential for greenhouse gas reduction goals to be met.

Needless to say, over the last several years, New York has pursued conflicting policy with respect to nuclear energy. Renewables like wind and solar can certainly help meet the state's goals, but they are not enough. If New York hopes to achieve a carbon-free grid by 2040 and beyond, we will need more renewables ***and*** more nuclear power. Mindful of facts and setting politics aside, we urge state leaders to require the development of effective, rational policies that recognize the important value that all forms of carbon-free generation, including nuclear power, have in decarbonizing our energy system.

Enclosed as part of this written testimony are various documents that we have submitted to the Climate Action Council and the Department of Public Service detailing many of these points with references. We are also including a set of unanswered questions that we submitted to NYSERDA regarding its integration analysis last October and several times since then, including through the DPS Clean Energy Standard proceeding.

Thank you for considering these comments.

Sincerely,

Keith Schue, technical advisor
New York Energy & Climate Advocates
407-470-9433 (cell)

Enclosures:

Letter to CAC on importance of nuclear power from James Hansen, et al – June 24, 2020
Comments on CES White Paper to Implement the CLCPA – July 24, 2020
Comments of E3 Pacific Northwest Study – September 15, 2020
Response to NYC comments on CES – December 1, 2020
Response to RHN in gas proceeding – December 15, 2020
Response to Order Modifying the Clean Energy Standard – March 5, 2021
Comments on need for nuclear power referencing California study – April 7, 2021
Response in gas proceeding to PSC and legislators – August 24, 2021
Comments in CES proceeding response to petition for a zero-emission program – Sept 17, 2021
Comments in CES proceeding in support of technical conference – Dec 8, 2021
Comments to NYS Assembly Committee on Environmental Conservation – Dec 9, 2021
Questions to NYSERDA about CLCPA Integration Analysis (NYECA) – Dec 7, 2021

ENCLOSED DOCUMENTS

June 24, 2020

TO: NYS Climate Action Council ClimateAct@dec.ny.gov

RE: Importance of Nuclear Power to CLCPA Goals

Dear Ms. Barton, Mr. Seggos, and members of the Climate Action Council,

Thank you for your service as members of the Climate Action Council. Your collaborative work will be essential to achieve ambitious goals of the CLCPA while meeting the state's ongoing demand for energy.

We are writing to urge the Council to recognize and plan for the essential role that carbon-free nuclear power—existing and advanced—must play in the future.

Renewable energy and energy efficiency will be important components of a coherent strategy for meeting state climate goals. But they are not enough. As wind and solar comprise a larger portion of electricity generation on the grid, the challenges of intermittency become increasingly difficult, resulting in the need to overbuild, as well as curtail, renewable capacity. Due to these dynamics and the practical limitations of storage, attempting to serve baseload demand with intermittent sources in the real world leads to the "partnering" of renewables with fossil fuels, specifically gas. This not only puts carbon in the air, but can also result in less efficient gas-fired generation.

On the other hand, the combination of nuclear power, renewables, and energy efficiency offers a credible path forward. Because nuclear serves baseload demand, it will be a critical part of any realistic plan to achieve the CLCPA goal of 100% carbon-free electricity by 2040. Last year, nuclear power provided a third of New York's in-state generation and over half of its carbon-free electricity. However, by closing just half of one nuclear power plant this year (Indian Point Reactor 2), New York eliminated more carbon-free electricity on an annual basis than generated by all of the wind turbines and solar panels currently in the state. Losing nuclear power in New York would jeopardize greenhouse gas reduction objectives of the CLCPA, wiping out most of the benefit that might otherwise be achieved by the 70% renewable goal. Moreover, the reality is that choosing to shut down nuclear is a choice to keep power plants that burn fossil fuels within Environmental Justice communities running longer.

Recently, the New York Independent System Operator found that with the beneficial electrification of transportation and heating systems, even assuming aggressive targets in energy efficiency are achieved, demand for electricity in the state could increase by 40% in the next twenty years and by over 60% in 2050. Clearly, we cannot afford to take any carbon-free sources of energy off the table if goals of the CLCPA are to be met.

Moving forward, it will be important for the Climate Action Council to base decisions on science and a solid understanding of viable solutions. Nuclear power will be essential for the CLCPA to succeed. We look forward to working with the Council to make abundant carbon-free energy, vital to tackling climate change and securing a bright future for New York, a reality.

Sincerely,

The undersigned (next page)

James E. Hansen, PhD
Columbia University Earth Institute and former Director of NASA's Goddard Institute
475 Riverside Drive (Room 401-O), New York, NY 10115
jeh1@columbia.edu

Dietmar Detering, PhD, Co-founder, Nuclear New York
3961 47th St, Sunnyside, NY 11104
info@nuclearny.org

Isuru Seneviratne, Energy Investor and Climate Analyst, Radiant Value Management
35-20 Leverich St #A609, Jackson Heights, NY 11372
isuru@radiantval.com

Leonard Rodberg, PhD, Physicist and Professor Emeritus of Urban Studies, Queens College/CUNY
310 W. 86th St. #6B, New York, NY 10024
lensqc@infoshare.org

Keith Schue, Electrical Engineer and Technical Advisor, NY Energy and Climate Advocates
9 Maple Avenue, Cherry Valley, NY 13320
keithschue@gmail.com

Dennis Higgins, Assistant Professor Mathematics and Computer Science, SUNY Oneonta, retired
592 County Highway 5, Otego, NY 13825
dennis.higgins@oneonta.edu

Gary Krellenstein, Nuclear Engineer and Environmental Analyst,
former Managing Director for JPMorgan-Chase Energy and Environmental Group
107 Hemlock Rd, Manhasset, NY 11030
gkrell@gmail.com

Herschel Specter, President of Micro-Utilities, Inc., Nuclear Safety Engineer
20 Old Mamaroneck Rd, White Plains, N.Y. 10605
mhspecter@verizon.net

Philip Kahn, PhD, Atmospheric Science, Co-Leader of NYC Chapter of Citizen Climate Lobby
120 East End Ave., Apt. 9C, New York, NY 10028
phkahn@hotmail.com

Ethan Bodnaruk, Civil and Nuclear Engineer
24B Emmons Road, Lansing NY 14882
ebodnaruk@gmail.com

Charles Rose, President RBG Design-Build, Industrial Engineer and Systems Analyst
P.O. Box 189, New Paltz, NY 12561
crose@rbgdesignbuild.com

CC: The Honorable Andrew M. Cuomo, Governor of New York

STATE OF NEW YORK
PUBLIC SERVICE COMMISSION

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

PRELIMINARY COMMENTS ON
"WHITE PAPER ON CLEAN ENERGY STANDARD PROCUREMENTS TO IMPLEMENT NEW YORK'S CLIMATE LEADERSHIP AND COMMUNITY PROTECTION ACT"
BY NEW YORK ENERGY AND CLIMATE ADVOCATES AND NUCLEAR NEW YORK

July 24, 2020

I. Introduction

On June 18, 2020, the New York Department of Public Service (DPS) and the New York State Energy Research and Development Authority (NYSERDA) issued a document titled "White Paper on Clean Energy Standard to Implement New York's Climate Leadership and Community Protection Act" in the above referenced case. This was followed on June 30, 2020 by a public notice to solicit comments and to schedule a technical conference, which took place on July 14, 2020. These preliminary comments are submitted pursuant to that solicitation.

In the comments that follow, we discuss what we believe to be an improper lack of attention by the white paper to Clean Energy Standard (CES) procurement measures needed to meet requirements of the Climate Leadership and Community Protection Act (CLCPA), including specifically the mandate for 100% carbon-free electricity by 2040. We discuss the essential role of nuclear power in achieving that mandate, and we discuss potential approaches for the support of nuclear power and firm carbon-free resources within the tier structure of the CES. We also discuss the important relationship between these matters and Environmental Justice provisions of the CLCPA.

II. Relevance of White Paper to the CLCPA's zero-emission mandate

The public notice issued on June 30, 2020 (Notice Scheduling Technical Conference and Soliciting Comments) states:

> *Following the Technical Conference, interested entities are invited to submit preliminary feedback on the substance of the White Paper and the discussion at the conference to help inform NYSERDA and DPS Staff on whether further stakeholder outreach is warranted.*

We do believe that further stakeholder outreach is warranted to address critical matters essential to successful implementation of the CLCPA. As we discuss here, important components of the Clean Energy Standard (CES) are absent from the June 18th white paper and were not addressed during the technical conference.

As indicated by its title, the purpose of the white paper produced by DPS and NYSERDA is to evaluate CES procurements needed to implement New York's Climate Leadership and Community Protection Act (CLCPA). As articulated in the Act, the CLCPA establishes two very specific targets for the electricity sector: 70% renewable electricity from load serving entities by 2030 and 100% carbon-free electricity by 2040. The white paper discusses proposals for implementing the 70% renewable goal at length. However, except for mentioning the existence of a carbon-free electricity goal in the introduction, all discussion of CES procurement activities necessary to achieve the 2040 goal is conspicuously absent from the white paper. Further, during the technical conference which occurred on July 14th, DPS and NYSERDA staff summarily declared that any questions regarding the 2040 goal would not be answered. Nor was any information provided by staff to indicate when the 2040 carbon-free goal and related CES procurement activities would be discussed.

Respectfully, DPS and NYSERDA are aware that state agencies do not have discretion to selectively implement some parts of statute and not others. As such, it is necessary and appropriate for the CES to include provisions that address both electricity sector targets, which have distinct material and temporal requirements. In its introduction, the white paper states:

> *The economy-wide decarbonization called for by Governor Cuomo – and codified in the CLCPA – requires that New York harness a* ***power generation sector that no longer emits greenhouse gases*** *and* ***provides electricity for a greater proportion of the overall economy****. Both strategies, decarbonization of the generation sector and electrification of other sectors – all while ensuring efficiency and cost-effectiveness – must be carried out simultaneously and vigorously. (emphasis added)*

We agree. Achieving zero-emissions in the power generation sector is critical to meeting greenhouse gas reduction targets. NYISO has also confirmed that with the beneficial electrification of transportation and heating, New York will require significantly more electricity in the future, which renders the task even more challenging.[1] However, even if New York were to achieve its ambitious 70% renewable goal by 2030, this is no guarantee that it will attain emission-free electricity just ten years later.

Most importantly, the non-linear aspect of intermittency must be addressed. As wind and solar comprise a larger and larger portion of total generation, intermittency becomes an increasingly difficult problem—one characterized by the overbuilding and curtailment of renewable capacity, duck curves (with respect to daily solar use), and the systemic inefficiency of underutilized resources that must be maintained to ensure reliability under all conditions. Storage can help to normalize peak loads. However, storage at a scale required to overcome day-to-day, week-to-week, and seasonal differences between the supply of electricity from intermittent sources and real-time demand is not in the foreseeable future.

[1] See New York ISO Climate Change Impact Study, Phase 1: Long-Term Impact, NYISO, December 2019 https://www.nyiso.com/documents/20142/10773574/NYISO-Climate-Impact-Study-Phase1-Report.pdf Assuming efficiency targets are met, NYISO estimates that electricity demand in New York will increase 40% by 2040 and 63% by 2050 (including demand served by behind-the-meter solar). In a presentation to the CAC on June 24, 2020, the consulting group E3 estimated up to 80% greater demand.

All credible research points to the fact that achieving a carbon-free power sector requires a guaranteed amount of dispatchable zero-carbon generation to ensure system reliability. We encourage DPS and NYSERDA to consider the research and modeling work performed by Dr. Jesse Jenkins at Princeton's Arlington Center for Energy and the Environment.[2] The importance of firm generation was even discussed by NYSERDA's consultant, E3, in a recent presentation to the Climate Action Council on June 24, 2020 (although in our opinion it was not adequately emphasized).

Rather than acknowledging the challenges of providing reliable carbon-free electricity from renewables and proposing ways of securing firm zero-emission generation, the white paper put forth by DPS and NYSERDA simply proclaims that by using the CES to achieve the 70% renewable goal, it will "*set the state on a rapid and irreversible path to achieve the 2040 Zero Emission Target."* This may be an aspiration statement, but it is not one supported by evidence. Achieving the 2040 zero emission target will only happen by planning for it. Failures in planning and procurement discovered late this decade will mean that neither 2030 nor 2040 goals are met.

If firm zero-carbon resources do not exist to compensate for intermittent renewables, then firm ***carbon-intense*** resources—fossil fuels, namely gas—will perform this function, and New York will ultimately fail to achieve its climate and energy goals. In places like California and Germany, where renewables have been aggressively pursued without attention to other zero-emission sources, gas has become an unavoidable "partner" to wind and solar, perpetuating dependence on fossil fuels and hindering the prospects of a carbon-free grid. Even worse, coupling gas with renewables can lead to inefficient gas-fired generation. This is seen in frequent power plant startups and shutdowns that degrade performance, reliance on simple-cycle gas plants that respond quickly but burn more fuel per watt-hour than combined-cycle generators, and running plants in "hot standby" (meaning that gas is burned even when not producing electricity). Although operating an electric grid this way may help to prop up an arbitrary renewable energy target, it undermines the objective of greenhouse gas reduction.

For these reasons, we strongly recommend that DPS and NYSERDA broaden the substance of their white paper to properly reflect the entire scope of CLCPA mandates, including the requirements for carbon-free electricity by 2040. If New York hopes to meet its climate and energy goals, it will have to invest in action today to ensure that existing firm zero-emission generators which do not rely on combustion are retained, and that an environment exists for new ones to be deployed.

As discussed below, this requires maintaining and expanding support for nuclear power within New York, clearly and without equivocation.

III. Importance of Nuclear Power in achieving New York Climate Goals

In December 2015, Governor Cuomo directed the DPS to develop a Clean Energy Standard, the purpose of which was to make good on commitments to seriously tackle climate change and curb greenhouse gas emissions from the power sector. With respect to nuclear energy, the Governor wrote:

[2] Jesse Jenkins, PhD. of Princeton University, Arlington Center for Energy and the Environment. https://mae.princeton.edu/people/faculty/jenkins In particular, see his May 15, 2020 presentation to the Clean Energy State Alliance: *Decarbonizing Electricity: The Critical Role of Firm Low-Carbon Resources*; https://vimeo.com/419053746

> *In developing the Standard, additional attention needs to be given to ensure emissions free sources of electricity remain operational. Specifically, elimination of upstate nuclear facilities, operating under valid federal licenses,* ***would eviscerate the emission reductions achieved through the State's renewable energy programs, diminish fuel diversity, increase price volatility, and financially harm host communities****.*
> *--Governor Andrew M. Cuomo (letter to DPS CEO Audrey Zibelman, December 2, 2015)*

This statement is as true today as it was in 2015. In 2019, nuclear power in New York produced 44,788 GWh of carbon-free electricity, over half of all carbon-free electricity in the state and a third of total electricity generation. Almost all of the remaining carbon-free generation in New York is large-scale hydropower which has existed for decades and, although very important, has limited potential for expansion.

Significantly, when Indian Point Reactor 2 closed in 2020, the state lost over 8300 GWh of annual carbon-free electricity, leaving an immediate gap in generation that was replaced by fossil fuels.[3] If New York's remaining nuclear facilities also close, then the state will lose over half of its carbon-free electricity. This is equivalent to six times the amount carbon-free electricity produced on an annual basis by all of the wind turbines and solar panels existing in the state today.[4] Moreover, New York would lose reliable baseload electricity serving customer demand 24 hours a day, rain or shine, summer or winter—a important function that intermittent renewables are unable to provide.

Through Tier 3 of the existing CES, a program of Zero-Emission Credits (ZECs) was established to support New York's upstate nuclear plants. This has had the positive effect of avoiding over 11 million metric tons of CO_2 emissions annually.[5] Yet despite the fact that nuclear power constitutes the largest source of carbon-free electricity in the state and that achieving 100% zero-emission electricity by 2040 is mandated by the CLCPA, the new CES white paper says nothing about the role nuclear power should play in the future. This is a critical omission, for which DPS and NYSERDA have not offered any explanation.

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[3] Proponents for the closure of Indian Point have incorrectly stated that renewables and energy efficiency installed since 2017 "replaced" IP2. In reality, investment in renewables and efficiency implemented prior to close of IP2 were not held in a lockbox waiting to replace nuclear power. Those positive improvements were absorbed in the system, reducing the demand for fossil fuels. When IP2 later closed, that demand resumed and was met by gas and dual fuel generation. Unlike fossil fuel plants, intermittent renewables do not have excess capacity (i.e. fuel) which can be called upon to produce more electricity. Examination of real-time data from the NYISO online dashboard confirms that when comparing periods with similar supply and demand, gas and duel-fuel use increased following the deactivation of IP2.

[4] According to the NYISO 2020 Gold Book, in 2019 wind produced 4,454 GWh (Figure III-3), utility-scale solar produced 52 GWh (Figure III-3) and there was 1,896 MW of installed behind-the-meter solar capacity in the state (Table 1-9A). Using a liberal capacity factor of 14%, this corresponds to 2325 GWh of behind-the-meter solar annually. This totals 6831 GWh. In 2019, nuclear plants in New York produced a total of 42,788 GWh. (Table III-2). https://www.nyiso.com/documents/20142/2226333/2020-Gold-Book-Final-Public.pdf

[5] This is a very conservative estimate using a 2018 combined-cycle natural gas heat rate of 7627 BTU/kWh and natural gas CO2 emission coefficient of 117 pounds per million BTU. For less efficient simple-cycle gas or oil generation, this figure would be higher. In 2019, New York's upstate nuclear plants produced 28,093 GWh of electricity. https://www.eia.gov/electricity/annual/html/epa_08_02.html ; https://www.eia.gov/environment/emissions/co2_vol_mass.php

Operating at an average capacity factor of 90%, New York's existing fleet of nuclear plants have delivered reliable carbon-free electricity to customers for years. Pending successful relicensing, they should be allowed to continue doing so. Furthermore, advanced nuclear technology promises superior, passively safe design and flexibility to serve tomorrow's grid. As correctly expressed by Governor Cuomo, the loss of nuclear power from New York's energy portfolio would set the state dramatically backwards in accomplishing deep and rapid decarbonization from the power sector, essential to combatting climate change. Moreover, as previously discussed, firm carbon-free electricity is essential to compliment wind and solar resources that are unable to generate electricity all the time.

In the real world, without nuclear power, achieving the CLCPA's mandate of 100% carbon-free electricity will become essentially impossible.[6] Likewise, the availability of abundant, reliable energy is vital to industry and a vibrant growing economy. If New York is serious about achieving its climate and energy goals, it will develop a Clean Energy Standard that recognizes the value of supporting carbon-free nuclear power—now and in the future.

IV. Options for Supporting Nuclear Power and Firm Carbon-Free Resources

Several potential methods exist for retaining and expanding nuclear power within New York. Although we intend to submit additional comments on this, the following are offered as possible approaches for consideration.

Consistent with CLCPA goals, and involving the least amount of CES restructuring, the most straightforward and effective method of ensuring the viability of nuclear power is by committing to extension of the Tier 3 program through at least 2040. We also recommend expansion of the program to include any nuclear plants that exists with a valid federal license in the state or that may be built in the future.[7] As an alternative, a separate Tier could be created to support the development of advanced nuclear resources, including for example small modular reactors using Generation IV technology and enhanced load-following capability.[8]

Another approach would be to restructure other tiers within the CES to include the procurement of carbon-free energy credits from nuclear power. Importantly, reducing greenhouse gas emissions from the power sector is not achieved by deploying "renewables." It is achieved by the deployment of

[6] Another technology that has been suggested to achieve firm carbon-free generation is Carbon Capture and Sequestration (CCS). This involves collecting the combustion emissions of fossil fuel power plants, instead of releasing them into the atmosphere, and then sequestered those emissions in some way, such as within deep underground rock formations. However, the sheer scale of capture required (millions of tons of CO_2 per year) renders this difficult to implement at scale. CCS technology also requires the substantial overhead of additional energy (more fossil fuels to be burned) in order to capture and forcibly sequester CO_2. Furthermore, CCS is unable to address the problem of methane leakage, inherent to all gas systems from wellhead to point of combustion. The CLCPA requires that methane emissions be counted, including from electricity and natural gas imported into New York. Therefore, even if other technical hurdles could be overcome, achieving 100% carbon-free electricity with CCS is not possible. Unlike CCS, nuclear power already exists in New York. The most credible path to achieving rapid deep decarbonization is one that includes resources that function and already exist.

[7] This could include Indian Point, since both IP2 and IP3 have federal approval to continue operating through 2024.

[8] Although typically not done today, it should be noted that existing commercial reactors are also capable of load-following within certain operational parameters.

carbon-free energy, which may include renewables, but is not limited to them. Allowing nuclear to participate in the REC program for existing Tiers 1 and 2, as well as proposed Tier 4, would more consistently align with action needed to address climate change. In this case, however, we would also recommend the creation of an attribute that appropriately assigns value to resources, like nuclear power, that are capable of providing "firm" carbon-free electricity.

Along these lines, another alternative would be to create an additional tier (perhaps Tier 5) that is specifically intended to support the procurement of "firm carbon-free resources", including nuclear power. Such a tier would be applicable to zero-emission generators capable of providing electricity whenever it is needed. Needless to say, obligations of the CES program have changed. Prior to the CLCPA, the CES only sought to achieve a target of 50% renewables with support for nuclear power as part of that transition. However, the CLCPA establishes a much more aggressive renewable goal and a mandate that all electricity serving New York demand be zero-emission by 2040. Knowing that firm zero-emission generation is absolutely essential to achieving that mandate, DPS and NYSERDA should seriously consider the development of a dedicated tier or equally effective procurement provisions to ensure that those necessary resources exist.

Relating to this, we must emphasize that not all watt-hours are created equal. After reading the CES whitepaper and participating in the technical meeting, we are very concerned that DPS and NYSERDA are attempting to craft a program that is based simply on the summation of watt-hours. A program that does not take into account real-world grid dynamics is destinated to fail, especially as more intermittent resources are added to the system. The CES and subsequent procurement activities by DPS and NYSERDA must be informed by integrated system modeling that evaluates electricity generation and demand needs that span hourly, daily, and season timeframes. Such modeling should be performed by zone with attention to regional dynamics, transmission, and storage. Further, the types of electricity generation sought through the CES procurement process within respective tiers must be responsive to this analysis.

V. Relationship to Environmental Justice

The white paper puts proper focus on Environmental Justice and asserts that implementation of the CES has potential to address harm to disadvantaged communities. We strongly agree. However, for that potential to be realized, it will essential that the benefits to environmental justice communities from renewable energy are not cancelled out by fossil fuel generation needed to make up for the loss of nuclear power. For example, the CES states:

> *The environmental and health benefits of reducing pollution from fossil fuel-fired generators will be shared broadly, but will likely have its greatest benefit in those communities that disproportionately bear the burden of that pollution today. In particular, because many of the communities experiencing the worst impacts of fossil fuel-fired generation are located downstate, the increased penetration of offshore wind energy and, if approved, energy from Tier 4 resources, will result in substantial public health benefits.*

The reference here to offshore wind ignores recent events, and is therefore only partially accurate. The deactivation of Indian Point Reactor 2 (IP2) this year resulted in an immediate hole in downstream

electricity supplies equal to over a gigawatt of continuous power and eight terawatt-hours of annual generation over the next year. The immediate consequence of this will be fossil fuel generation in the region that adversely impacts downstate air quality—generation that could have been avoided if IP2 had remained in operation.[9] Particularly vulnerable are environmental justice communities located near older power plants in Astoria and Queen's "Asthma Alley".

In this case, the eventual deployment of offshore wind will indeed have a public health benefit, but only to the extent that it makes up for additional damage to public health that came from IP2's closure. Moreover, the intermittent nature of electricity expected to eventually come from offshore wind means that it will likely be quite some time before the amount of fossil fuels burned for power generation downstate actually declines.[10] DPS and NYSERDA should consider these impacts and be careful not to repeat them as the CES is revised to reflect objectives of the CLCPA, including its Environmental Justice provisions.

Respectfully submitted,

/s/
Leonard Rodberg, New York Energy and Climate Advocates
lensqc@infoshare.org

/s/
Dietmar Detering, Nuclear New York
info@nuclearny.org

[9] Based on replacement with combined-cycle natural gas, this corresponds to over 3 million metric tons of additional CO_2 emissions annually, more than this if less efficient gas or oil generation is used. In 2019, IP2 produced 8352 GWh of electricity. (See also footnote 5.)

[10] It should also be noted that the first phase of offshore wind, the Empire and Sunrise projects, are not scheduled to be complete until 2024 and if slippage occurs, may not come online until later.

New York Energy
and Climate Advocates
310 W. 86th St. #6B, New York, NY 10024

September 15, 2020

VIA ELECTRONIC MAIL

The Honorable Michelle L. Phillips
Secretary to the Commission
New York State Public Service Commission
Three Empire State Plaza
Albany, NY 12223-1350

RE: Comments by NYECA on E3 Pacific Northwest Study, relevant to PSC Case No. 15-E-0302

Dear Secretary Phillips:

Please accept these comments by New York Energy and Climate Advocates in CASE 15-E-0302, Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard. We appreciate input that the energy consulting firm E3 has provided in the state's assessment. These comments are filed with the expectation that as studies are completed, New York will continually re-evaluate its 2030 and 2040 planning. The E3 study on the role of nuclear power in Washington State's transition to a carbon-free grid is of particular relevance. Enclosed are comments by NYECA, online information about the E3 study, executive summary of the E3 study, and the E3 study itself.

Respectfully,

/s/
Leonard Rodberg, New York Energy and Climate Advocates
lensqc@infoshare.org

STATE OF NEW YORK
PUBLIC SERVICE COMMISSION

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

Relevance of E3 Pacific Northwest Study to New York State
By New York Energy and Climate Advocates

September 15, 2020

As New York undertakes efforts to achieve 2030 and 2040 CLCPA electricity goals, careful scrutiny of grid requirements will be needed to avoid repeating mistakes elsewhere. Except in science fiction, there is no storage to power New York City or Buffalo or Rochester or Albany through extended windless, sunless days. Dr. James Hansen, at Columbia, advises that we should not engineer energy solutions around technology that does not yet exist. Instead, we must develop zero-emission solutions for the electricity sector, grounded in technology that we know will work.

Responding to the extent of unprecedented wildfires in his state, California Governor Gavin Newsom recently said, "If you do not believe in science, I hope you believe observed reality."

"The hots are getting a lot hotter and the wets are getting a lot wetter," he observed. "The science is absolute. The data is self-evident." Calling for more aggressive action on combat climate change, Newsom added "We have to own that reality and we have to own the response to that reality."

The fact is that California has more hydropower than New York, superior solar capacity factor than New York, and has already installed more than four times the wind and solar of New York. However, California is still burning a tremendous amount of gas for electricity, with no end in sight to that dependency. Governor Newsom himself must own some of the failures of the California energy plan, whereby solar is curtailed in the daytime, gas is burned at night, and zero-emission baseload-nuclear is being shut down.

Germany is failing in its climate ambitions as well, abandoning reliable zero-emission nuclear power as it increases its dependency on Russian gas and puts more carbon into the air by burning wood imported from around the globe.

There is a distinct difference between understanding the science of climate change and understanding *applied* science—that is engineering—associated with the design and development of solutions that can effectively respond to the climate crisis given real-world constraints. The situations in California and Germany show us where New York is headed unless we *apply* science more intelligently than they have.

Washington State, like New York, hopes to achieve a zero-emission electric grid. The consulting firm Energy & Environmental Economics (E3), which is also currently reviewing New York's energy

portfolio, investigated the role of firm zero-emitting resources needed to reach that goal. In its 2020 study for the Pacific Northwest, E3 states that "achieving deep emissions reductions from the electric sector is achievable at manageable cost, provided that firm capacity is available to avoid the infrequent but large electricity shortages that can occur on highly renewable grids." [1]

Specifically, in its analysis, E3 found that existing nuclear power plants should be relicensed, and that additional nuclear technology will be needed if the state hopes to shut down gas-fired power plants. E3 determined that planning for a zero-carbon electric grid should include careful consideration of the role that baseload nuclear power can serve. Quoting from E3's online post describing various future scenarios:

- **E3's study finds that the Columbia Generating Station – the Northwest's only nuclear generator and Washington's third-largest generating resource – is relicensed in all scenarios in which it is available.**

- **Small modular reactors (SMRs) offer potential cost, performance, and safety advantages over conventional nuclear generation and could reach commercialization by the mid-2020s.**

- **The role of SMRs in the Northwest's future electricity system depends on three factors: their cost; the stringency of regional emissions limits; and whether gas generators are allowed to provide firm capacity.**

- **E3 finds that SMRs have their largest build-out in cases where gas generators, powered by either natural gas or biomethane, are prohibited. In these cases, the first SMRs are built by 2030, with at least 6.3 GW of SMRs built by 2045.**

The executive summary of E3's analysis provides information about Energy Northwest:

> **The agency owns and operates the Columbia Generating Station (CGS), the only nuclear generator in the Northwest and third largest generating resource in the state of Washington. CGS is licensed to operate through 2043, with the potential for a second 20-year license extension through 2063. Energy Northwest, leveraging its expertise in the nuclear industry, is also exploring a potential role developing small modular nuclear reactors (SMRs) in the region. SMRs are an emerging, technology – with domestic commercial operation planned for the mid-to-late 2020s – that offer potential cost, performance and safety advantages over conventional nuclear generation.**

Many studies have shown that when all factors are considered, including the health impacts of air pollution from combustion, nuclear power is the safest form of electricity generation. However, as noted by E3, SMRs offer cost, performance, and safety advantages even over conventional fission reactors.

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[1] *E3 Examines Role of Nuclear Power in a Deeply Decarbonized Pacific Northwest*, News: Resource Planning, Energy & Environmental Economics, March 9, 2020; downloaded September 15, 2020.
https://www.ethree.com/e3-examines-role-of-nuclear-power-in-a-deeply-decarbonized-pacific-northwest/

E3 further notes:

> **SMRs have their largest build out in cases where gas generators—powered by either natural gas or biomethane—cannot be built.**

In terms of achieving GHG emissions reductions for 2040 and 2050, E3 finds:

> **SMRs reduce the cost of achieving a 100% electric sector GHG reduction by nearly $8 billion per year). That value stems from those resources' ability to provide firm capacity, thereby avoiding a large overbuild of renewables.**

The need to overbuild generation from wind and solar, construct significantly more transmission capacity to support those intermittent generators, and develop battery storage at a scale which does not exist anywhere in the world must also be considered in any benefit-cost analysis of solutions that rely on a high penetration of intermittent sources.

To claim success on greenhouse gas reduction, it may be tempting to fudge emission numbers from 1990 or the future, or perhaps play a shell game with emissions claimed from out-of-state energy. But if New York intends to make real progress on climate change, it must do the hard work of phasing out power plants that rely on combustion.

In its analysis, E3 draws the technically sound conclusion that any realistic plan which involves the decommissioning of gas-fired power plants will recognize the value of firm zero-emission sources and include the provision of nuclear power—both from existing generation and emerging SMR technology. Of course, since the CLCPA requires zero-emission electricity by 2040, we must also accept that any plan for New York will be deemed a failure if it does not include shutting down fossil fuel power plants or is dependent on fossil fuel generation outside New York. This is regardless of whatever claims might be made about state greenhouse gas emissions, past or future.

Certainly, much can be said about electricity costs, which E3 models in its study. Nonetheless, two truths cannot be disputed: (1) Gas is cheaper than anything else for baseload electricity, unless we appropriately value human society and life on the planet; and (2) it is going to cost more to save the planet than to cook it.

It will be important to keep these considerations in mind as New York seeks to develop realistic plans that are capable of meeting the state's goal of carbon-free electricity.

Enclosed:

E3 Examines Role of Nuclear Power in a Deeply Decarbonized Pacific Northwest, News: Resource Planning, Energy & Environmental Economics, March 9, 2020; downloaded September 15, 2020. https://www.ethree.com/e3-examines-role-of-nuclear-power-in-a-deeply-decarbonized-pacific-northwest/

Executive Summary: Pacific Northwest Zero-Emitting Resources Study, E3, January 29, 2020.

Pacific Northwest Zero-Emitting Resources Study, E3, January 13, 2020.

NEWS: RESOURCE PLANNING

E3 Examines Role of Nuclear Power in a Deeply Decarbonized Pacific Northwest

March 9, 2020

Following 2019 Washington state legislation calling for emissions-free electricity by 2045, E3 recently investigated the role of zero-emitting firm resources in achieving regional carbon goals and maintaining reliability in a deeply decarbonized Pacific Northwest.

E3 considered permutations of resources including renewables, storage, and natural gas, as well as zero-emitting firm resources – the Columbia Generating Station nuclear power plant, new small modular reactors, biomethane, and carbon capture and sequestration (CCS) – in calculating the cost of meeting regional carbon reduction goals ranging from 80 percent to 100 percent below 1990 levels by 2045.

As in past studies, E3 found that **achieving deep emissions reductions from the electric sector is achievable at manageable cost, provided that firm capacity is available** to avoid the infrequent but large electricity shortages that can occur on highly renewable grids.

E3's study finds that the Columbia Generating Station – the Northwest's only nuclear generator and Washington's third-largest generating resource – is relicensed in all scenarios in which it is available.

Small modular reactors (SMRs) offer potential cost, performance, and safety advantages over conventional nuclear generation and could reach commercialization by the mid-2020s.

Categories

Cost of service and rate design
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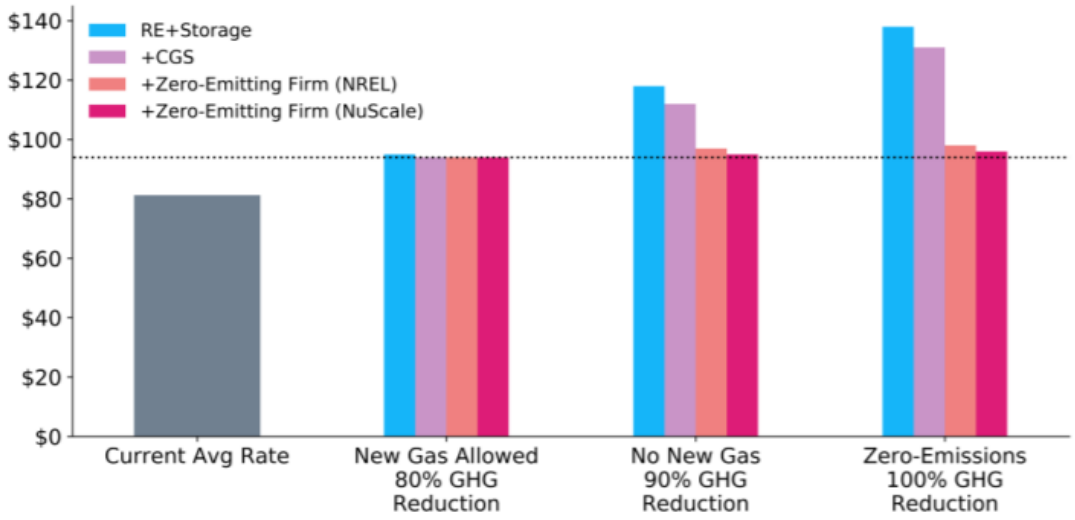
The role of SMRs in the Northwest's future electricity system depends on three factors: their cost; the stringency of regional emissions limits; and whether gas generators are allowed to provide firm capacity.

E3 finds that SMRs have their largest build-out in cases where gas generators, powered by either natural gas or biomethane, are prohibited. In these cases, the first SMRs are built by 2030, with at least 6.3 GW of SMRs built by 2045.

E3's SMR cost estimates came from NREL's **Annual Technology Baseline (ATB) nuclear resource** and "nth of a kind" estimates from NuScale, an SMR vendor.

The study uses E3's **RESOLVE** model to optimize the resource portfolio and minimize the total net present value (NPV) of electric system costs over the study time horizon. The figure below shows 2045 electricity rates under different resource and emissions scenarios, according to E3's analysis.



2045 Pacific Northwest electricity rates under different resource and emissions scenarios

The study builds on several notable E3 studies, including **Pacific Northwest Low Carbon Scenario Analysis** and last year's **Resource Adequacy in the Pacific Northwest**.

The study was commissioned by Energy Northwest, a public power agency comprising 27 public utility districts and municipalities across the State of Washington. Energy Northwest's portfolio, which includes the Columbia Generating Station, consists solely of carbon-free resources: wind, solar, hydropower, and nuclear.

Report

Pacific Northwest Zero-Emitting Resources Study

Pacific Northwest Zero-Emitting Resources Study: Executive Summary

Media

POWER Magazine, "**Energy Northwest Study Makes a Case for SMRs in Future Power Mix**"

YakTriNews, "**Energy Northwest considering new small modular reactor to help meet clean energy goals in Washington**"

filed under: Resource planning

Energy and Environmental Economics, Inc. (E3)

Part of the Willdan Group, Inc.

San Francisco 415.391.5100 | Boston 617.203.7689 | New York 646.699.3773
info@ethree.com |

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New York Energy & Climate Advocates • Footprint to Wings
Stop Cricket Valley Energy • Protect Orange County • Verdansa
Sustainable Otsego • Concerned Citizens of Oneonta • Compressor Free Franklin

December 1, 2020 ***VIA ELECTRONIC MAIL***

The Honorable Michelle L. Phillips, Secretary
New York State Public Service Commission
Three Empire State Plaza
Albany, NY 12223-1350

RE: Response to New York City comments in Case 15-E-0302

Dear Secretary Phillips,

Please include the following in the record for Case 15-E-0302, *Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard*.

On October 13th, 2020 Russell King, Counsel for the City of New York, and Susan DesRoches, New York City Deputy Director for Infrastructure and Energy, submitted comments in the aforementioned case. In those comments, King and DesRoches wrote: "The City supports increased development of large-scale renewable generation, which is necessary to achieve the rapid decarbonization envisioned in the Climate Leadership and Community Protection Act, and to realize the City's goals of ensuring continued prosperity and providing a safe and healthy environment for City residents."

Ideology, absent critical analysis, is seldom good public policy. While at face value the above statement from the City sounds inspiring, it ignores real-world aspects of electricity generation, including constraints particular to downstate New York. Failure by the City, and by the state of New York, to squarely address these factors and to plan effectively for a broader suite of zero-emission sources in the near term will undermine the CLCPA's goal of carbon-free electricity by 2040 and threaten human health by perpetuating the City's dependence on fossil fuels long into the future. The following discussion is intended to shed light upon these consequences with respect to nuclear power, which until this year provided a third of all electricity in New York and almost all of downstate New York's carbon-free electricity.

Please note that this filing is supported by a number organizations that represent communities in the greater metropolitan area. Poor planning has perpetuated dependency on inner city power plants that target environmental justice communities, and it has prompted the recent construction of large fossil fuel plants in the region including CPV and Cricket Valley Energy. Likewise, pipeline expansion projects including Dominion, Millennium, and Iroquois have intensified gas infrastructure impacts upstate. These communities know first-hand that misplaced priorities put them directly in harm's way.

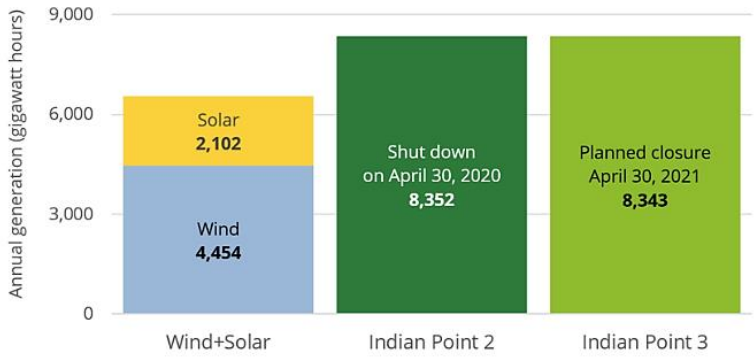
Sincerely,
The above-listed organizations

Contact: Dr. Leonard Rodberg, lensqc@infoshare.org , 917-601-0186
Dr. Dietmar Detering, ddetering@gmail.com , 917-251-2235
Isuru Seneviratne, isuru@radiantval.com , 646-462-9018
Keith Schue, keithschue@gmail.com , 407-470-9433
Dennis Higgins, higgindm@gmail.com , 607-988-9647

New York City Post Indian Point: More fossil fuels, more pollution, more greenhouse emissions

When one of the two operating reactors at Indian Point Energy Center, Indian Point reactor #2, was deactivated this year, downstate New York lost approximately 8300 GWh of annual zero-emission electricity. This is more electricity than produced annually by every wind turbine and solar panel in the entire state of New York, including behind-the-meter solar. Another 8300 GWh of annual carbon-free electricity will be lost if Indian Point's remaining reactor shuts down in 2021.

Electricity from Statewide Wind, Solar, and Indian Point (2019)

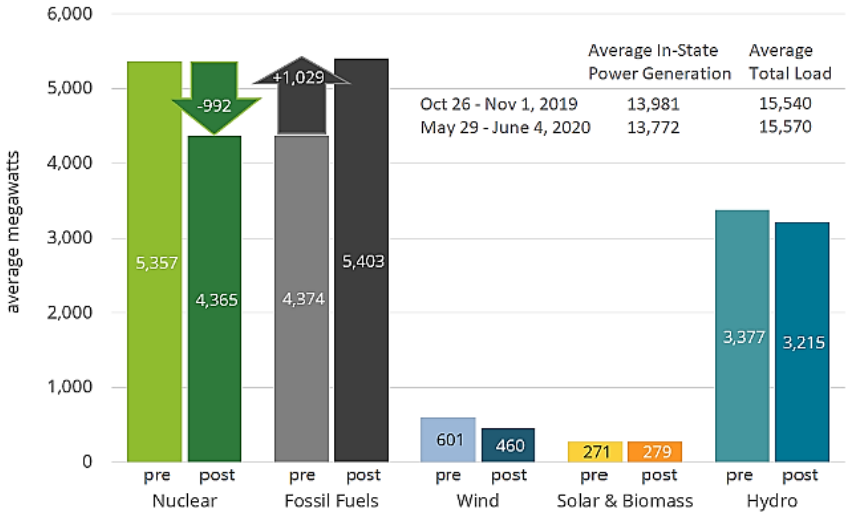


Source: NYISO Gold Book 2020

Despite prior progress in renewables and energy efficiency, this newly-created real-time gap in downstate electricity generation is being filled by fossil fuels, principally natural gas combustion. (See chart below which compares periods of similar total load and generation before and after deactivation of Reactor #2.) The direct result has been greater dependence on new gas-fired power plants in the Hudson Valley like Cricket Valley Energy in Dover, NY and CPV in Wawayanda, NY, as well as increased use of existing gas and oil power plants in the New York City metropolitan area—plants like Astoria, Ravenswood, and Gowanus. According to the NYISO 2020 Gold Book, new power plants are proposed for the downstate region and several existing facilities are also proposed for expansion or repowering.

New York Electric Generation by Source

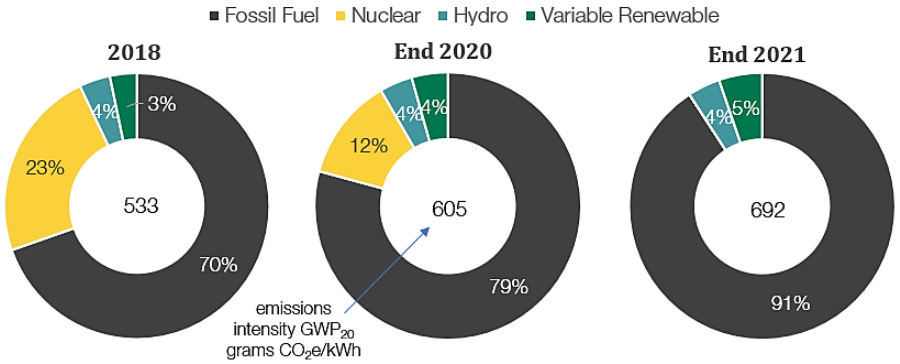
Weeks with similar load and generation pre- and post-IP2 shutdown



Source: NYISO Real-Time Dashboard

The inescapable consequence of closing Indian Point is that new and existing power plants that burn fossil fuels will run more and remain operational longer than if zero-emission nuclear power were to remain part of the downstate regional energy portfolio. From a climate standpoint, the ramifications are significant. As seen below, prior to 2020, Indian Point accounted for over three quarters of carbon-free generation downstate and contributed about a quarter of all generation in the downstate region. The remaining 70% of downstate electricity came from fossil fuels. However, if Indian Point closes completely in 2021, the region's fossil-fuel component will swell to 90%. This could result in 12-15 million metric tons of ***additional*** greenhouse gas emissions entering the atmosphere every year, taking into account both carbon dioxide from combustion and life-cycle methane emissions[1] —a rather inauspicious start to implementation of the CLPLA.

Lower Hudson Valley NY Electricity Mix and Global Warming Potential



Assumes 2.3% methane leak rates, sufficient & lossless storage/transmission for variable renewables.
Sources: NYISO Power Trends 2019; Indian Point Deactivation Assessment (2017); NYISO Gold Book 2020; Interconnection queues NYISO (Mar 2020), ConEd, Orange & Rockland, Central Hudson (Feb 2020); IPCC (2014, 2018); EDF (2018), de Gouw, et al (2014).

However, closing Indian Point not only increases greenhouse gas emissions; it also contravenes the CLCPA by unnecessarily exposing Environmental Justice communities to pollution that endangers public health, including increased risks of respiratory disease, cardiovascular disease, and cancer. Shutting down Indian Point means that polluting fossil fuel power plants in and around New York City will have to run instead, thus targeting communities that have already been disproportionately impacted by New York's addiction to fossil fuels.

Dr. James Hansen is the former director of NASA's Goddard Institute, a world-renowned scientist with Columbia University's Earth Institute, and the premier authority on climate change. For 30 years, he has brought attention to the catastrophic consequences of continued fossil fuels use. Summing up both climate and justice issues, Hansen recently said:

> *If New York cares about people and Environmental Justice, then it should shut down Ravenswood and other power plants like it instead of Indian Point. Responding effectively to climate change means that we simply cannot afford to remove carbon-free power from the grid…We absolutely need to close fossil-fuel power plants first.*

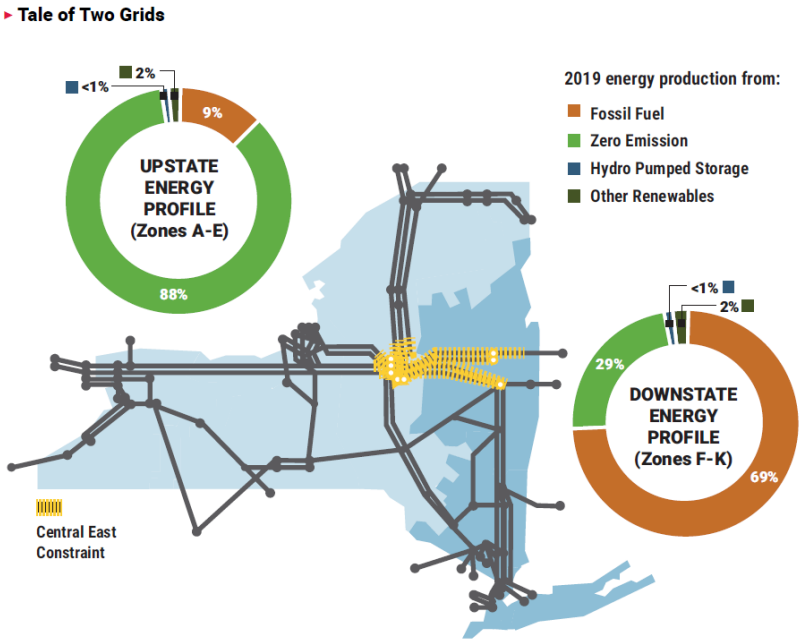
Sadly, Dr Hansen's prudent words have fallen on deaf ears. Instead of applying gains in renewable generation to close fossil-fuel power plants, the state appears to be on course to remove nuclear power from its energy portfolio, ultimately handing over the market share of electricity generation to gas.

[1] Expressed as carbon dioxide equivalents (CO2e); range corresponds to methane leakage rates of 2.3% to 3.5%

New York City's Future without Nuclear Power

Setting ideology about "renewables" aside, intellectual honesty requires admitting that the closing of Indian Point will set New York, and particularly the downstate region, substantially backwards with respect to state climate goals. To claim carbon-free energy parity with downstate generation before Indian Point's closure on an annualized basis, New York would first need to triple the amount of wind and solar sources that currently exists in the entire state today *and* transmit all of the additional electricity generated by those sources downstate. Moreover, to actually "replace" the real-time ***function*** of Indian Point in generating reliable baseload electricity without fossil-fuels to compensate for intermittency, New York would need to build adequate storage to ensure that this electricity from intermittent sources is available all the time.

With respect to transmission, electricity infrastructure within New York is a "tale of two grids." Today, the upstate region is powered mostly by zero-emission sources (hydro, nuclear, and some wind). However, the downstate region—with the exception of Indian Point—is powered almost exclusively by fossil fuels. To the chagrin of system operators, these two regions have limited interconnection capacity, which creates a bottleneck. Along with growing opposition to large-scale deployment of land-intensive wind and solar upstate, this presents a formidable barrier to the downstate delivery of electricity from renewables outside the region and, in turn, makes elimination of fossil fuel power plants downstate difficult.



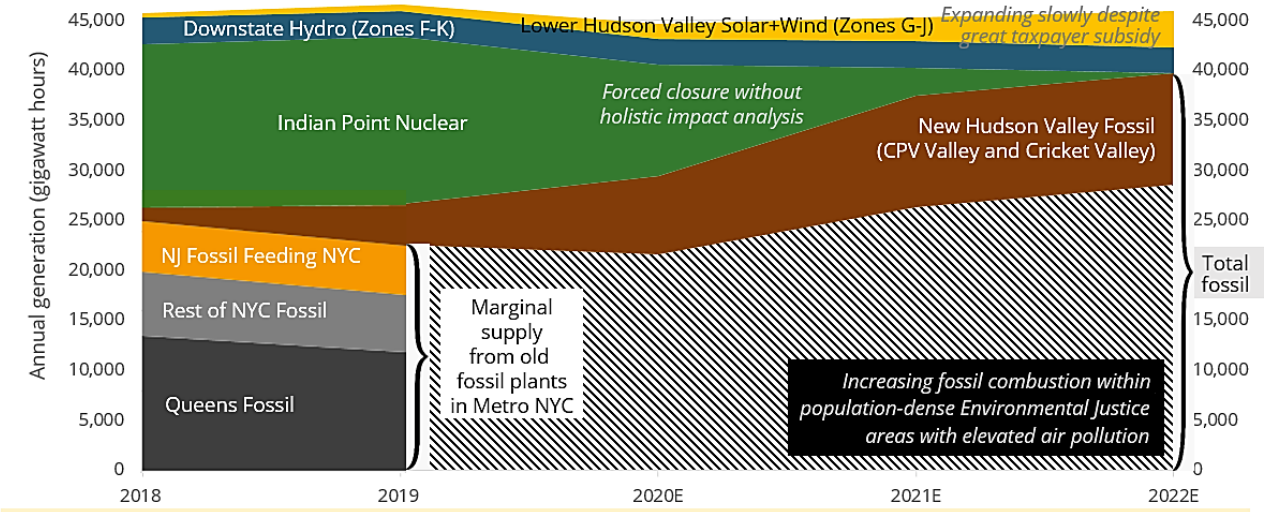
Source: NYISO 2020 Power Trends

Prospects of the greater metropolitan area meeting its energy needs from renewables deployed locally downstate are even more bleak. Due to their land-intensive requirements, low capacity factor, and operational limitations affecting daily and seasonal performance, solar panels installed downstate are unlikely to make a sizable contribution to total electricity consumption. (Today rooftop solar in the lower Hudson Valley, including New York City and Westchester County, contribute about 1.3% of electricity generation.) The potential for onshore wind downstate is even smaller.

From the following chart which analyzes watt-hours of annual generation through 2022, it is apparent that even using optimistic projections, growth in downstate renewables will do little to offset the need for more combustion from new and existing fossil fuel power plants within the Hudson Valley and greater metropolitan area following the closure of Indian Point.

Electricity Generation Serving New York City (NYCA Zone J)

(includes on-grid sources plus rooftop solar, excludes imports)



Sources: NYISO *Gold* Books (2019, 2020); Power Trends (2019, 2020); Indian Point Closure Agreement (2017); NYS Dept of Envl Conservation (2017) Interconnection queues of NYISO (Mar 2020), ConEd, Orange & Rockland, Central Hudson (Feb 2020), growing 20%/a; Johns Hopkins U (2020)

Offshore Wind

Looking further into the future, much attention has been given to the deployment of offshore wind in the hope that it might eventually satisfy downstate New York's demand for energy. On closer examination, one finds that any realistic application of offshore wind will not eliminate—and may not even significantly reduce—the need for downstate fossil fuel power plants.

The state has currently contracted for approximately 1700 MW of offshore wind, which may be available by late 2024 if schedules hold.[2] Assuming an extremely optimistic capacity factor of 50%, which has been referenced by the City and NYSERDA, this corresponds to about 7400 GWh of electricity annually.[3] Even ignoring the impacts of intermittency, this is significantly less than the amount of electricity produced by either one of Indian Point's two reactors individually. Based on annual generation alone, it will be many years before renewables achieve parity with energy generation conditions prior to Indian Point's closure.

[2] https://www.spglobal.com/platts/en/market-insights/latest-news/electric-power/022020-eversource-expects-over-1700-mw-of-us-northeast-offshore-wind-power-online-in-2024

[3] Susan DesRoches, New York City Deputy Director for Infrastructure and Energy, stated in public testimony before the New York City Council on November 24, 2020 that proposed offshore wind projects would have a capacity factor of 50%. In email communication with D. Higgins on June 29, 2020, Adrienna Downey of NYSERDA estimated a capacity factor of 51.8%.

Notably, the CLCPA establishes a 9000 MW goal for offshore wind by 2035. But even if this much more ambitious target can be met, it would only bring total offshore wind generation to less than 40,000 GWh (again assuming 50% capacity factor). In 2019, downstate New York (defined by NYISO to include Zones F through K) produced 66,475 GWh of electricity, 94% of which came from Indian Point plus fossil fuels. Therefore, even under ideal circumstances (high capacity factor, no degradation, and no curtailment), the state's plan for offshore wind would still not come close to meeting downstate New York's demand for electricity.

Taking real-world factors into account should further temper expectations. While a 50% capacity factor or higher may be possible under optimal circumstances, it is not the norm. An objective review of performance for existing offshore wind farms, such as those in the U.K. and Denmark, reveals that most sites run closer to about 40%, or less. [4] Performing at a capacity factor of 40%, 9000 MW of offshore wind would offset less than half of the downstate region's demand for electricity today. Furthermore, it is not valid to assume that all of the turbines associated with a large-scale project deployed over many years will perform equally. A recent Manhattan Institute report by Jonathan A. Lesser casts serious doubt on the long-term economics of offshore wind, finding substantial degradation in the performance of turbines (4.5% annually) as well as considerable recurring costs of maintenance, a risk of shutdown in extreme cold, and vulnerability to storms.[5] If Lesser's analysis is accurate, then the initial performance of turbines installed in 2024 could decline by almost half before those remaining to meet the state's 2035 target are in place. Over the last several years, the performance of offshore turbines has improved and it is not impossible that a capacity factor approaching 50% may be achieved for new very large towers with optimal siting. However, for New York City or the state to assume this on projects that have no performance history in the region, or to make planning decisions based on such, is reckless.

State planners have also failed to explain how the power from offshore wind will be integrated into the grid, including how wide output variations are to be handled. This is especially important because New York lies in the path of storms which regularly come up from the Caribbean in the late summer and fall. When wind velocity exceeds a specified "cut-out speed", turbines automatically shut down and feather their blades to avoid structural damage. These "cut-outs" can be expected whenever tropical storms approach. Consequently, there could be extensive periods when the state's offshore wind projects are shut down entirely.

Even more concerning is how these facilities will survive as climate change and ocean warming cause storms to become more frequent and intense. A 2010 NYSERDA assessment found that extreme wind speeds can be expected every 50 to 100 years. However, with "100-year storms" now the norm, it is disturbing that the state is basing critical planning on potentially obsolete projections. Current wind turbines are not designed to withstand storms greater than Category 3.[6] Yet superstorm Sandy was a Category 3 event. The following photo shows what happened to wind turbines in Puerto Rico when Hurricane Maria, a Category 5 storm, hit.

[4] https://energynumbers.info/capacity-factors-at-danish-offshore-wind-farms#.

[5] https://media4.manhattan-institute.org/sites/default/files/out-to-sea-dismal-economics-offshore-wind-JL.pdf

[6] Presentation on wind turbine durability sponsored by Our Energy Policy Foundation, Dec. 2, 2019. https://www.ourenergypolicy.org/offshore-wind/

Onshore wind turbines in Puerto Rico damaged by Hurricane Maria in 2017. Photo: AFP/Getty

With weather patterns changing so dramatically in the past few years, it would be unwise to assume that New York is immune to such an event. If this kind of storm were to impact the state, it could be years before power from offshore wind was restored.

Gas Dependence due to Intermittency

On their own, the above issues cast serious doubt on the ability of renewables to alleviate New York City's dependence on fossil fuel. However, it should be noted that the figures referenced above only compare the annual amount of energy from different sources. The systemic difficulties of relying heavily on wind and solar run much deeper when the consequences of intermittency, which affect the time-sensitive delivery of electricity, are considered.

A fact to which NYISO can attest is that grid management requires continuous monitoring of network conditions (on a moment by moment basis) to match electricity generation with demand. The consequences of not doing so are blackouts, brownouts, and electrical infrastructure damage. This management is a sophisticated task even if using only traditional sources of energy that provide baseload and dispatchable power to meet variable demand. The task is considerably more difficult when variable and unpredictable supply sources are added to the equation. Significantly, intermittent wind and solar provide electricity when they can, which may have no bearing on when the energy they produce is needed. The jobs of system operators become increasingly difficult—perhaps impossible—when those sources comprise a large portion of a region's total generation portfolio.

There is a naïve misconception that the world is on the cusp of a revolution in battery storage technology that will solve the problem of intermittency. In fact, the use of batteries to substitute for peaker plants, sometimes coupled with renewables, is often cited as an example of that progress. However, as their name suggests, "peakers" exist only to meet peak demand; they are small facilities that operate rarely, typically 1% to 2% of the time. For a peaker plant to be replaced with batteries, the amount of energy that must be stored is modest and only needed for a short duration. This allows sufficient time between discharge periods for energy to be replenished from other sources, including those that may operate intermittently. However, emulating the function of a very large baseload power plant that constantly produces electricity is an entirely different matter, requiring far more storage than will realistically be developed in the foreseeable future.

For example, Ravenswood is proposing to install a 316MW battery with eight hours of storage capability to avoid the use of peaker turbines at its power generation facility in Queens, NY. The project, if built, would actually be the largest battery in the world, capable of dispatching 2528 MWh of energy. Still, this is equivalent to only

about **one hour** of electricity that Indian Point's two reactors were able to generate continuously. Notably, no plans have been announced to eliminate the much larger gas-fired generators at Ravenswood which burn much more gas than peakers.

Any reliable, real-world system must account for a wide range of operating conditions, which makes the analysis of storage required to achieve grid reliability a complex statistical exercise—and its implementation an expensive undertaking. In the foreseeable future, short-term storage could begin to mitigate hourly fluctuations in demand—for example helping to address the "duck curve" that plagues deployment of solar panels in California. However, batteries capable of mitigating longer term fluctuations in demand and supply that occur day to day, week to week, and seasonally due to the widespread use of intermittent renewables will not be available anytime soon.[7]

It is also important to understand that the process of charging and discharging batteries—as with any type of storage—incurs inherent energy losses that contribute to system inefficiency. More exotic types of storage mechanisms have been floated, including hydrogen or "renewable" natural gas (RNG) synthesized directly from water and/or carbon dioxide from the environment using electricity, then reoxidizing it in fuel cells to create electricity. However, these are even less efficient processes and would require large industrial facilities comparable to refineries to implement at scale. Dropping even farther down on the spectrum of efficiency and credibility, fossil fuel industry proponents have advocated for the combustion of RNG (or hydrogen) in repurposed gas-fired power plants. The industry is well aware that the public's tolerance for the intensity and price tag of wind and solar farms, transmission lines, and factories to synthesize RNG will evaporate long before these imagined solutions materialize—thus ensuring a market to burn gas from fossil fuels far into the future.[8]

When wind and solar are a small fraction of a region's electricity portfolio, storage is not an issue. However, without significant storage, when they constitute a large portion of total generation, the electricity intermittent sources produce must be *curtaile*d (i.e. "dumped") during periods of high supply or low demand. This means that those sources, which already have low capacity factors, are disconnected from the grid, and the energy they produce is wasted. This results in even lower effective capacity factors, inefficiency, and increased cost associated with deploying and maintaining underutilized resources. Moreover, during periods of low supply from renewables or high demand, another source of energy must be available. As seen in systems throughout the world today, that dispatchable source of energy is fossil fuels, predominantly gas.

The consequence of deploying wind and solar on a large scale is an unavoidable co-dependency with fossil fuels that thwarts the attainment of 100% carbon-free electricity. But the carbon impact of this is not simply proportional to the amount of remaining electricity generated from fossil fuels. Modern gas-fired power plants that generate baseload electricity utilize large-scale combined-cycle technology that is typically 30% more efficient than simple-cycle turbines. However, when wind or solar development seeks to displace baseload

[7] Pumped hydro is another means of storing large amounts of energy. For example, the Blenheim-Gilboa plant in New York's Catskill Mountains can store 12GWh of energy and deliver 1100MW of power, although a quarter of input energy is not recoverable due to efficiency losses. Like other hydroelectric impoundments, pumped hydro plants can have significant ecological impacts. However, if the state was serious about developing a carbon-free grid dominated by intermittent sources, many more pumped hydro facilities with even greater capacity would already be under construction.

[8] Ironically, there is a way to make large-scale hydrogen or hydrocarbon synthesis viable involving high-temperature nuclear power, similar to concepts being explored by the Navy to produce jet fuel on nuclear aircraft carriers. This could also have practical applications for vehicles as an alternative to gasoline refined from crude oil.

power, the gas-fired power plants used to offset intermittency are typically less efficient simple-cycle plants that are able to power up and down rapidly in response to fluctuating supply.

As previously discussed, batteries have the potential to reduce the need for simple-cycle peakers during periods of *peak demand*—but when gas serves as backup to the large-scale deployment of renewables during periods of *low supply*, those same types of inefficient gas plants again become necessary. Another technique used is to run gas-fired power plants in "hot standby", which means that they burn gas even when not producing electricity. Operating grid resources in this manner may help to achieve a certain quota of "renewable" electricity generation, but it undermines the real goal of greenhouse gas reduction.

An approach that can partly reduce the need for fossil fuel backup is to "overbuild" renewable capacity. This may assist in meeting demand during periods of marginal generation (cloudy days and winter for solar, or during periods of low wind). However, this must be weighed against the obvious consequence of even greater curtailment at other times. As indicated at the outset of this section, matching supply with demand is a challenge made exceptionally difficult by intermittent sources. These factors require in-depth feasibility and cost-benefit analyses that the state has yet to perform.

One can see how these real-world operational constraints can result in large investments in intermittent renewables with little impact on emissions or reduction in fossil fuels. Indeed, this has been the case in California and Germany where wind and solar has grown, nuclear has declined, but natural gas use has remained relatively constant, and ratepayer costs have skyrocketed. It is naïve to think that New York is forging a different path when the laws of physics are the same on both sides of the country and on both sides of the world.

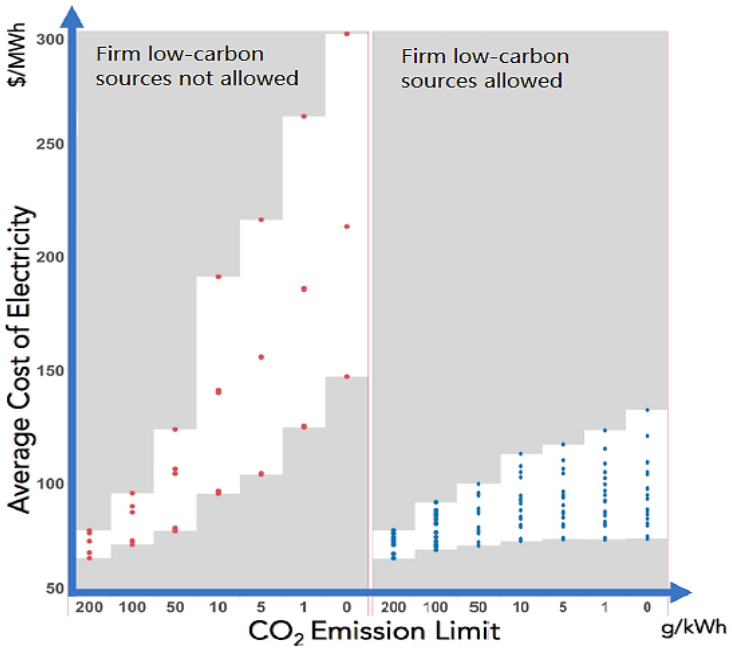
The Need for "Firm" Carbon-Free Generation

An assumption often made by advocates of "100% renewables" is that if a state like California can reach 20% penetration of wind and solar (we are at 4% wind currently in New York), then it is easy to attain 100% by just doing more of the same. This is profoundly incorrect. For reasons discussed above, integrating wind and solar sources into the grid becomes exponentially more difficult and costly as more of it is added. Recent drops in the installed cost of wind and solar fail to tell the whole story because they do not take into account total system levels impacts of creating a grid that reliably works.

Credible studies have found that establishing a reliable low-carbon electric grid that has a large component of intermittent renewable sources requires a certain amount of that low-carbon electricity to come from ***firm*** generators—meaning sources that are available when needed, regardless of uncontrollable conditions like the weather. In the absence of these firm sources, cost and logistical constraints of achieving carbon-free electricity become prohibitive. For example, Dr. J. Jenkins of Princeton and his colleagues have modeled how electricity prices would be impacted by the availability of firm generating sources under various scenarios. In the northern United States, they found that the cost of electricity in systems which exclude firm generators dramatically exceeds those that do not for carbon dioxide emission levels under 100 grams per kWh.[9]

[9] N. Sepulveda, J. Jenkins, F.J. de Sisternes, R.K. Lester. *The Role of Firm Low-Carbon Electricity Resources in Deep Decarbonization of Power Generation,* Joule 2, 2403–2420, November 21, 2018, Elsevier. https://doi.org/10.1016/j.joule.2018.08.006
See also literature by J. Jenkins, Arlington Center for Energy and the Environment at Princeton. https://mae.princeton.edu/people/faculty/jenkins

Cost of Electricity for Northern U.S. Systems with and without Firm Low-Carbon Generation



Source: Sepulveda, et al. *The Role of Firm Low-Carbon Electricity Resources in Deep Decarbonization of Power Generation*

It is important here to note that nowhere in the world have wind and solar been deployed at penetration levels approaching this. However, in places like California and Germany, where wind and solar now comprise about a quarter and a third of electricity generation, reliability and cost are already serious issues. As widely reported, rolling blackouts in the summer of 2020 demonstrate that California has done a poor job of managing its grid as more renewables come online.[10] In an analysis titled *Renewables and decarbonization: Studies of California, Wisconsin and Germany*, Brick and Therstrom found that achieving an 80% renewable portfolio in California would increase the total cost of renewable infrastructure by a factor of 16.[11]

Perhaps most telling is that in California, Germany, and throughout the world where firm carbon-free nuclear power has been retired, renewables have failed to make up for its loss. The consequence of that failure has been little progress—and in the case of New York's closure of Indian Point, backwards movement—on greenhouse gas reduction. As seen below, despite a monumental effort to expand renewables, by simultaneously shutting down nuclear power, Germany still generates about as much electricity from fossil fuels as it did 25 years ago. Likewise, in the midst of its current grid management crisis, California is finding that it must grant compliance

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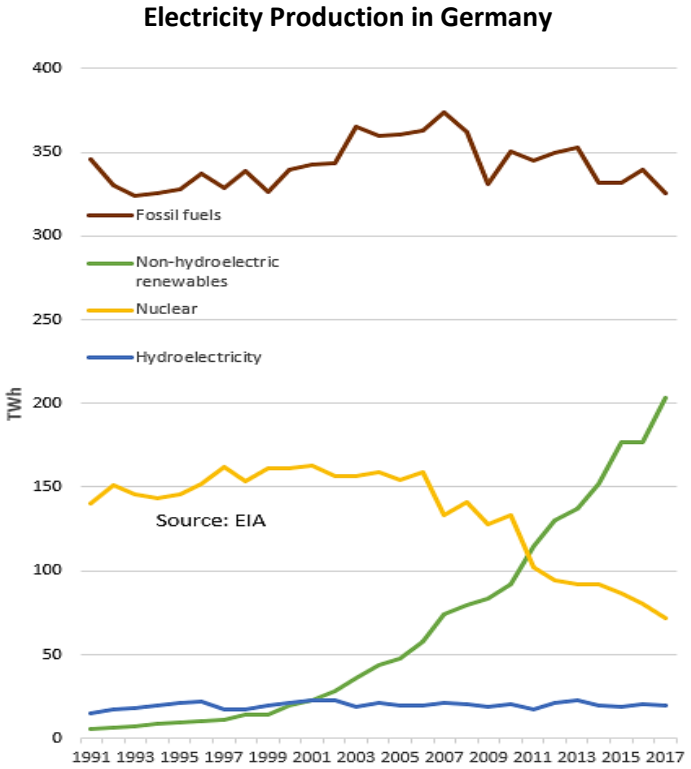
And May 15, 2020 presentation to the Clean Energy State Alliance: *Decarbonizing Electricity: The Critical Role of Firm Low-Carbon Resources* https://vimeo.com/419053746

[10] Blackouts: Green California has the nation's worst power grid | CFACT ; Why California's Climate Policies Are Causing Electricity Blackouts (forbes.com) ; California blackouts expose problems in state's transition to clean energy – Santa Cruz Sentinel ; California Gov. Gavin Newsom demands probe of power blackouts (cnbc.com)

[11] Brick, Therstrom. *Renewables and decarbonization: Studies of California, Wisconsin and Germany*; Elsevier, The Electricity Journal (2016) 6-12. Renewables and decarbonization: Studies of California, Wisconsin and Germany (core.ac.uk)

wavers to nine aging gas plants as it continues to build more. These are events further exacerbated by its decision, now being challenged, to shut down the Diablo Canyon nuclear plant.[12]



The Need for Nuclear Power

If New York is wise, it will not repeat mistakes made elsewhere. Even with a herculean effort to build offshore wind, renewables alone will be insufficient to rid New York City—let alone the entire state—of fossil fuels.

A myopic focus on renewables will not only prove ineffective in combating climate change; it will particularly harm New York City by saddling the region with a costly, inefficient, and vulnerable electric grid that hinders economic growth. Moreover, it will prolong the suffering of those who have already borne the brunt of the city's addiction to fossil fuels for too long. Perpetuating the existence of fossil fuel power plants to support intermittent renewables and forcing low- and middle-income ratepayers to cover the cost of infrastructure that cannot ultimately solve the climate problem is a "double whammy" to environmental justice communities. It also directly undermines justice provisions of the CLCPA emphasized in NYSERDA's recent Whitepaper on a Clean Energy Standard.

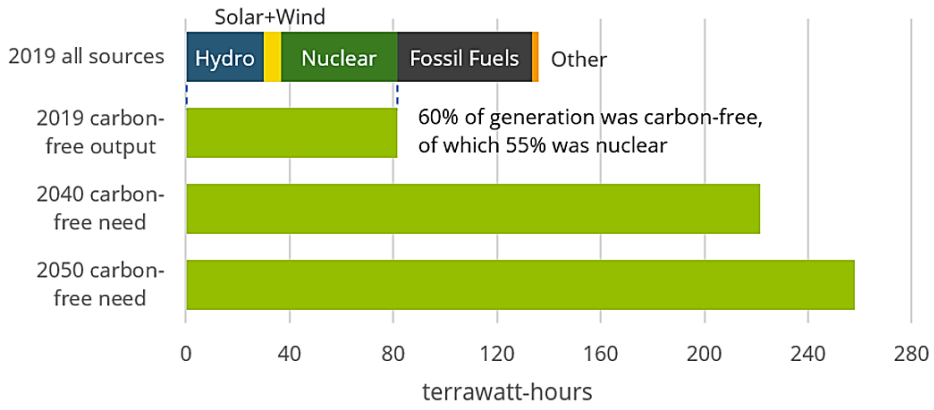
Regardless of state climate and justice goals, NYISO will not let the lights go out. So, in the absence of firm carbon-free generation to provide baseload electricity or electricity when renewables are unavailable, carbon-intensive sources will. As previously discussed, hydrogen or synthetic RNG are forms of storage, not primary energy sources; and the inherent inefficiency of their production makes burning a significant amount of either one as fuel in power plants unrealistic.

[12] Battle Brewing About California's Role in Diablo Canyon Nuclear Plant Retirement (powermag.com)

The answer is therefore clear. It would be irrational to shut down a third of the state's existing carbon-free electricity while asserting that we are in the midst of an *existential* climate crisis. If New York is serious about meeting its greenhouse gas reduction goals and eliminating fossil fuels, it will take steps necessary to ensure that its existing fleet of zero-emission nuclear power plants remain in operation and that their licenses are renewed. In addition, the state should embrace opportunities to pilot a new generation of passively-safe reactors, including small modular reactors with load-following capability, both upstate and downstate.

Perhaps the most compelling reason to support nuclear power comes from understanding how far the state must go to meet its energy and climate goals. A recent NYISO Climate Change Impact Study predicts that under the CLCPA, New York's demand for electricity could grow a dramatic 40% by 2040 due to electrification of transportation and heating systems. By 2050, demand could swell 63%.[13] With the state's existing nuclear power plants in the mix (including Indian Point's two reactors), this would require generating about three times more carbon-free electricity from wind, solar, and nuclear than in 2019—a challenging but feasible endeavor. However, without nuclear power, New York would require the equivalent of over 30 times more wind and solar, along with massive investments in transmission and essentially impossible amounts of storage.[14]

New York Carbon-Free Electricity Needs Under CLCPA



Sources: NYISO Gold Book (2020), Climate Change Impact Study (2019)

[13] According to Phase 1 of the NYISO Climate Change Impact Study (Table A-156), demand in the CLCPA case is predicted to be 158,043 GWh in 2020, 221,479 GWh in 2040, and 258,011 GWh in 2050, including behind-the-meter solar. This corresponds to an increase of 40% in 2040 and 63% in 2050.
https://www.nyiso.com/documents/20142/10773574/NYISO-Climate-Impact-Study-Phase1-Report.pdf

[14] Based on NYISO 2020 Gold Book data, wind and solar produced 6,556 GWh in 2019. Nuclear power produced 44,788 GWh in 2019 (Figure III-3 and Table III-2). Hydropower produced 30,141 GWh in 2019. Using NYISO demand projections in the CLCPA case (endnote 6), if existing nuclear is retained (including Indian Point reactors 2 and 3), then this yields a carbon-free gap of 139,994 GWh in 2040 and 176,526 GWh in 2050. This corresponds to 2.7 times more wind, solar, and nuclear in 2040 and 3.4 times more wind, solar, and nuclear in 2050 than deployed in 2019. If existing nuclear is not retained, this yields a carbon-free gap of 184,782 GWh in 2040 and 221,314 GWh in 2050. This corresponds to about 28 times more wind and solar in 2040 and 34 times more wind and solar in 2050 than deployed today. However, these figures do not account for obstacles of storage and transmission, which would likely require significant overbuild of wind and solar sources to accommodate daily and seasonal fluctuations of intermittent generation. This also excludes biomass and assumes minimum expansion of hydropower.

Conclusion

With a dedicated effort by government leaders and agencies at every level, it is still possible for New York to meet its goals of deep greenhouse gas reduction and carbon-free electricity. However, the only way of achieving that very ambitious mandate will be by expanding the scope of its focus. The CLCPA calls for 100% carbon-free electricity by 2040, not 100% "renewable" electricity. Intermittent renewable sources, including offshore wind, have a role to play. However, understanding their limitations is essential to developing a comprehensive energy plan that is actually capable of achieving CLCPA goals. Reliable zero-emission nuclear power is a vital part of the state's energy portfolio today and must be in the future as well. It is time for leaders in both New York City and Albany to recognize and plan for that future.

New York Energy
and Climate Advocates
310 W. 86th St. #6B, New York, NY 10024

December 16, 2020 ***VIA ELECTRONIC MAIL***

The Honorable Michelle L. Phillips, Secretary
New York State Public Service Commission
Three Empire State Plaza
Albany, NY 12223-1350

RE: A response to the Renewable Heat Now filing on Case 20-G-0131 by parties

Please also file also on related docket 15-E-0302

Dear Secretary Phillips,

We wish to commend the recent Renewable Heat Now filing on this docket for its recognitions of a number of issues and—importantly—for implicitly connecting this generic proceeding with 15-E-0302. However, signatories to these proceedings wish to provide some necessary clarification and request that this response be filed on both dockets.

Respectfully,

Dr. Leonard Rodberg; New York Energy and Climate Advocates
Dr. Dietmar Detering; Nuclear New York
Ethan Bodnaruk; Civil Engineer, MS Environmental Engineering, MS Nuclear Engineering
Keith Schue; MS Electrical Engineering
Dennis Higgins; SUNY Oneonta Professor of Mathematics/Computer Science
Isuru Seneviratne; Radiant Value Management
Suzanne Winkler

PUBLIC SERVICE COMMISSION

Proceeding on Motion of the Commission	**)**	
In Regard to Gas Planning Procedures	**)**	**Case 20-G-0131**
	)	

Response to Renewable Heat Now filing
December 16, 2020

The Renewable Heat Now filing dated December 7, 2020 implicitly links this proceeding with the 15-E-0302 Clean Energy Standards proceeding by recognizing:

- that grid infrastructure will need improving;
- that beneficial electrification of end-user systems is necessary; and
- that a timely and orderly transition to meet 70-by-30 and 100-by-40 Climate Leadership and Community Protection Act (CLCPA) goals is necessary.

Significant clarification is needed however on these points. In many areas of New York, the electricity grid will not readily support solar farm connections. As connection costs may be passed to developers, deployment of solar distributed energy resources (DERs) is difficult. The state, through the Department of Public Service (DPS), must require and oversee a transition to a smart grid, able to support renewable DERs, and also provide the necessary load-balancing.

The New York Independent Systems Operator (NYISO) has recognized that beneficial electrification may mean that the state needs 50% to 60% more electricity in the next several decades. While the Renewable Heat Now push for air-source and ground-source heat pumps is an important component of this transition, we must recognize that without a parallel effort to provide firm carbon-free dispatchable and/or baseload electricity, we will simply be burning more gas at new and existing gas-fired power plants to support end-user electrification. Indeed, this may be happening already.

On the eve of CLCPA passage, two very large gas-fired power plants, CPV (680 MW) and Cricket Valley Energy (1,100 MW), became operational. These two plants, along with increased utilization of existing gas/oil power plants in the metro-area, are replacing electricity previously generated by the Indian Point nuclear power plant in Buchanan, NY. When the state removed the annual electricity contribution of 8,300 GWh from Indian Point unit 2 this year, New York lost more carbon-free electricity than is generated by all the solar panels and wind turbines currently deployed in the state.

Unlike dispatchable generators that can run more to compensate for the loss of another load-serving entity, intermittent renewables such as wind and solar are only able to produce additional electricity if more wind and solar generators are built, and even then, only when sun or wind is available. Furthermore, they can only compensate for the loss of an existing load-serving entity if the electricity they generate is produced at the same time as that of the load-serving entity being ostensibly "replaced" *and* if that electricity is deliverable to the same customer base. Additional renewable generators along with storage and transmission capable of serving real-time demand met by Indian Point have not been brought online following deactivation of reactor unit 2. Instead, excess capacity

from existing and recently built gas-fired power plants in the downstate region have been called upon ("dispatched") to fill the real-time energy gap created by the loss of unit 2.

Wind and solar will be important in meeting CLCPA targets. However, we must temper this filing's enthusiastic support for intermittent energy sources. Intermittent sources supply electricity when they can, not necessarily when needed. Significantly, the proposed 2.5 GWh battery at Ravenswood—which, if built, would be the largest battery in the world—will only be able to store about one hour's worth of energy that Indian Point's two reactors produced reliably every hour of the day last year.

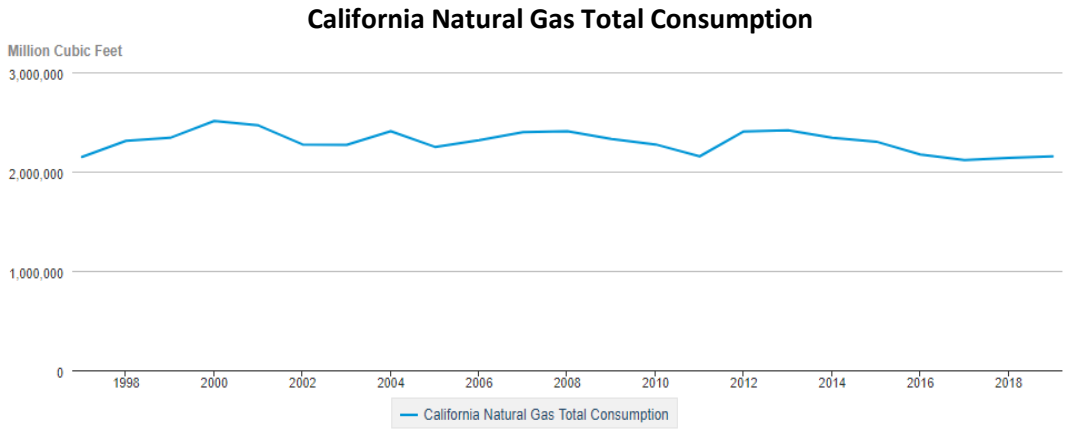
Batteries can certainly help with peak shaving and potentially reduce the need for inefficient gas-fired peaker plants. However, peaker plants operate infrequently, typically 1% or 2% of the time, and consequently represent a tiny piece of the problem. Meeting the demand for electricity served by baseload generation is a very different undertaking. As seen in California, when grid operators attempt to integrate significant amounts of wind and solar into the grid to displace baseload generation, those renewable sources must be "partnered" with gas-fired generators. Further, to respond rapidly to renewable intermittency, those gas-fired generators often employ the same type of inefficient simple-cycle technology used by peakers, thus undermining the carbon-reducing benefit of renewable deployment.

Significant research on the real-world experience of California and Germany—each with four times the solar and wind penetration of New York—demonstrate that shutting down nuclear power has substantial negative ramifications, and actually creates a greater need for dispatchable sources of energy to meet demand when intermittent sources are not available. In their research paper, *Renewables and decarbonization: Studies of California, Wisconsin and Germany (April, 2016)*, Stephen Brick and Samuel Thernstrom find:

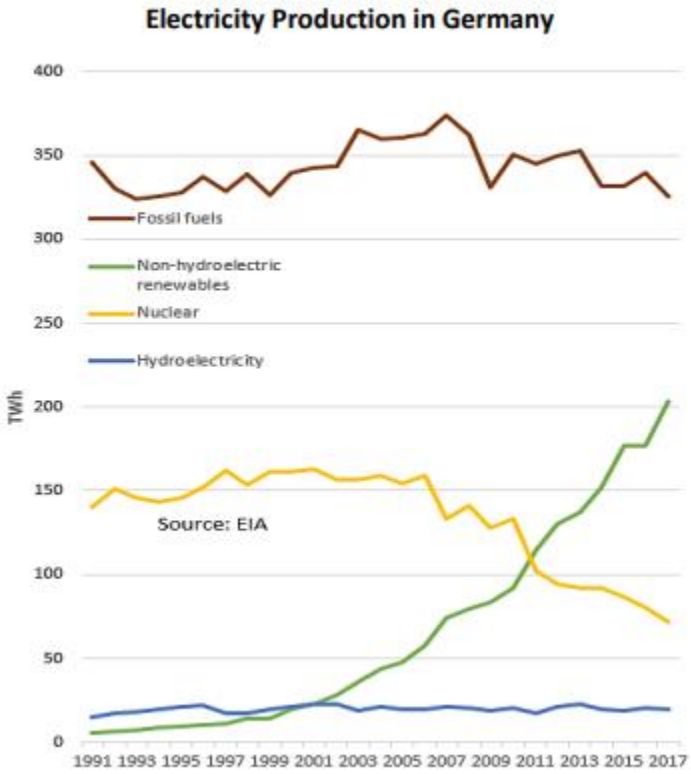
> Under 50% [Renewable Portfolio Standards (RPS)] scenarios, more than 40% of the installed capacity remains gas-powered; under 80% RPS scenarios, the [Natural Gas Combined Cycle] NGCC component of the system remains almost as large, only supplemented with much larger renewables systems that produce smaller emissions reductions. This data suggests that building more renewables is not an efficient or effective way to displace conventional generation capacity.

Both California and Germany are burning about as much gas as they did a decade or two ago. In the absence of scrutiny, critique, and planning readjustment, New York may commit to the same expensive, and ineffective strategy.

As seen below, gas consumption in California has not decreased despite higher rate-payer costs and considerable intermittent resource deployment. Likewise, electricity production from fossil fuels in Germany has remained essentially constant due to the simultaneous decline of nuclear power. In fact, the country has become increasingly dependent on foreign gas and in 2020 even fired-up a new coal plant. To satisfy demand not met by intermittent sources, Germany is burning wood imported from forests around the world that had previously sequestered carbon, electricity from dirty fossil fuel power plants in neighboring states, and—ironically—nuclear power from France.



Source: U.S. Energy Information Administration



Source: U.S. Energy Information Administration

Both California and Germany also have high rate-payer costs. In their paper, *Do Renewable Portfolio Standards Deliver Cost-Effective Carbon Abatement? (November 2020),* Michael Greenstone and Ishan Nath find:

> RPS program passage leads to substantial increases in electricity prices that mirror the program's increasing stringency over time. Seven years after passage, we estimate that average retail prices are 1.2 cents per kWh, or 11%, higher than they otherwise would be, with over half the increase due to increased transmission and distribution costs. The corresponding effect twelve years later is 1.9 cents per kWh, or 17%, higher.

Germany has some of the highest priced electricity in Europe. Meanwhile neighboring France, which is powered predominantly by nuclear power, has affordable electricity and the cleanest air in Europe. California has created an unstable electrical grid and saddled rate payers with rolling blackouts and high energy prices. Without nuclear power, New York is likely to follow the same disastrous path.

Conclusion

Certainly, parties here support renewable heat, as well as solar and wind DERs. However, a push for air-source and ground-source heat pumps that ignores the need for firm carbon-free sources of electricity is short-sighted: It will serve only to perpetuate reliance on existing and new gas-fired combustion. In 2019, 30% of New York City's electricity came from carbon-free sources, most of which was provided by Indian Point. However, as confirmed in testimony by the City, if Indian Point unit 3 is deactivated next year, the metropolitan area will go from 70% fossil fuel electricity in 2019 to 90% in 2021. Moreover, Environmental Justice communities in the region will be exposed to even higher levels of air pollution as a result—not an auspicious start for the CLCPA. How can we claim progress when heat pumps installed in New York City are powered with gas burned in the environmental justice communities of Queens and beyond?

In parallel with the worthy renewable-heat-now effort, New York needs a companion effort to provide reliable carbon-free electricity to support beneficial electrification at scale. Despite solar and wind deployment that we may envy, Germany and California have wasted decades on ineffective climate action. NYISO has already reported to the Climate Action Council that even if New York succeeds in meeting its efficiency and renewable targets, the state will still not have enough dispatchable or baseload electricity (*Planning for a Grid in Transition* – NYISO CEO Rich Dewey's presentation to the Climate Action Council on October 8, 2020; pages 18 and 20).

New York will be unable to meet its 100-by-40 goal of carbon-free electricity simply through efficiency improvements and the deployment of renewable DERs. There must be substantial amounts of firm, deliverable zero-emission electricity in the mix, and nuclear power is the only source that can realistically provide it.

New York Energy and Climate Advocates

310 W. 86th St. #6B, New York, NY 10024

Nuclear New York

Independent Advocates
for Reliable Carbon-Free Energy
3961 47th St, Sunnyside, NY 11104
www.NuclearNY.org

Citizens' Climate Lobby
Citizens' Climate Education
Columbia County (NY) Chapter

Footprint to Wings

www.footprinttowings.org

RACE TO ZERO CARBON

GREEN NUCLEAR DEAL

Forging A New America

www.gndcampaign.org

SUSTAINABLE OTSEGO

PO Box 1306 Cooperstown, NY 13326
www.sustainableotsego.net

CLIMATE COALITION

www.climatecoalition.org

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Sustainable Otsego • Concerned Citizens of Oneonta • Compressor Free Franklin
StopCricketValley.org • Protect Orange County • Mohawk Valley Keeper

March 5, 2020 ***VIA ELECTRONIC MAIL***

The Honorable Michelle L. Phillips, Secretary
New York State Public Service Commission
Three Empire State Plaza
Albany, NY 12223-1350

RE: Response to *Order Adopting Modifications to the Clean Energy Standard;* Case 15-E-0302

Dear Secretary Phillips,

Please include the following as a filed document in the record for Case 15-E-0302, *Proceeding on Motion of the Commission to Implement a Large-Scale Renewable Program and a Clean Energy Standard*. This is submitted on behalf of the above-listed organizations, several of which are party to this proceeding.

On October 15th, 2020 the New York Public Service Commission adopted its "Order Adopting Modifications to the Clean Energy Standard". Unfortunately, the Order ignores significant real-world aspects of electricity generation and fails squarely to address the limitations of intermittent resources arising from increasing levels of renewable penetration, the resulting impact to environmental justice communities, and the associated cost to rate-payers. Most significantly, it fails to effectively plan for a broader suite of zero-emission sources essential to meeting goals of the Climate Leadership and Community Protection Act (CLCPA). These failures undermine the CLCPA's mandate of substantial greenhouse gas reduction and carbon-free electricity by 2040, and threaten human health by perpetuating dependence on fossil fuels long into the future.

The following discussion is intended to shed light upon problems with the Order, including its conspicuous neglect of nuclear power, which in 2019 provided a third of all electricity in New York and over half of the state's carbon-free electricity.

Sincerely,

The above-listed organizations and parties to this case

Contact: Dr. Leonard Rodberg, lensqc@infoshare.org , 917-601-0186
Dr. Dietmar Detering, ddetering@gmail.com , 917-251-2235
Isuru Seneviratne, isuru@radiantval.com , 646-462-9018
Keith Schue, keithschue@gmail.com , 407-470-9433
Dennis Higgins, higgindm@gmail.com , 607-988-9647

PUBLIC SERVICE COMMISSION

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

Response to PSC Order
March 5, 2020

Introduction

It is critical, as the state attempts to meet goals of the CLCPA, that we take a hard look at the PSC Order issued on October 15, 2020 and the contributing White Paper by NYSERDA and the Department of Public Service.[1] It will be too late to fix problems with state energy planning down the road if adequate steps are not taken early this decade to ensure that greenhouse gas reduction and carbon-free electricity requirements due in 2030 and 2040 can be met. To this end, we examine problems with the PSC Order today, in the hope that the state will amend the current Order and devise an effective energy plan in the near term. A number of deficiencies require attention:

1. The PSC Order considers only the 70% renewable goal for electricity by 2030. Given major challenges that come into play as renewables comprise an increasing portion of total generation, and the timeframes within which implementation must occur, any plan that is not designed up-front with attention to the CLCPA's 2040 goal of 100% carbon-free electricity will fail.

2. The comprehensive monitoring of demand and supply by subregion and in time, as well as carbon-based fuel consumption and line loss, will be critical to measuring progress, discovering issues as they unfold, and taking corrective action necessary to completely decarbonize New York's electric grid. The Order does not address these important variables.

3. Although the White Paper acknowledges that the intermittency of renewable sources is a concern, the PSC has not exercised due diligence to evaluate the issue of intermittency or other factors impacting the efficacy of intermittent renewable sources. This includes failing to take heed of lessons from other jurisdictions in which intermittent sources were deployed while abandoning nuclear power.

4. The CLCPA requires attention to Environmental Justice (EJ). However, new EJ communities are created by construction of new fossil-fuel power plants, and existing EJ communities continue to be harmed when older fossil fuel plants must continue operating to compensate for the unnecessary loss of zero-emission electricity. Likewise, the impacts of implementation choices on cost affect disadvantaged communities the most. The PSC Order neglects these important issues.

For the record, we also include links in the docket to prior comments from several organizations and individuals that raised serious concerns not addressed by the Order. Said documents are incorporated herein by reference.

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[1] Public Service Commission, *Order Adopting Modifications to the Clean Energy Standard*, Case 15-E-0302, October 15, 2020. http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={EAAF1A1E-2A05-49A7-A4D1-C5755E5BE536} ;
NYS Department of Public Service & NYSERDA, *White Paper on Clean Energy Standard Procurements to Implement New York's Climate Leadership and Community Protection Act*, Case 15-E-0302, June 18, 2020.
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={E6A3B524-6617-4506-A076-62526F8EC4CB}

1. **The PSC Order considers only the 70% renewable goal for electricity by 2030, contrary to requirements of the CLCPA. Given major challenges that come into play as renewables comprise an increasing portion of total generation, and the timeframes within which implementation must occur, any plan that is not designed up-front with attention to the CLCPA's 2040 goal of 100% carbon-free electricity will fail.**

As described in the White Paper issued by NYSERDA and DPS, the Commission's role pursuant to the CLCPA and now codified in Section 66-p of the Public Service Law (PSL) is to establish a program whereby:

> *(1) jurisdictional load serving entities (LSEs) have secured adequate amounts of renewable energy resources to serve at least 70% of load in 2030 (referred to as the "2030 Target" or "70 by 30 Target"), and (2) there are zero emissions in 2040 associated with electrical demand (referred to as the "2040 Zero Emission Target").*

Yet, despite this clear mandate to address two distinct objectives, the PSC has chosen only to address one. By ignoring the need to maintain and expand carbon-free sources critical to achieving the 2040 goal, the Commission has not fulfilled its obligation under the PSL and CLCPA. In particular, the White Paper and Order ignore the significant contribution of nuclear power, which in 2019 provided a third of New York's total in-state electricity generation and over half of its carbon-free electricity. This is reliable baseload energy vital to decarbonization of New York's electric grid. The Commission's conspicuous neglect of nuclear power is curious given substantial comments timely submitted by multiple parties to this proceeding, including several listed as signatories here.

Specifically, the PSC's Order ignores the very words used by NYSERDA and DPS in their White Paper to describe importance of the CLCPA:

> *The economy-wide decarbonization called for by Governor Cuomo – and codified in the CLCPA – requires that New York harness a power generation sector* ***that no longer emits greenhouse*** *gases and provides electricity* ***for a greater proportion of the overall economy.*** *Both strategies, decarbonization of the generation sector and electrification of other sectors – all while ensuring efficiency and cost-effectiveness – must be carried out simultaneously and vigorously.*

By only addressing the 2030 goal, the numerical targets and provisions adopted by the Commission clearly do not facilitate the creation of a power generation sector "that no longer emits greenhouse gases". Nor do they adequately account for electricity demand to serve "a greater proportion of the overall economy."

In December 2019, NYISO commissioned Phase I of a *Climate Change Impact Study* to evaluate long-term demand on New York's electric grid resulting from implementation of the CLCPA, including beneficial electrification of end-user systems necessary to achieve greenhouse gas reduction goals.[2] Demand estimates for 2030 accepted by the PSC fall short of those identified in this study. Even worse, the PSC completely ignores the substantial increase in demand that can be expected due to beneficial electrification after 2030. In 2040, the climate change impact study for NYISO estimated that New York will need 221,479 GWh of electricity, even if the state achieves 50,636 GWh of energy efficiency gains. This corresponds to 69,801 GWh more electricity than NYSERDA and DPS predict will be needed in 2030, all of which must be carbon-free. Beyond this, the study for NYISO forecasts 258,011 GWh of demand in 2050. These figures further underscore the need for ample, reliable, carbon-free electricity.

[2] Itron, *New York ISO Climate Change Impact Study - Phase I: Long-Term Load Impact*, December 2019. https://www.nyiso.com/documents/20142/16884550/NYISO-Climate-Impact-Study-Phase1-Report.pdf

By using load projections that do not account for actions critical to meeting CLCPA goals, the PSC has tacitly accepted a future in which the CLCPA fails.[3] The math is not difficult to understand. Beneficial electrification will mean that the state may require nearly twice as much electricity in the future. Therefore, if the 70% renewable target is met, but the remaining 30% is ignored and nuclear is lost, then the state will eventually need fossil fuels to supply the equivalent of almost 60% of today's generation. Today 40% of New York's electricity comes from fossil fuels. So, ignoring the 2040 mandate could mean even more fossil-fuel power plants in the future.

Rather than engaging in meaningful planning for a carbon-free grid, the White Paper by NYSERDA and DPS simply asserts that "a*chieving the 70 by 30 [renewable] Target is a necessary and foundational precondition for achieving the 2040 Zero Emission Target."*

No facts or evidence are provided to support this claim. Indeed, history suggests the opposite. Over 90% of electricity produced in France is carbon-free with only about 20% of that being from renewable sources. France receives over 70% of its electricity from 56 nuclear power plants which were built in a little over a decade. France is also a significant exporter of carbon-free electricity. Increasing electricity generation from intermittent wind or solar was clearly NOT a "necessary and foundational precondition" for France to achieve among the lowest emissions and cleanest air in Europe. In fact, the country would only need to procure another 10% of its electricity from carbon-free sources—whether they be renewables or nuclear—to achieve a carbon-free grid. Perhaps most telling is that when France recently tried to replace some of its nuclear capacity with wind and solar, the carbon-intensity of its electric grid actually increased because dispatchable electricity from gas-fired power plants was needed to compensate for renewable intermittency.[4]

The only countries or states which have achieved deep decarbonization are those which use nuclear power or are fortunate enough to have vast amounts of hydro and geothermal resources. Thus, there is no merit to the claim that a renewable target, particularly one dominated by intermittent sources, is a "necessary and foundational precondition" to achieve carbon-free electricity in New York or anywhere else.

As discussed further in these comments and those submitted earlier, the challenges of integrating intermittent renewables into the grid become increasingly difficult and costly with increased penetration. This in turn creates an inextricable dependence on dispatchable gas that undermines the goal of carbon-free electricity. As seen in California and Germany where baseload nuclear power is being systematically retired, the result has been essentially no reduction in gas use, despite major investments in both wind and solar at tremendous taxpayer expense. Why should New York, which receives less sunshine than California, and whose residents are unlikely to tolerate the massive rate increases seen in Germany, believe it will fare better?

Perhaps any reduction in greenhouse gas emissions—regardless of cost—can be considered better than nothing. But should we applaud a massive statewide buildout of renewables which, due to poor planning and myopic thinking, will be unable to achieve the state's intended goal and may burn nearly the same amount of fossil fuels? Clearly, it would be smarter to develop a plan that can meet those goals instead of pursuing policies that will fall far short. In New York, if reliable carbon-free nuclear power is lost, fossil fuels will step in and operate either as replacement baseload power or in "partnership" with intermittent sources, which works against the state's carbon-free target (as well as against the 70% renewable target). This should be obvious because it has already

[3] The Order accepts the White Paper's forecast of 151,678 GWh of load in 2030. Adding behind-the-meter solar to grid-delivered generation, the Itron study forecasts 154,096 GWh + 8,081 GWh = 162,177 GWh in 2030, 212,594 GWh + 8,885 GWh = 221,479 GWh in 2040, and 248,379 GWh + 9,662 GWh = 258,011 GWh in 2050. See Itron study (Table A-156).

[4] https://quillette.com/2019/02/27/why-renewables-cant-save-the-planet/

happened: As ink was drying on the CLCPA, gas-fired power plants with nearly the same nameplate capacity as Indian Point—Cricket Valley Energy Center (CVE) and CPV Energy Center (CPV)—fired up to replace electricity lost when the first of Indian Point's two reactor shut down.[5] Millions of tons of greenhouse gas emission will be produced annually as a result of that additional gas combustion.

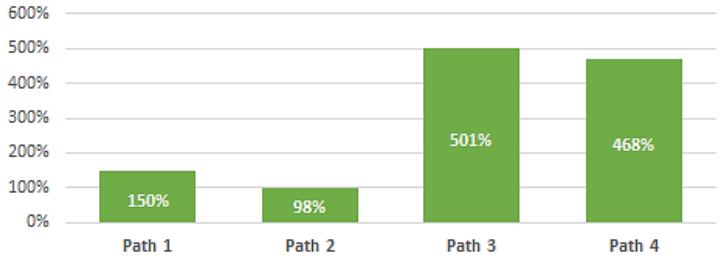
In page 2 of the Order, the PSC states:

> *In this Order, the Commission adopts several modifications to its existing Clean Energy Standard (CES) in order to align with the CLCPA mandates. The Commission also adopts a competitive procurement program under Tier 2 of the CES to secure the continued availability of existing renewable resources. These actions together will put New York on a path toward achieving the State's ambitious climate and clean energy objectives.*

Although the Order refers to 2030 and 2040 targets, all enhancements made to the CES address only "renewable" sources of electricity. They exclude nuclear power, which is carbon-free. Consequently, the Order's modifications to the CES do not "align" with CLCPA mandates. Likewise, the Order announces improvements under Tier 2 to protect existing "renewable" resources, yet future Tier 3 support of zero-emission sources are not addressed. Finally, addressing only the 2030 goal of 70% renewable electricity, the Order appears to conclude that New York will be well positioned to meet the CLCPA's goal of 100% carbon-free electricity by 2040. As previously discussed, this is not supported by any arguments or empirical evidence.

By focusing exclusively on an arbitrary "renewable" target, rather than the goal of carbon-free electricity, the PSC has lost sight of the fundamental purposes for which the CLCPA was crafted, which is to reduce greenhouse gas emissions and protect public health. According to the Intergovernmental Panel on Climate Change (IPCC), for all viable pathways that limit global warming to 1.5 degrees Celsius, nuclear power remains steady or expands.[6] Similarly, the International Energy Agency (IEA) has said that global nuclear capacity must double by 2050 to achieve this 1.5 C target.[7] The U.S. has just survived four years of an administration in Washington that rejected science in general, and global warming specifically. The administration in Albany, and committees appointed to it, should realize that, in the end, **denying effective solutions to the climate crisis has the same consequences as denying climate change itself.**

Nuclear Generation in IPCC Pathways that Limit Global Warming to 1.5 C (2050 vs. 2010)



Source: IPCC 2018

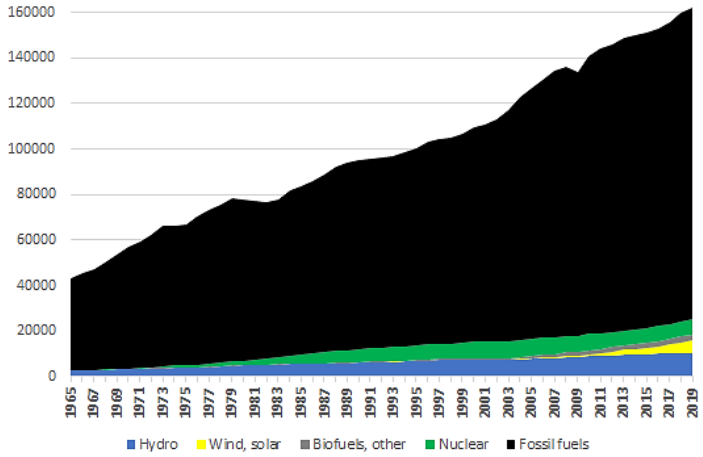
Arguably the economic capital of the world, New York has a unique opportunity and, indeed, a profound responsibility, to set a course for the future as an advocate for nuclear power—leadership that it previously demonstrated by adopting a program of zero-emission credits (ZECs) to support nuclear plants upstate. However,

[5] http://www.nuclearny.org/ip2-press-release/
[6] https://www.ipcc.ch/sr15/download/#full
[7] https://www.goodenergycollective.org/policy/whats-in-store-for-nuclear-in-a-biden-administration

if New York now decides to let carbon-free nuclear power slip away, it must accept responsibility for not only its own failure to meet climate and clean energy goals, but the failure of others who look to New York for leadership. Non-governmental organizations that spread misinformation about nuclear power or are unwilling to reconsider their own ideological positions—when the planet's future demands that they do—must also share responsibility.

As climate scientist Dr. James Hansen has said, whatever effective solutions are developed to address climate change here in the United States must be solutions that work in the rest of the world, too. This includes Asia and India where the demand for energy has caused skyrocketing growth in fossil-fuel consumption. The fact that many of today's solar panels are built in China is no consolation for this environmental and public health catastrophe. Throughout the world, current efforts to stem climate change and decrease dependence on fossil fuels without energy-dense nuclear power have been an abysmal failure, and the planetary harm of that failure grows every year that we continue down the same ignorant path.

World Energy Consumption 1965-2019 (TWh)



Source: Our World in Data (Energy Mix)

It should be abundantly clear that the world's energy supply will not be decarbonized with wind turbines, solar panels, and existing hydro plants alone. On the other hand, nuclear power—as seen in France and Sweden—has a proven track record of scaling up rapidly to satisfy a nation's demand for electricity without fossil fuels.

The technical and logistic problems that renewables present in meeting the energy needs of a growing world are very real: low energy-density, low capacity-factor, intermittency, land use and resulting ecological impacts, material requirements, and significant material waste. The fear-mongering claims launched by anti-nuclear activists against the safety and viability of nuclear power are not.[8] Indeed, such claims remind us of anti-science misinformation spread by the previous administration in Washington. New York will have little chance of meeting its bold goal of zero-emission electricity when policy makers are afraid to even utter the word "nuclear". Unless the PSC recognizes the value of nuclear power (existing and advanced), the goals of meaningful greenhouse gas reduction and carbon-free electricity will remain an elusive aspiration. Stated more bluntly, if New York fails to take action in the near-term to ensure that nuclear power remains a robust part of its future energy portfolio, then in nineteen years when Cricket Valley and other fossil fuel power plants are still pumping carbon into the atmosphere, these comments will serve as stark historical testimony to the fact that policy makers were either not serious about climate change or not courageous enough to craft an effective plan for New York.

[8] https://climatecoalition.org/isnt-nuclear-dangerous/

A review of energy portfolios elsewhere in the U.S. confirms the need for nuclear power as well. Like New York, Washington State hopes to achieve a carbon-free grid. As discussed in prior NYECA testimony, a 2020 Pacific Northwest study prepared by the consulting firm Energy & Environmental Economics (E3)—which is also reviewing plans for New York—found that Washington's existing nuclear plant, Columbia Generating Station, should be relicensed. E3 further determined that advanced nuclear technology, particularly Small Modular Reactors (SMRs) would help the state shut down gas-fired generation, noting the distinct performance, cost, and safety advantages that SMRs offer.[9] Significantly, E3 found the ability of nuclear power to provide "firm" carbon-free electricity invaluable to full decarbonization even though Washington receives most of its electricity from baseload hydropower and has achieved 70% renewable penetration.

Similarly, as discussed by NYECA and Sustainable Otsego in prior testimony, Ontario prepared *a Green Ribbon Panel* report for the purpose of identifying "Clean Air, Climate Change and Practical, Innovative Solutions to Grow the Economy and Reduce GHG Emissions."[10] By displacing coal, nuclear power has already been responsible for a significant reduction in emissions from Ontario's electricity sector. However, the Canadian report found that much of this gain will be lost if its Pickering Nuclear Generating Station is replaced with gas-fired generation. The report determined that sustaining and refurbishing Ontario's nuclear fleet will be essential to achieving its 2030 greenhouse gas reduction goals while increasing the amount of electricity required to meet demand. Ontario and New York have similar climates, similar energy portfolios, and similar per-capita energy use. Consequently, we should take advantage of studies underway by our northern neighbor to inform decisions made here. Analysis prepared for NYISO, including a *Phase II Climate Change Impact and Resiliency Study* in September 2020, also found the retention of nuclear power to be essential in each scenario considered for meeting the CLCPA's 2040 goal of carbon-free electricity.[11]

In a 2020 filing submitted to this proceeding, NYECA and Nuclear NY suggested several methods by which the CES could be modified to support the retention and expansion of carbon-free nuclear power in New York. First among these was extension of the Tier 3 program of Zero-Emission Credits through at least 2040. It was also suggested that the CES support development of new advanced nuclear projects, which will be essential in the decades ahead as existing plants retire and the state's demand for electricity continues to grow. This could be accomplished by expanding the scope of Tier 3 or by developing a separate tier. Alternatively, nuclear power could be permitted to participate in the REC program created for renewables, a holistic approach recognizing the importance of all carbon-free energy. Finally, understanding the need for "firm" carbon-free generators to complement intermittent sources, parties suggested that the CES incorporate a new tier or attribute structure that gives added value to those carbon-free sources capable of providing continuous or dispatchable energy.

The Commission failed to act upon, or even discuss, any of the above recommendations in its Order, even though they directly affect decarbonization of the electricity sector, a mandate of the CLCPA necessary to achieving greenhouse gas reductions goals. We maintain that these issues require investigation and urge the PSC, in the observation of due diligence, to evaluate them in an amended CES.

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[9] *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/

[10] Green Ribbon Panel, *Clean Air, Climate Change and Practical, Innovative Solutions to Grow the Economy and Reduce Greenhouse Gas Emissions in Ontario,* September 2020. http://s34294.pcdn.co/wp-content/uploads/2020/09/200062_GreenReport_ClimateChange-FINAL-SEPT-10.pdf

[11] Analysis Group, *Climate Change Impact and Resilience Study - Phase II: An Assessment of Climate Change Impacts on Power System Reliability in the United States. Long-Term Load Impact*, September 2020. https://www.nyiso.com/documents/20142/16884550/NYISO-Climate-Impact-Study-Phase-2-Report.pdf

2. **The comprehensive monitoring of demand and supply by subregion and in time, as well as carbon-based fuel consumption and line loss, will be critical to measuring progress, discovering issues as they unfold, and taking corrective action necessary to completely decarbonize New York's electric grid. The Order does not address these important variables.**

The CLCPA provides specific instructions with respect to the monitoring of progress toward achieving goals in the electricity sector. As reiterated on page 9 of the Order:

> *The CLCPA requires the Commission, by July 1, 2024 and every two years thereafter, to issue for notice and comment a "comprehensive review" that considers "(a) progress in meeting the overall targets for deployment of renewable energy systems and zero emission sources, including factors that will or are likely to frustrate progress toward the targets; (b) distribution of systems by size and load zone; and (c) annual funding commitments and expenditures."*

However, directions provided in the Order to state agencies fall far short of this. One pages 22-23, the Commission simply directs DPS and NYSERDA to:

> *provide annual updates of both the load forecasts and procurement targets to assure that the renewable energy projects being developed are on schedule to meeting the 70 by 30 Target and that adjustment to procurement targets are timely made.*

Contrary to CLCPA instructions, this does not constitute a "comprehensive review" of factors that "will or are likely to frustrate progress." In testimony, several parties recommended that daily and seasonal demand and supply profiles be collected and analyzed on a subregional basis. Statewide annual reports focused on the 70% renewable target will not provide sufficient granularity or attention to factors that need to be understood by state planners. Electricity must be able to move from where it is generated to where it is needed as the availability of intermittent sources fluctuate. Thus, ongoing real-time assessments of demand and carbon-free supply on a subregional basis are essential. Here again, the PSC recklessly ignores the non-linear difficulties of incremental decarbonization. Real-time information on how challenges manifest themselves is critical to discovering problems as they unfold and to taking corrective action needed so that a complete conversion to carbon-free electricity will be possible.

In addition, since decarbonization is the goal, the PSC should require the collection of real-time information on fuel use and greenhouse gas emissions from all generating sources that are not carbon-free (fossil fuels, biomass, and any sources which consume hydrogen or synthetic-fuel produced from fossil fuels). This is necessary to evaluate the extent to which operational inefficiencies associated with "partnering" non-carbon-free generation with intermittent sources of electricity contravenes progress on greenhouse gas reduction. As discussed in the next section, the "partnering" of gas with renewables in California and elsewhere has led to behavior that undermines climate objectives. This includes the increased use of inefficient simple-cycle gas-fired generation, frequent startup/shutdown of gas-fired facilities, and the burning of gas at plants which run in "hot standby" while waiting to be brought online if solar or wind stop producing. Line-loss inefficiencies associated with the transport of electricity from distant renewable sources must also be tracked. Coupled with such data, the Commission and state planners should pursue benefit-cost analyses to avoid system inefficiencies that perpetuate fossil-fuel dependence and undermine greenhouse gas reduction.

If New York follows in the footsteps of California, significant time and money will be spent on solutions that manufacture a victory for "renewables" on paper, but do little to curtail the consumption of fossil fuels. Tracking of the aforementioned metrics is essential if the state hopes to make real progress on climate change.

3. **Although the White Paper acknowledges that the intermittency of renewable sources is a concern, the PSC has not exercised due diligence to evaluate the issue of intermittency or other factors impacting the efficacy of intermittent renewable sources. This includes failing to take heed of lessons from other jurisdictions in which intermittent sources were deployed while abandoning nuclear power.**

Consequences of Losing Nuclear Power

In 2015, the PSC initiated a proceeding to adopt a Clean Energy Standard (CES) which recognized the value of all forms of carbon-free electricity. It created a system of Renewable Energy Credits (RECs) to achieve the realistic goal of 50% renewables by 2030, and it created a program of Zero-Emission Credits (ZECs) to ensure the economic viability of New York's upstate nuclear power plants. At the time, Governor Cuomo wrote:

> *In developing the Standard, additional attention needs to be given to ensure emissions free sources of electricity remain operational. Specifically, elimination of upstate nuclear facilities, operating under valid federal licenses,* ***would eviscerate the emission reductions achieved through the State's renewable energy programs, diminish fuel diversity, increase price volatility, and financially harm host communities****. --Governor Cuomo (letter to DPS CEO Audrey Zibelman, December 2015)*[12]

Through 2019, nuclear power provided 33% of the state's electricity, and 55% of its carbon-free electricity.[13] Thus, through diligent implementation of the 2016 CES Order, and continued operation of Indian Point, New York could have been well on its way to 80% carbon-free electricity by 2030. Unfortunately, actions taken—and not taken—by policy makers since then put New York on a reverse path, jeopardizing prior progress and threatening to put the CLCPA's goal of 100% carbon-free electricity out of reach.

With adoption of the CLCPA, which calls for complete decarbonization of the electric sector, the Governor's words about nuclear power are even more valid today. Yet instead of supporting the renewal of Indian Point's operating license, the state fought relicensing and the PSC pushed through an Indian Point "contingency plan" which encouraged the permitting and construction of large gas-fired power plants to compete in the same service area—the 678 MW CPV facility, mired in political scandal, as well as the behemoth 1,100 MW CVE plant.[14] CVE announced construction plans just a few days after the agreement to shut down Indian Point became public, and it went online only days prior to the deactivation of Indian Point Reactor 2 (IP2).

The recent PSC Order modifying the 2016 CES appears to follow suit, as it has conspicuously avoided taking any action to support—or to even discuss—the future of nuclear power after 2030. This failure is particularly striking given substantial testimony by NYECA and other parties on the importance of existing and advanced nuclear power to provide reliable firm capacity. Meanwhile, the PSC, Climate Action Council, and its Power Generation Committee are entertaining combustion alternatives including biogas (agricultural methane), hydrogen, and renewable natural gas (synthesized methane) which have no chance of achieving levels of deployment comparable to nuclear power. When imaginary solutions fall short, power plants like Cricket Valley will continue to burn fracked gas long after 2040 unless nuclear power is in the mix.

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[12] https://www.governor.ny.gov/sites/governor.ny.gov/files/atoms/files/Renewable_Energy_Letter.pdf

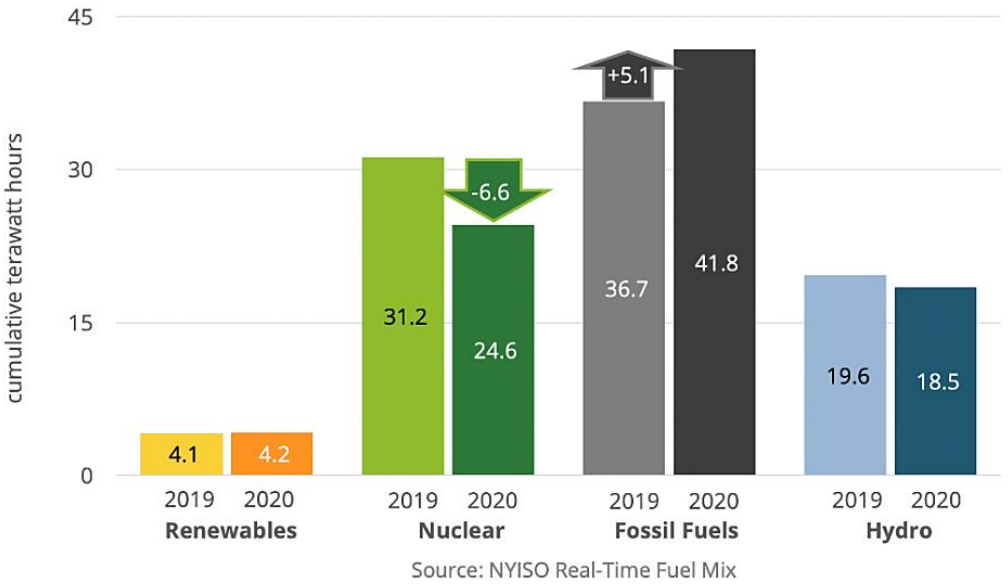
[13] This figure includes behind-the-meter solar.

[14] https://public-accountability.org/report/the-percoco-connection-the-money-trail-linking-competitive-power-ventures-cuomo-and-trump/

As seen throughout the country and the world—Vermont, Massachusetts, California, and Germany—wherever nuclear power has been lost, a commensurate amount of fossil fuel combustion replaces it. However, one need not look any further than New York itself to know this. Shortly after the deactivation of IP2, NYECA analyzed real-time data available from the NYISO "dashboard" to examine the impact that the loss of IP2 has had on the mix of generation. As explained in prior testimony, significantly more gas-fired generation was required during weeks of similar load and generation after IP2 was deactivated. The record accumulated since then is even more compelling. Examining NYISO data for the last eight months of 2020 following closure of IP2, it is seen that fossil fuel generation rose by more than 5,000 GWh compared to the same eight-month period in 2019. Significantly, this occurred even during the COVID pandemic when total electricity demand fell nearly 2,800 GWh.[15]

NY Electricity Generation Mix Pre- and Post- Indian Point 2 Closure

Eight Months from May to December



Source: NYISO Real-Time Fuel Mix

Contrary to the claims of some anti-nuclear activists, renewable energy and energy efficiency did not replace Indian Point. Gas did. In fact, as pointed out in our prior testimony, shutting down just half of Indian Point in 2020 removed more carbon-free electricity from the grid annually, 8,300 GWh, than is generated by every wind turbine and solar panel in the entire state. Another 8,300 GWh of annual carbon-free electricity will be lost if Indian Point's remaining reactor shuts down in 2021.[16]

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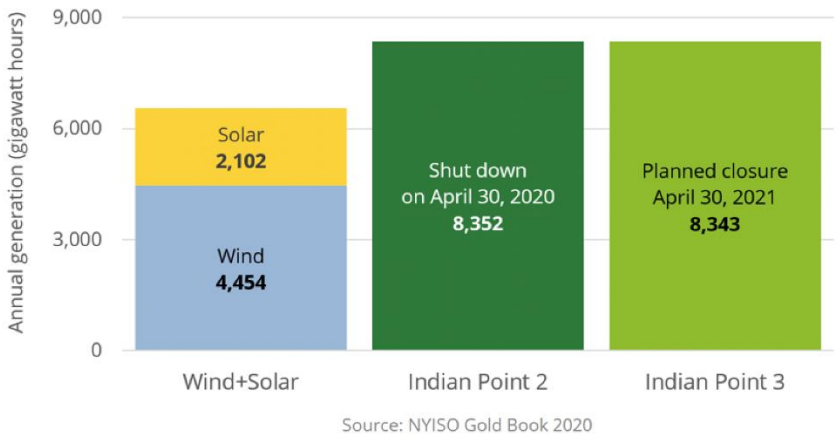
[15] Generation data from NYISO for May through December of 2019 and 2020. http://mis.nyiso.com/public/P-63list.htm.
Actual load data from NYISO for May through December of 2019 and 2020. http://mis.nyiso.com/public/P-58Clist.htm
See also: https://climatecoalition.org/setting-the-record-straight-on-indian-point

[16] NYISO 2020 Gold Book. https://www.nyiso.com/documents/20142/2226333/2020-Gold-Book-Final-Public.pdf
In 2019, wind produced 4,454 GWh (Figure III-3), utility-scale solar produced 52 GWh (Figure III-3) and there was 1,896 MW of behind-the-meter solar (Table 1-9A). Applying a capacity factor of 12.34%, this corresponds to 2050 GWh of behind-the-meter solar annually. This capacity factor is derived from NYISO projections of nameplate capacity and annual generation for statewide behind-the-meter solar in 2020 (Table 1-9A and 1-9B). At a 14% capacity factor, this corresponds to 2,325 GWh. For either capacity factor, the total amount of generation from all of the wind and solar in the state is less than the annual output produced by IP2 in 2019. Generation data for IP2 and IP3 is found in Table III-2.

Electricity from Statewide Wind, Solar, and Indian Point (2019)



The inconvenient truth is that in the CLPA's first year, New York took an enormous step backwards on climate change. Losing 16,700 GWh of nuclear power annually will result in 7 million metric tons of avoidable carbon dioxide emissions every year—and this reality will persist until the grid is fully decarbonized, assuming that occurs. Moreover, those greenhouse gas impacts double if lifecycle emissions of methane are taken into account.[17] As we discuss, shuttering Indian Point also sets the state backwards on environmental justice because dirty fossil-fuel power plants in EJ communities, including disproportionately impacted communities within New York City, must continue operating longer, and may even need to run more.

"100% renewables" has become a popular rallying cry and campaign slogan for several NGOs. However, slogans are not science and rallies are not a plan. Climate experts James Hansen, Kerry Emanuel, Kenneth Caldeira, and Thomas Wigley write:

> *To solve the climate problem, policy must be based on facts and not on prejudice. The climate system cares about greenhouse gas emissions – not about whether energy comes from renewable power or abundant nuclear power. Some have argued that it is feasible to meet all of our energy needs with renewables. The 100% renewable scenarios downplay or ignore the intermittency issue by making unrealistic technical assumptions, and can contain high levels of biomass and hydroelectric power at the expense of true sustainability. Large amounts of nuclear power would make it much easier for solar and wind to close the energy gap. The climate issue is too important for us to delude ourselves with wishful thinking. …The future of our planet and our descendants depends on basing decisions on facts, and letting go of long-held biases when it comes to nuclear power. (The Guardian, December 2015)*[18]

One can certainly find papers touting "100% renewables". However, these have been sharply refuted by experts in energy systems and electric grid operation. For example, in *Burden of proof: a comprehensive review of the feasibility of 100% renewable- electricity systems,*[19] Dr. Benjamin Heard and colleagues critically evaluated 24 such

[17] This estimate is based on a global warming potential of methane that is 86 times that of CO_2 over 20-years.

[18] https://www.theguardian.com/environment/2015/dec/03/nuclear-power-paves-the-only-viable-path-forward-on-climate-change

[19] B. Heard, B. Brook, T. Wigley, C. Bradshaw. *Burden of proof: A comprehensive review of the feasibility of 100% renewable-electricity systems*. Renewable Sustainable Energy Reviews, Volume 76, September 2017, Pages 1122-1133.

papers by Jacobson, Greenpeace, and others, finding numerous deficiencies including lack of or inadequacy of system-level simulations, unrealistic demand forecasts, and inadequate analysis or extraordinary assumptions relating to storage needs, technology, and transmission. Further, as Hansen and colleagues also noted, many "100% renewable" reports relied heavily on biomass combustion, raising concerns of environmental sustainability, air pollution, and social justice.

But perhaps the most compelling rebuttal to those proclaiming affordable 100% renewable electricity is not in academia, but in the real world. As discussed, other than places with naturally abundant hydropower and geothermal resources (like Iceland), there is no technologically advanced society on Earth that has achieved or is close to achieving 100% renewable electricity. (Communities that buy renewable credits from elsewhere, but use electricity from fossil fuels, do not count.) Furthermore, losing nuclear power has crippled the efforts of those that have tried to tackle climate change with a renewable-only approach.

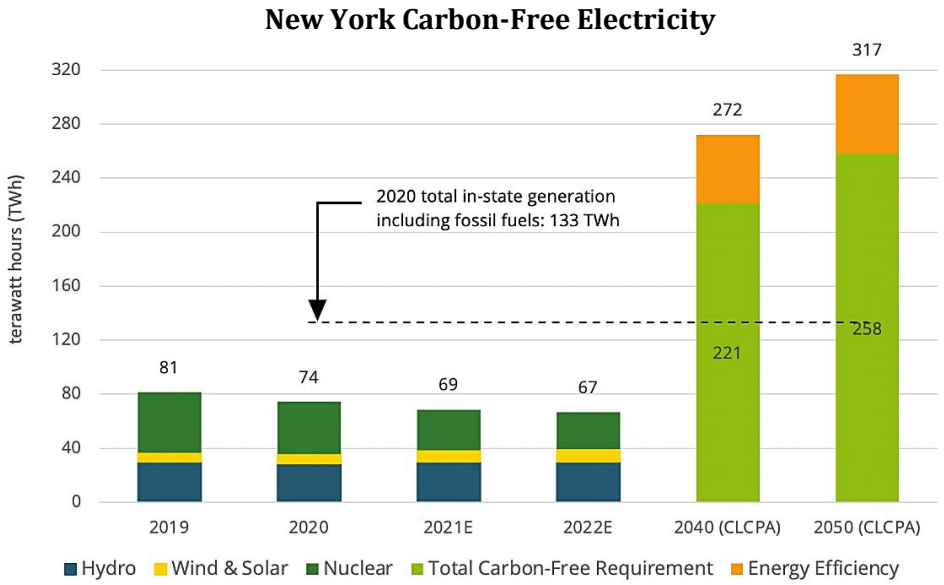
In 2010, Germany undertook "Energiewende," once described as the most ambitious energy revolution by an industrialized nation. However, the country simultaneously decided to eliminate nuclear power within its borders, wiping out a source of carbon-free electricity that had provided over a quarter of its total electricity. Despite half a trillion Euros invested in wind, solar, and other efforts, Germany is now increasingly dependent on foreign gas, and in 2020 even fired-up a new coal plant. To compensate for intermittent sources, Germany depends on electricity produced by burning fossil fuels at home and in neighboring countries. In fact, after deciding to shut down carbon-free nuclear power, Chancellor Merkel now wants to receive gas from Russia through a pipeline under the Baltic Sea and import liquified natural gas (LNG) from the United States. Under the pretense of "renewable energy", Germany also burns wood from forests around the world that had previously sequestered carbon, as well as crops from farmland that could have fed people. Perhaps most ironic is that Germany continues to import electricity from nuclear power plants in France to balance its grid. Meanwhile France, which receives almost all of its electricity from nuclear, has among the lowest carbon emissions and cleanest air in Europe—a success achieved years ago in a little over a decade.

With a misplaced focus on "renewables" rather than "carbon-free" energy, and with growing public resistance to wind turbines and solar panels carpeting the land, Germany has boxed itself into a corner.[20] Similarly, in the United States, California has managed to increase non-hydro renewables to about a third of electricity generation. However, since it has reduced nuclear power, the state still relies on gas for 40% of its electricity. This is roughly the same amount of electricity California has received from gas for the last two decades. To make matters worse, utility customers in California and Germany face soaring electricity rates, and Californians suffer from rolling blackouts that expose the fragility of an unreliable grid. New York ought to learn from these failed experiments rather than repeat them.

The following graph helps put in perspective how losing nuclear power has impacted New York's progress in achieving CLCPA goals. The first two columns depict 2019 and 2020 annual generation from carbon-free sources based on NYISO actual data. The third and fourth columns depict projected annual generation based on projects in the NYISO queue.[21] Note that these also include reductions in statewide nuclear power resulting from the closure of IP2 in April 2020 and the closure of Indian Point Reactor 3 (IP3) in April 2021. The last two columns depict estimated future demand for electricity, which must be entirely carbon-free by 2040, as well as projected

[20] https://www.spiegel.de/international/germany/german-failure-on-the-road-to-a-renewable-future-a-1266586.html
[21] 2020, 2021, and 2022 behind-the-meter contributions to total solar generation are based on NYISO 2020 Gold Book projections.

gains in energy efficiency, as determined by the Phase 1 Climate Impact Study for NYISO which takes into account beneficial electrification. In these two columns, efficiency projections additionally serve to illustrate what total demand would be if those efficiency gains are not achieved.



Sources: NYISO Power Trends 2020, Gold Book 2020 (for rooftop solar), Real-Time Fuel Mix (for 2020), Interconnection Queue (for grid solar & wind, probability adjusted), Itron CLCPA Study 2020 (for 2040 & 2050)

As seen above, in the CLCPA's first year, New York has lurched backwards on the CLCPA's climate goals, and will continue to regress each year through 2022 due to the loss of Indian Point. As previously discussed, this has resulted in significantly more fossil fuel combustion within the downstate region. Incremental gains in renewables pale by comparison. Assuming that ambitious plans for offshore wind take place on schedule, the amount of annual carbon-free electricity produced downstate is unlikely to return to 2019 levels until late this decade. Further loss of nuclear power within New York would compromise efforts even more. Notably, accounting for capacity factor, the loss of nuclear power statewide would more than cancel out the annualized energy contribution of the state's entire 9,000 MW offshore wind project. For reasons discussed in the following section, the impact to grid reliability would be even more severe.

Consequences of Intermittency and the Need for Firm Generation

Recent events in Texas underscore the importance of reliability and diversity of clean energy sources. A common misconception by advocates of "100% renewables" is that if a state like California can reach 30% penetration of wind and solar then it must be easy to attain 100% by just doing more of the same. This is profoundly incorrect. Wind turbines and solar panels produce electricity when they can, not necessarily when it is needed. In New York, new photovoltaic solar has an average capacity factor of 14%, which dwindles to nearly zero in the winter, and the capacity factor of onshore wind is about 26%. So, when the weather does not cooperate, there are large gaps in generation. Likewise, the overbuilding of intermittent capacity leads to the curtailment ("dumping") of excess electricity, which results in even greater system-wide inefficiencies and cost because deployed wind and solar sources are underutilized. As intermittent sources become a larger and larger portion of a region's electric

portfolio, the challenges they create become increasingly pronounced, which in turn makes the job of maintaining a functioning, reliable grid increasingly difficult.

Storage can help, but understanding its limitations is important. Batteries, sometimes coupled with renewables, can be used for peak shaving, and this is helping to eliminate inefficient peaker plants. However, the reason this works is because peakers are small facilities with low operational capacity factor. Since peakers only supply electricity occasionally and for limited duration, the amount of stored energy needed to replace them with batteries is modest—and with sufficient time between discharge periods, it may be possible to recharge those batteries from intermittent sources.

On the other hand, replacing the function of large baseload power plants is an entirely different scenario for which batteries are not well suited. For example, the largest battery in the world today is California's Moss Landing project with 1,200 MWh of storage. This corresponds to only about one half-hour of the energy that Indian Point delivered reliably 24 hours a day prior to the loss of IP2. Notably, Ravenswood Development proposes to construct and operate a 316 MW battery with eight hours of storage (2,538 MWh) at its power generation facility in Queens, NY. This is equal to only about 15% of Indian Point's deliverable power. If configured to match the nameplate capacity of Indian Point, the proposed Ravenswood battery could deliver only about 80 minutes' worth of the electricity that Indian Point generated all the time.

With improvements in battery technology, one might expect that short-term storage could begin to mitigate hourly fluctuations in demand, for example helping to address the "duck curve" that plagues the operation of large-scale solar farms in California. However, batteries capable of adequately mitigating longer term fluctuations in supply and demand that occur day-to-day and seasonally due to the widespread deployment of intermittent renewables will not be available anytime in the foreseeable future. The bottom line is that batteries do not come close to replacing the critical function served by nuclear power in delivering reliable, baseload electricity.

One of the more effective ways of storing large amounts of energy for later use continues to be traditional pumped hydro. For example, the Blenheim-Gilboa plant in New York's Catskill Mountains can store 12 GWh of energy and deliver 1,100 MW of power. Like other hydroelectric facilities, pumped hydro plants can have significant ecological impacts and about a quarter of input energy is not recoverable due to efficiency losses. However, if the state was serious about developing a carbon-free grid dominated by intermittent sources, many more pumped hydro facilities with much greater capacity than Blenheim-Gilboa would already be under construction. It should also be noted that the Blenheim-Gilboa plant is only capable of about ten hours of storage at rated nameplate capacity. Consequently, its function in the grid is to moderate hourly fluctuations of supply and demand (like a peaker plant, except larger). Even with higher capacity, pumped storage facilities are unable to overcome significant seasonal variations associated with intermittent sources like solar.[22]

As pointed out by NYECA and others, the real-world limitations of storage make "firm" carbon-free generators—meaning carbon-free sources that produce electricity all the time or that can be dispatched as needed—not only extremely important, but essential to achieving both stability and decarbonization of the grid. Yet while the Commission seems to vaguely recognize the need for firm carbon-free generation in its Order, nowhere does the PSC discuss the importance of retaining the state's largest source of firm carbon-free electricity: nuclear power.

[22] https://www.eia.gov/todayinenergy/detail.php?id=11991;
https://en.wikipedia.org/wiki/Blenheim%E2%80%93Gilboa_Hydroelectric_Power_Station

Instead, the PSC appears to have given voice to fossil fuel interests which suggest that large gas-fired power plants should continue operating—and that perhaps even more should be built—based on the unbelievable notion that those plants might one day burn hydrogen, biogas, or "renewable" natural gas (RNG). The Commission, DPS staff, and NYSERDA ought to know that these concepts rely on technologies that have not been demonstrated at scale, lack a track record, or simply do not exist. The amount of retrievable biogas from agriculture is negligible compared to what would be required for large-scale electricity generation. Further, the production of hydrogen and RNG (methane synthesized directly from hydrogen and carbon dioxide) are both incredibly energy-intensive processes that require far more input energy than recovered upon combustion. Manufacturing, storing, and transporting quantities of hydrogen or RNG sufficient to sustain the grid would necessitate the construction of massive industrial facilities, which has not been done anywhere on earth. Moreover, powering those fuel-producing operations would still require wind farms, solar farms, and transmission to make those processes carbon-neutral—assuming that running those processes from intermittent sources is even possible.[23]

Another technology that has been suggested to achieve firm carbon-free generation is Carbon Capture and Sequestration (CCS). This involves collecting the combustion emissions of fossil fuel power plants and sequestering those emissions in some way, such as within deep underground rock formations. However, underground sequestration of CO_2 is a largely unproven technology and the sheer scale of capture required (millions of tons of CO_2 per year) raises doubt about its viability. CCS also requires substantial additional energy (more fossil fuels combustion) to capture and sequester CO_2. Further, it does not address the systemic problem of methane leakage, inherent to all gas systems from wellhead to point of combustion. Unlike nuclear power which has provided carbon-free electricity for decades, CCS has not been demonstrated at scale and only a few pilot projects exist.

Finally, biomass incineration has been suggested as a potential source of firm "carbon-free" energy. It is not. Like fossil fuels, wood and other biomass materials produce carbon dioxide when burned. For biomass combustion to be "carbon neutral", trees would have to grow as fast as they burn. Moreover, biomass has even lower energy density than fossil fuels, meaning that more material must be combusted to produce energy. This translates into a perpetual caravan of people, chainsaws, front-loaders, and diesel trucks to extract wood from forests that sequester carbon and transport it to facilities for incineration. Most tragic from a public health standpoint, if New York embraces biomass for energy, it will be opting for a fuel source that, when burned, is almost as dirty as coal.

Needless to say, the fossil fuel industry understands that the public's tolerance for the intensity and price tag of unrealistic, exotic solutions will evaporate long before they ever materialize, thereby ensuring a market to burn gas from fossil fuels far into the future. By ignoring nuclear power and contemplating impractical, Rube Goldberg solutions that are divorced from the real world or pollute the environment, New York is following in the footsteps of California and Germany, pursuing an energy plan that is destined to fail.

Unlike government agencies that may interpret their responsibilities through a political lens, NYISO recognizes that its job is to keep the lights on. Understanding this, in September 2020, *Analysis Group* released Phase II of a climate change impact study for NYISO which evaluated potential energy resources needed to maintain resiliency while achieving carbon-free electricity. Candidly discussing the difficulty of meeting the CLCPA's 2040 goal, authors of the Phase II study wrote:

[23] Ironically, there is a way to make large-scale hydrogen or hydrocarbon synthesis viable involving high-temperature nuclear power, similar to concepts being explored by the Navy to produce jet fuel on nuclear aircraft carriers. This could also have practical applications for vehicles as an alternative to gasoline refined from crude oil. However, using nuclear power to produce hydrogen or methane for electricity generation would not be necessary, since nuclear power plants already produces electricity.

> *The scope of changes that will be needed to the state's building, transportation and electric sectors is unprecedented.* ***Meeting this level of emission reductions will not only require rapid advancement of existing advanced energy technologies, but will also likely require technologies, policies, and programs that have not yet been conceived of or developed.***[24]

Two scenarios were considered: one created by authors of the Phase II report and another that had been considered previously by the Brattle Group**. Notably, both scenarios retain existing nuclear power through 2040.** Both also include undefined, dispatchable emission-free "backstop" generators (described as "DE sources") to compensate for renewable intermittency. These might include RNG, hydrogen, or other technologies not currently conceived of or developed. Importantly, however, **the scenario in which more nuclear is retained requires significantly less of these dubious solutions.** For that scenario (the CCP2 case), the report assumes that all three of New York's upstate plants—Nine Mile Point 1 and 2, Fitzpatrick, and Ginna still operate in 2040.[25]

With respect to reliability, the report leaves no doubt about the difficulties created by intermittent sources:

> ***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 LOLOs [loss of load occurrences], or requiring substantial contributions from DE 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. … Even outside the specific seven-day climate disruption wind lull period, one can see that base case reductions in wind output create periods of significant reliance on the DE resource to avoid losses of load. 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. As can also be seen across the full winter month, periods of solar output are not able to contribute during the early evening winter peak hours.*[26]

Additionally, the Phase II report raises serious concerns about the practical limitations of storage, even if much more is provided than called for by the CLCPA:

> ***Battery storage resources help to fill in voids created by reduced output from renewable resources, but periods of reduced renewable generation rapidly deplete battery storage resource capabilities.*** *…[T]he CCP2-CLCPA resource set includes the development and operation of over 15,600 MW (124.8 GWh) of new storage resources, configured as eight-hour batteries, and distributed throughout the state to maximize their ability to time shift excess generation from renewable resources. …While this represents a substantial level of assumed growth in battery storage within New York, the contribution of storage is quickly overwhelmed by the depth of the gap left during periods of time with a drop off in renewable generating output over periods of a day or more.*[27]

Importantly, the report clearly identifies the fundamental problem of attempting to maintain a functional grid without ample fuel-based solutions, which essentially constitute "pre-charged" energy storage.

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[24] Phase II report, page 8.
[25] Phase II report, pages 23-24, Figures 46 and 47 on page 77, and Figures 48 and 49 on page 79.
[26] Phase II report, page 10.
[27] Phase II report, page 11.

> ***The current system is heavily dependent on existing fossil-fueled resources to maintain reliability, and eliminating these resources from the mix will require an unprecedented level of investment in new and replacement infrastructure, and/or the emergence of a zero-carbon fuel source for thermal generating resources.*** *A power system that is effectively free of GHG emissions in 2040 cannot include the continued operation of thermal units fueled by well-based natural gas. However, these are the very units that are currently vital to maintain power system reliability throughout the year. This is the fundamental challenge of the power system transition that will take place over the next two decades. Indeed, this transition must take place at the same time that electricity demand in the state will grow significantly if electrification of other economic sectors, such as transportation and heating, is needed to meet the economy-wide GHG emission reduction requirements.*[28]

A concern raised by many, including Dr. James Hansen, is that addressing climate change and meeting CLCPA goals cannot depend on science fiction devices. Although the Phase II report prepared for NYISO focuses much of its attention on the potential need for exotic solutions, it nevertheless clearly underscores, and in fact relies upon, the value of firm emission-free sources that *already exist*, including nuclear power. Removing reliable, baseload nuclear from New York's electricity portfolio will make the extremely difficult problem of grid decarbonization impossible.

Relating to this, while nuclear power plants operate most efficiently as continuous baseload generation, they also have modest throttling capability, similar to other steam-based systems. In fact, France does this today. Although the Phase II report for NYISO does not consider the expansion of nuclear power in its analysis, this could become a more viable mode of operation if new, advanced nuclear reactors are added to New York's current fleet. In combination with realistic amounts of battery storage, nuclear power can also help to address peak load conditions that require faster response. Coupling batteries with nuclear power in this way would avoid the problems of storage depletion that result from extended lulls in wind or solar generation. Small Modular Reactors with dynamic load-following capability may be available in the near future as well.

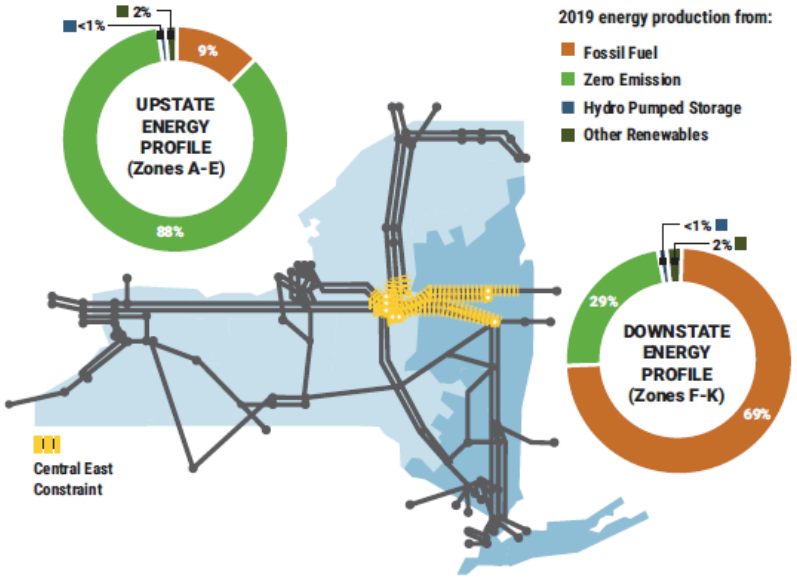
Regardless of CLCPA goals, the PSC and NYISO are obligated to ensure reliable electricity service. So, in the absence of realistic sources of firm carbon-free electricity to meet demand when intermittent sources are unavailable, carbon-intensive sources—**fracked gas**—will remain a cornerstone of electricity generation in New York. Although using fossil fuels to complement intermittent renewables undermines greenhouse gas reduction, the gas industry is certainly not shy about promoting it as a "perfect partnership."[29] But even worse than destroying the goal of carbon-free electricity, this "partnering" leads to systemwide inefficiencies. To effectively respond to renewable intermittency, smaller simple-cycle gas generators tend to be used which can fire-up rapidly but burn more gas per watt-hour than larger, more efficient combined-cycle gas plants. Ironically, these smaller generators are essentially the same as "peakers", except that instead of running during periods of peak demand, they run during periods of low renewable supply. Another technique is to run gas-fired generators in "hot standby", which means that gas is burned even when not producing electricity. These are the convoluted practices occurring in California. Operating a grid this way might help meet arbitrary renewable energy targets, but it does little for greenhouse gas reduction and climate change. All of these issues were raised by NYECA and other parties in testimony prior to the Commission's adoption of its Order modifying the Clean Energy Standard.

[28] Phase II report, page 13.

[29] This ExxonMobil video is an example: https://twitter.com/exxonmobil/status/1202616524437180417

Transmission, Resilience, and Energy Density

Electricity infrastructure in New York is a "tale of two grids" due to limited transmission capability that creates a bottleneck between upstate and downstate regions. The mix of generation capacity upstate and downstate are very different as well. Today, the upstate region is powered mostly by zero-emission sources (hydro, nuclear, and some wind), whereas the downstate region—except for generation from Indian Point—is powered almost exclusively by fossil fuels. If Indian Point closes completely, , carbon-free generation downstate will plummet from 29% to 4%.



Source: NYISO 2020 Power Trends

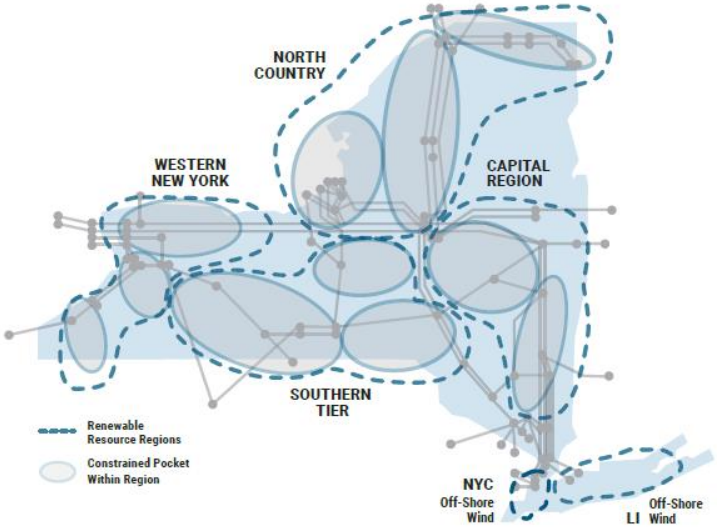
The PSC seems to acknowledge this conundrum, but dismisses the severity of it by proposing a "Tier 4" solution focused on renewables that is woefully inadequate to address the problem. The CLCPA establishes a 9,000 MW goal for offshore wind by 2035. This would bring annual offshore wind generation to almost 40,000 GWh, assuming that this ambitious target is achieved, that offshore wind performs at a capacity factor of 50%, and that turbine performance does not degrade over time.[30] These are all unlikely assumptions, as we discuss below. However, one might conclude on paper that this means offshore wind can meet a sizable portion of downstate New York's electricity.

The flaw with this type of number crunching—one that stems from summing watt-hours wherever and whenever generated—is that it fails to recognize the dynamics of grid operation when intermittent sources are in the picture. The provision of downstate wind capacity does not alleviate the problem of transmission. Instead, it makes the problem worse. Regardless of average annual generation that might come from offshore wind, NYISO knows that the grid must be designed to function reliably even when wind turbines downstate produce no electricity at all. This means that in the absence of firm carbon-free generation downstate (like Indian Point), complete decarbonization would require expanding the *transmission* capacity of power into the downstate region to levels

[30] Susan DesRoches, New York City Deputy Director for Infrastructure and Energy, stated in public testimony before the New York City Council on November 24, 2020 that proposed offshore wind projects would have a capacity factor of 50%. In email communication with D. Higgins on June 29, 2020, Adrienna Downey of NYSERDA estimated a capacity factor of 51.8%.

comparable to the total amount of *generation* capacity that currently exists downstate. According to NYISO, downstate summertime installed capacity is 25,000 MW. This exceeds the transmission capacity of any plans being contemplated. Of course, this would also require that abundant firm carbon-free *generation* capacity exists upstate to produce all of that electricity for use downstate when needed. The loss of New York's upstate nuclear power plants would eviscerate any hope of that occurring.

The above problems occur within subregions of the state as well. In its 2020 Power Trends report, NYISO identified "renewable resource regions" and discussed its analysis of transmission connectivity as New York attempts to meet the CLCPA goal of 70% electricity generation from renewables. This analysis derives from its biennial Congestion Assessment and Resource Integration Study (CARIS).



Source: NYISO 2020 Power Trends

NYISO found that *"In each of the major pockets observed, renewable generation would be curtailed due to the lack of sufficient bulk and local transmission capability to deliver the power."* One way that NYISO proposes to address the problem is with more "building generation within constrained areas". This is also consistent with NYISO reports to the Climate Action Council indicating that energy efficiency and renewable goals alone will not guarantee that New York has sufficient baseload or dispatchable generation capacity.

Clearly, if the additional generation suggested by NYISO includes more fossil-fuel power plants, then this would defeat the goal of decarbonization. Disturbingly, 5000MW of new and repowered gas-fired generation are already in NYISO's queue. Moreover, NYISO's discussion of CARIS only addresses the difficulties of meeting the CLCPA's 70% by 2030 renewable target. It does not consider the much more difficult goal of 100% carbon-free electricity called for just ten years later. It should be abundantly clear that these constraints put New York's ambitious 70% renewable goal at risk and that, without nuclear power, the goal of grid decarbonization becomes essentially impossible.

Overzealous assumptions by the PSC and NYSERDA portend failure as well. For offshore wind, a 50% capacity factor may be achieved occasionally with optimal siting, but it is not the norm. An objective review of performance for existing offshore wind farms, such as those in the United Kingdom and Denmark, reveals that most sites run

closer to about 40%, or less.[31] Assuming this capacity factor, 9,000 MW of offshore wind would meet less than half of the downstate region's current demand for electricity. Furthermore, it is not valid to assume that all turbines associated with a large-scale project deployed over many years will perform equally. Recent analysis has found that offshore wind turbines degrade rapidly, suffer from costly recurring maintenance, and can fail during extreme cold.[32] At an annual degradation rate of 4.5%, the initial performance of turbines installed in 2024 might decline by half before the remainder needed to achieve the state's 2035 target are in place. Performance has improved as wind turbines become larger and taller. However, to assume a 50% capacity factor for projects that have no record of operation in the region, or to make planning decisions based on overly optimistic projections, is reckless.

Significantly, New York also lies in the path of storms which regularly come up from the Caribbean in the late summer and fall. When wind velocity exceeds a specified "cut-out speed", turbines automatically shut down and feather their blades to avoid structural damage. Consequently, there could be extended periods when the state's offshore wind farms shut down entirely. Vulnerability is also a concern, especially as climate change and ocean warming cause storms to become more frequent and more intense. A 2010 NYSERDA assessment found that extreme wind speeds can be expected every 50 to 100 years. However, with "100-year storms" now the norm, it is concerning that the state is basing critical planning on potentially obsolete projections. Current wind turbines are not designed to withstand storms greater than Category 3.[33] Yet superstorm Sandy was a Category 3 event.

The following shows what happened to wind turbines and solar panels in Puerto Rico when Hurricane Maria, a Category 5 storm, hit.[34] With weather patterns changing so dramatically in the past few years, it would be unwise to assume that New York is immune to these events.

Wind Turbines in Puerto Rico
Damaged by Hurricane Maria in 2017

[31] https://energynumbers.info/capacity-factors-at-danish-offshore-wind-farms#.
[32] https://media4.manhattan-institute.org/sites/default/files/out-to-sea-dismal-economics-offshore-wind-JL.pdf
[33] Presentation on wind turbine durability sponsored by Our Energy Policy Foundation, Dec. 2, 2019. https://www.ourenergypolicy.org/offshore-wind/
[34] Much of Puerto Rico's Wind and Solar Power Is Not Yet Operational - IER (instituteforenergyresearch.org); see also: 9-22-17 Puerto Rico Wind - Solar - Cellular Structures Destroyed - Aerial - YouTube

Solar Farm in Puerto Rico
Damaged by Hurricane Maria in 2017

Finally, the real-world consequences of implementing solutions that involve diffuse, extremely low energy-density sources must be considered. Even if fully realized, the state's plan to deploy many hundreds of offshore wind turbines by 2035 will only contribute a small fraction of the electricity needed to decarbonize New York's entire grid. At a capacity factor of 45%, 9,000 MW of offshore wind would correspond to only about a sixth of the total carbon-free electricity that NYISO predicts will be needed in 2040, just five years later—energy that must be deliverable statewide, summer and winter, day and night, rain or shine. This means that unless New York imports most of its electricity from somewhere else, a tremendous amount of new generation will have to be installed throughout the state in an extremely short amount of time.[35] If heavily reliant on low energy-density sources like wind and solar, this will require the very rapid siting, permitting, and construction of projects over large areas, along with transmission infrastructure and storage that has yet to be seriously contemplated. All of this will also have environmental impacts that must be considered.

Based on projections prepared for NYISO in its Phase I Climate Change Impact Study, after deploying offshore wind, New York would still need about 150,000 GWh of carbon-free electricity in 2040, excluding nuclear power.[36] Looking only at annual generation and ignoring all other realities involving the delivery of reliable electricity to match real-time demand, without nuclear in the mix, this would correspond to 122,000 MW of additional solar panels occupying nearly a million acres (almost the size of Hamilton County, one of the largest counties in New York), or 57,000 MW of wind, which equals tens of thousands of land-based wind turbines.[37] These should be sobering numbers for anyone trying to come up with solutions that are feasible in the real world. Moreover, for reasons already discussed at length, relying on this scale of intermittent generation would not work.

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[35] With respect to imported electricity, one must also recognize that unless a state or country supplying electricity to New York has already achieved carbon-free electricity itself and has renewable energy to spare, importing electricity long distances from out-of-state renewables sources will do little or nothing to reduce global emissions (i.e. "robbing Peter to pay Paul"). Importing significantly more electricity from distant out-of-state renewables sources would also require the development of additional transmission infrastructure and incur transmission losses that further reduce efficiency.

[36] Including behind-the-meter solar, the Climate Change Impact Study for NYISO forecasts 221,479 GWh in 2040 (Table A-156). Wind and solar (including behind-the-meter solar) currently produce 6,556 GWh annually and hydropower produced 30,141 GWh in 2019. At a capacity factor of 45%, 9000MW of offshore wind produces 35,478 GWh.

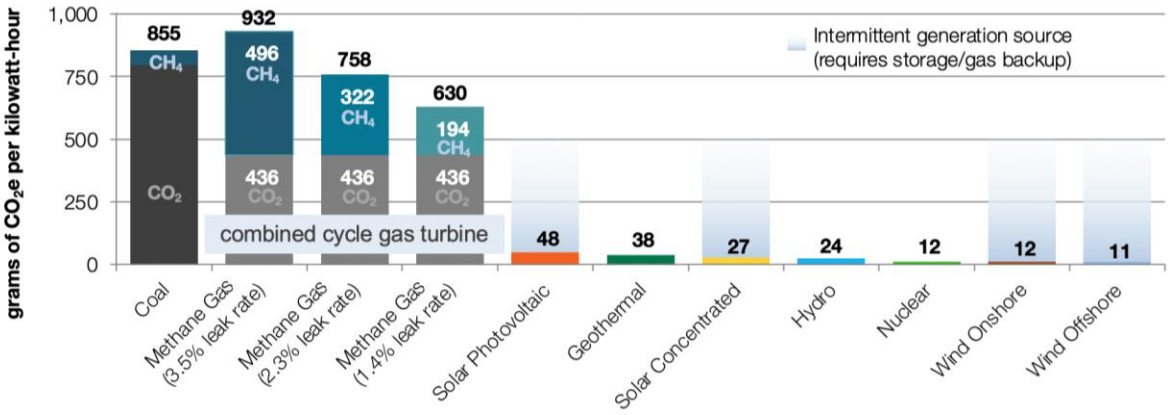
[37] National Renewable Energy Laboratory (NREL) has estimated on average 7.5 acres of total land area per megawatt of capacity for large fixed-panel photovoltaic installations (including service/access). Assuming a 14% capacity factor, 150,000 GWh of annual generation therefore corresponds to 915,000 acres. https://www.nrel.gov/docs/fy13osti/56290.pdf
Assuming a typical capacity factor of 30% for land-based wind, this corresponds to 19,000 wind turbines at 3 MW each.

Delving deeper, these concerns are also reflected in the more detailed Phase II Climate Change Impact and Resiliency Study prepared for NYISO which found that New York would need to deploy wind resources (land-based and offshore) at an annual rate between 32 and 38 times faster than it did historically between 2012 and 2020 to meet CLCPA goals. The Phase II report found that grid-connected solar would have to be deployed at a rate between 510 and 632 times faster. This is in *addition* to other resources identified in the report.[38]

Even in politically progressive states and western Europe where renewable energy is generally supported, the public's tolerance for impacts of this magnitude rapidly evaporates as industrial-scale wind farms, solar farms, transmission lines, and related infrastructure consume an increasingly large amount of the landscape, and as the cost of those facilities puts an ever-growing burden on ratepayers and taxpayers. Germany, which still receives more than half of its electricity from non-renewable sources, has invested heavily in renewable energy and is now encountering major public backlash to the installation of more.[39]

Prudent consideration of these factors would dictate preserving reliable, energy dense, carbon-free assets that already exist, rather than eliminating them. Notably one pound of uranium can generate as much energy as **three million** pounds of coal. Aside from the fact that nuclear power produces no combustion emissions, this extremely high energy density translates to a very small environmental footprint. The footprint of a 1,000 MW current-generation nuclear plant is orders of magnitude smaller than the size of a wind or solar farm of equal nameplate capacity, not to mention that a nuclear plant generates electricity 24/7, whereas wind and solar only produce electricity when the weather cooperates. An exhaustive comparison of climate, ecological, land use, and material impacts of nuclear power to other forms of energy is beyond the scope of this filing. However, the following information from credible sources should make it very clear that excluding nuclear power from the state's energy mix flies in the face of science and defies reason.

Lifetime CO_2 + Methane CH_4 Emissions by Electricity Source (GWP_{20})

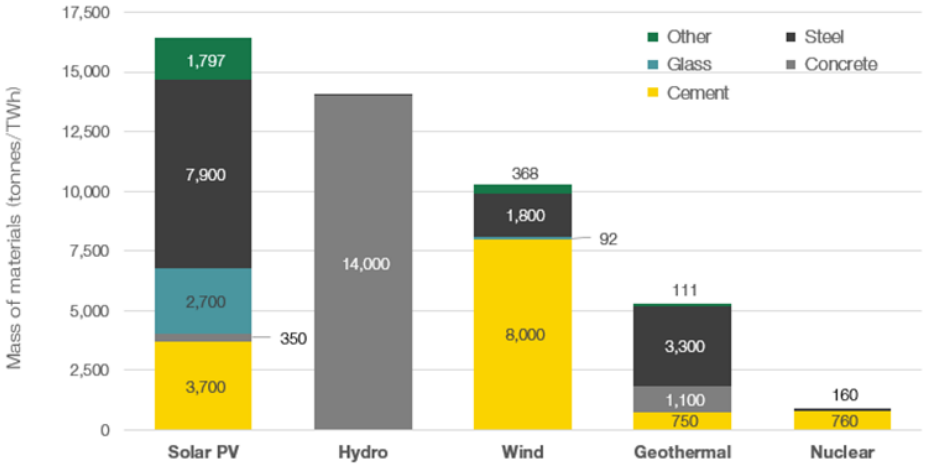


Sources: UN Intergovernmental Panel on Climate Change (AR5 2014), EDF (2018), de Gouw, et. al (2014), Howarth (2019)

[38] See Table ES-4 of the Phase II report, page 14. For land-based and offshore wind, the report identifies 2,714 MW/year in the CCP2 scenario and 2,319 MW/year in the GIT scenario for CLCPA compliance. Compared to 71.4 MW/year historically, this corresponds to a factor of 32-38. For grid-connected solar, the report identifies 1,960 MW/year in the CCP2 scenario and 1,581 MW/year in the GIT scenario for CLCPA compliance. Compared to 3.1 MW/year historically, this corresponds to a factor of 510-632.

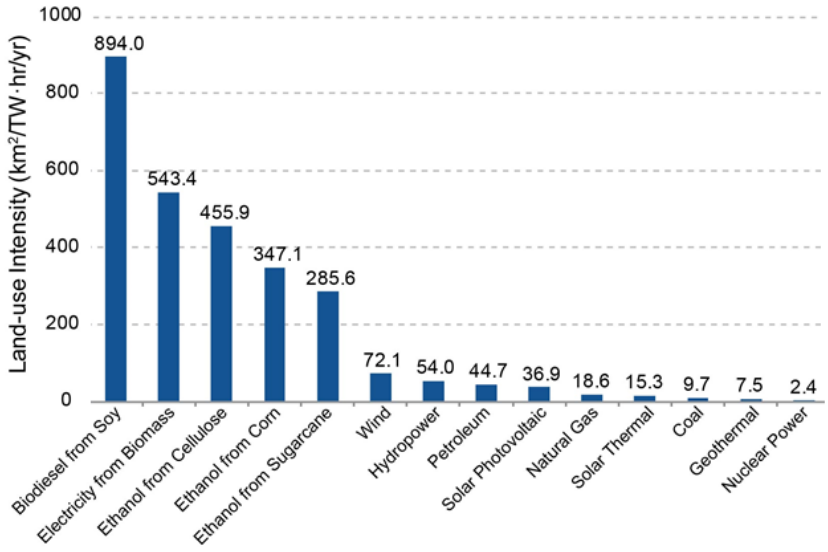
[39] https://www.dw.com/en/german-wind-energy-stalls-amid-public-resistance-and-regulatory-hurdles/a-50280676

Material Intensity by Electric Generation Technology



Sources: DOE Quadrennial Technology Review (2015)

Land-use Intensity by Generation Method



Sources: U.S. National Climate Assessment (2018), McDonald et al. (2009)

4. **The CLCPA requires attention to Environmental Justice (EJ). However, new EJ communities are created by construction of new fossil-fuel power plants, and existing EJ communities continue to be harmed when older fossil fuel plants must continue operating to compensate for the unnecessary loss of zero-emission electricity. Likewise, the impacts of implementation choices on cost affect disadvantaged communities the most. The PSC Order neglects these important issues.**

In their white paper, DPS staff and NYSERDA emphasize the importance of Environmental Justice and the need to protect disadvantaged communities. However, by neglecting the value of existing carbon-free sources of electricity, the white paper and subsequent Order categorically fail to uphold the CLCPA's commitment to Environmental Justice or protect those who are disadvantaged.

For example, the CES white paper states:

> *The environmental and health benefits of reducing pollution from fossil fuel-fired generators will be shared broadly, but will likely have its greatest benefit in those communities that disproportionately bear the burden of that pollution today. In particular, because many of the communities experiencing the worst impacts of fossil fuel-fired generation are located downstate, the increased penetration of offshore wind energy and, if approved, energy from Tier 4 resources, will result in substantial public health benefits.*

As explained in prior testimony by NYECA, the reference to offshore wind is out of context with recent events. The deactivation of IP2 in 2020 resulted in an immediate gap in downstream electricity supply equal to over a gigawatt of continuous power and eight terawatt-hours of annual generation. As previously discussed, this resulted in a significant increase in generation from fossil fuels within the region, which in turn impacts air quality—an impact that could have been avoided if IP2 had remained open.

A review of NYISO data and individual plant operation records maintained by the Energy Information Administration (EIA) suggests that this gigawatt gap in baseload electricity was replaced primarily by large new gas-fired generators in the lower Hudson Valley, CVE and CPV—both specifically built to replace Indian Point. With a nameplate capacity almost equal to that of IP2, CVE became operational a few days prior to IP2's closure and ran for the remainder of 2020 at an average capacity factor of 58%. During the same time period, CPV ran at a capacity factor of nearly 80%. The construction and operation of CVE and CPV has essentially created two new EJ communities, one in Dover and the other in Wawayanda, NY. If Indian Point's remaining reactor, IP3, shuts down in April 2021, then another gigawatt of baseload electricity will have to be produced by running dispatchable fossil-fuel power plants with excess capacity more than before. That burden could fall on CVE, CPV, or other facilities in the region, including older polluting oil and gas-fired plants within New York City.

Particularly vulnerable are EJ communities located within densely populated boroughs of the metropolitan area, such as Queens' "Asthma Alley". These are communities which already suffer disproportionately from greater risk of respiratory disease, cardiovascular disease, and cancer. However, whether polluting fossil-fuel plants within those communities run more or not, they will have to remain in operation longer than if Indian Point had continued operating. **The decision to eliminate nuclear power downstate was a decision to *not* shut down power plants that burn fossil fuel, thereby prolonging or increasing the exposure of EJ communities to pollution.**

Referring again to the white paper excerpt above, it is possible that offshore wind may eventually benefit EJ communities downstate, but only if it can first compensate for the energy use and resulting emissions from fossil-fuel combustion caused by the closure of Indian Point. Moreover, the intermittent nature of electricity expected

from offshore wind means that it will likely be quite some time before the amount of fossil fuels burned for power generation downstate actually declines. The NYISO 2020 Gold Book details 5,000 MW of additional new or repowered gas-fired generation that may be added to the downstate grid within the next few years. If this happens, the region will not see relief anytime in the foreseeable future and it will be clear that the CLCPA was not intended to succeed.

Relating to this, much has been said in recent times about the adverse impact of "peaker" plants on EJ communities and the potential for batteries to help curtail their use. The CES Order also speaks to this, stating on pages 7-8:

> *The CLCPA also requires the Commission to take steps to ensure reductions in emissions from peaker plants, many of which are located in low-income communities. The CLCPA requires the Commission: "[t]o the extent practicable, specify that a minimum percentage of energy storage projects should deliver clean energy benefits into NYISO zones that serve disadvantaged communities . . . and that energy storage projects be deployed to reduce the usage of combustion-powered peaking facilities located in or near disadvantaged communities.*

Peak shaving and the avoidance of fossil-fuel peakers is a good use of batteries, and, where possible, should be pursued. However, enthusiasm for such measures must be tempered by the extent of their applicability. As previously discussed, peakers run infrequently for short periods of peak demand, and therefore constitute a relatively tiny part of the problem. For example, the proposed 2.5 GWh battery by Ravenswood Development promises to eliminate several small peaker turbines at the Ravenswood power plant in Queens. However, most of those peakers are already out of service, and of those that operate, none ran at a capacity factor greater than 1.2% in the past three years. Of much greater significance is that the Ravenswood site also houses 2,000 MW of steam and combined-cycle generation, which in total produce far more emissions that the peakers being eliminated.[40] The closure of Indian Point makes the removal of those larger generators much more difficult. Speaking directly to these matters, Dr. James Hansen, former director of NASA's Goddard Institute and premier authority on climate change has said:

> *If New York cares about people and Environmental Justice, then it should shut down Ravenswood and other power plants like it instead of Indian Point. Responding effectively to climate change means that we simply cannot afford to remove carbon-free power from the grid…We absolutely need to close fossil-fuel power plants first.*[41]

By deciding to prematurely shut down carbon-free nuclear power instead of fossil fuels, the state appears to believe that there is time to spare on climate change. There is not. Moreover, by shutting down zero-emission nuclear power, the state has decided to target EJ communities ostensibly protected by the CLCPA. The damage to climate and justice goals caused by the premature closure of Indian Point is a poster child for what happens when nuclear power is lost. It is a scenario that has played out in Vermont, Massachusetts, and California—and one that will repeat itself in New York again if the state abandons emission-free nuclear power.

However, in addition to targeting EJ communities, the loss of nuclear power threatens disadvantaged communities in another way—in their pocketbook.

[40] NYISO Gold Book 2018, 2019, 2020

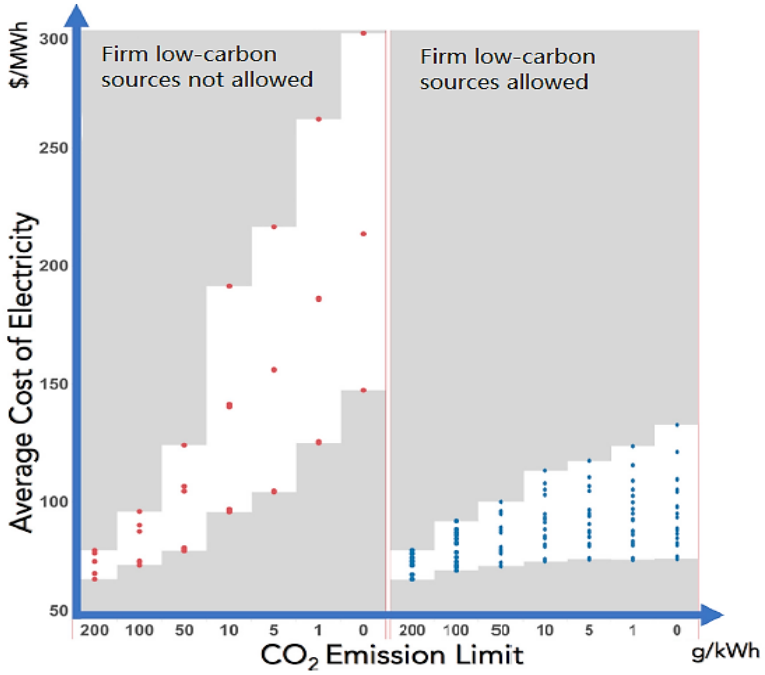
[41] http://www.nuclearny.org/ip2-press-release/

On page 8 of the CES Order, the Commission again cites the CLCPA, stating:

> *the CLCPA directs the Commission to design the programs for achieving the renewable energy targets "in a manner to provide substantial benefits for disadvantaged communities. . . including low to moderate income consumers, at a reasonable cost while ensuring safe and reliable electric service."*

As discussed earlier in this and prior filings, ensuring reliable electricity service becomes increasingly difficult as more intermittent sources are added to the grid. This in turn necessitates "firm" generators, which also must be emission-free if deep decarbonization is to occur. In the absence of firm generation, the cost and logistical constraints become prohibitive. For example, as seen in modeling performed by Dr. J. Jenkins and colleagues, the price of electricity in systems which exclude firm generators dramatically exceeds those that do not for carbon dioxide emission levels under 100 grams per kWh.[42]

Cost of Electricity for Northern U.S. Systems with and without Firm Low-Carbon Generation



Source: Sepulveda, et al. *The Role of Firm Low-Carbon Electricity Resources in Deep Decarbonization of Power Generation*

In addition to the above, it is important to recognize that nowhere in the world have intermittent sources been deployed at penetration levels approaching the graph on the left. In California and Germany, reliability and cost have become major obstacles already, even though wind and solar now comprise only about a third of electricity generation in California, and a quarter in Germany. In *Renewables and decarbonization: Studies of California,*

[42] N. Sepulveda, J. Jenkins, F.J. de Sisternes, R.K. Lester. *The Role of Firm Low-Carbon Electricity Resources in Deep Decarbonization of Power Generation,* Joule 2, 2403–2420, November 21, 2018, Elsevier. https://doi.org/10.1016/j.joule.2018.08.006
See also May 15, 2020 presentation to the Clean Energy State Alliance: *Decarbonizing Electricity: The Critical Role of Firm Low-Carbon Resources* https://vimeo.com/419053746

Wisconsin and Germany, Brick and Therstrom found that achieving an 80% renewable portfolio in California would increase the total cost of renewable infrastructure by a factor of 16.[43]

Recent drops in the installed cost of wind and solar fail to tell the whole story because they do not account for the total system-level impacts of creating a grid that reliably works. The incremental cost of wind and solar may be cheaper than nuclear today when those intermittent sources constitute only a tiny portion of the state's electricity mix. However, as intermittent sources grow, they become more difficult and costly to integrate into the grid, and thus less useful than "firm" generators which can produce electricity anytime. This makes "firm" sources of carbon-free electricity, including nuclear power, increasingly valuable to any effective strategy for decarbonizing the grid. It is also important to weigh the cost of maintaining functioning nuclear facilities that already exist against building entirely new generators, and in the case of wind and solar, major investments in transmission and storage needed to accompany them.

Several regional studies referenced by parties to this proceeding confirm the cost benefits of retaining or expanding the firm generation capacity of nuclear power. In its 2020 Pacific Northwest Study, the consulting firm E3 explicitly discusses the importance of retaining Washington's nuclear power plant in all deep decarbonization scenarios, as well as the value of advanced SMR technology to avoid gas-fired combustion:

> *Achieving deep decarbonization of the Northwest electricity system can be accomplished at reasonable cost if firm capacity can be built in the region.* ***Columbia Generating Station is relicensed in all scenarios while zero-emitting firm resources like SMRs are most valuable under very tight emissions reductions regimes.*** *In those cases, zero-emitting firm resources provide important reliability services that reduce the cost of achieving deep emissions reductions relative to scenarios that only rely on renewables and storage.*

With respect to decarbonization costs and SMR technology in particular, E3 found:

> *SMRs reduce the cost of achieving a 100% electric sector GHG reduction by nearly $8 billion per year. That value stems from those resources' ability to provide firm capacity, thereby avoiding a large overbuild of renewables.*

Likewise, Ontario recognizes, as New York should, that retaining and upgrading its nuclear capacity will be essential to any cost-effective plan for achieving greenhouse gas reduction goals. In support of nuclear refurbishment, Ontario's Green Ribbon Panel report found:

> *As a reliable, flexible, and low-cost source of low carbon electricity, nuclear can form the backbone of an integrated electrification solution… Not only will these refurbishments provide an economic boost to Ontario and Canada as a whole but, as stated in 2017 by Ontario's Financial Accountability Officer, "there are currently no alternative generation portfolios that could provide the same supply of low GHG emissions baseload electricity generation at a comparable price to the Base Case Nuclear Refurbishment Plan".*

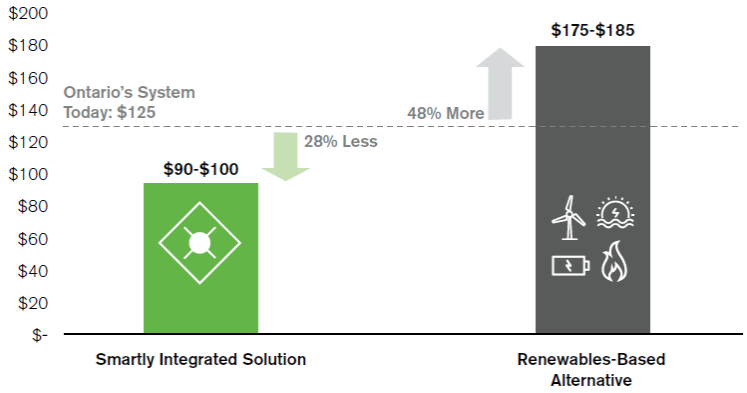
The Ontario report also acknowledges that beneficial electrification will increase demand. However, by intelligently integrating carbon-free energy sources, including nuclear power, it found that greenhouse gas reduction can be achieved for half the cost of a renewable-centric alternative. Discussing the quandary of gas

[43] Brick, Therstrom. *Renewables and decarbonization: Studies of California, Wisconsin and Germany*; Elsevier, The Electricity Journal (2016) 6-12. Renewables and decarbonization: Studies of California, Wisconsin and Germany (core.ac.uk)

being required to back-up renewables, the report compared a "Smartly Integrated Solution" to a "Renewables-Base Alternative":

> *While nuclear and hydro are low cost, the other forms of generation cost 3.4 times more and drive Ontario's system costs. As the demand for electrification increases, Ontario has two choices. On one hand, we could choose to rely on a predominantly renewables-based alternative with natural gas back-up which, given the high cost of the intermittency of renewables, will be 48 per cent more costly than Ontario's current electricity system. Or, on the other hand, we could pursue a smartly integrated solution that could,* ***thanks to the extensive use of nuclear generation,*** *be up to 28 per cent less costly than Ontario's system today and half the costs of the renewables-based alternative. This solution would smooth out demand for electricity, increase the efficient use of all assets, including storage, enhance system flexibility, and ultimately result in less generation, distribution and transmission costs.*

Ontario Comparison of Electricity Energy Costs ($/MWh)



Source: Ontario Green Ribbon Panel Report, September 2020

The state of New York effectively argued many of these points when challenges were brought against Tier 3 provisions of the CES by anti-nuclear organizations and the natural gas industry following adoption of the original PSC Order in 2016. Notably, that was prior to the adoption of the CLCPA which includes the mandate for 100% carbon-free electricity and requires that decarbonization of the grid occur affordably without unduly impacting disadvantaged communities. Although prudent logic previously put forth by the PSC in support of nuclear power is even more valid now under the CLCPA, the Commission fails in its recent Order to address these issues or give the future of nuclear power any attention. These are severe omissions that if not corrected will perpetuate harm to those in the state who are most vulnerable.

CONCLUSION AND ACTION NEEDED

We have a communication failure. In numerous filings, parties have explained to the Commission what it is doing wrong: that by only considering the CLCPA's 70% by 2030 goal, the PSC has launched New York down a path that is unlikely to meet its renewable energy targets and is certain to fail with respect to the CLCPA's 2040 mandate of carbon-free electricity.

NYISO has repeatedly told the Climate Action Council, the PSC, and the public that New York will need more firm generation capacity in coming years, even if renewable energy and efficiency targets are met. Yet in 2020, the state sacrificed a thousand megawatts of firm, carbon-free capacity by closing Indian Point Reactor 2. And now, the Commission has chosen to completely ignore the fact that the state's remaining nuclear fleet—3,400 MW worth of firm carbon-free capacity—could be lost by the end of this decade. Meanwhile NYISO has 5,000 MW of new or repower gas-fired generation in its queue.

The PSC may wish to believe that it has updated the state's Clean Energy Standard to comply with CLCPA goals, but It has not. Rather than recognizing the long-term value of reliable carbon-free nuclear power, state agencies and their consultants are promoting unproven, unscalable technology like biogas, hydrogen, or RNG to create the appearance of credibility. Perhaps by ignoring calls to carefully track daily and seasonal changes in demand and supply, the PSC hopes that evidence of unfolding trouble will remain hidden for as long as possible. However, problems will become increasingly apparent by mid-decade as gains in renewables and efficiency fall short, and they will become painfully obvious as large fossil fuel power plants throughout New York continue to spew emission into the atmosphere—or even more are brought online.

In the absence of any warning about the consequences, one might find the Commission's behavior here excusable. However, from the moment DPS and NYSERDA released its whitepaper in 2020, NYECA and others submitted testimony urging the PSC to take corrective action. We have provided critical analysis of errors, assumptions, and oversights; we have shown how the overuse of intermittent renewables creates an inextricable dependence on inefficient gas-fired combustion that undermines decarbonization; and we have demonstrated with real-world examples in the United States and overseas, how New York is charting a costly course that, without nuclear power, has failed elsewhere and will fail here as well.

In year one of the CLCPA, the state has already lurched backwards on its goals. Large gas-fired power plants built to compensate for the loss of Indian Point have created new environmental justice communities. Likewise, older polluting fossil-fuel plants within vulnerable communities of the metropolitan area are having to remain in service longer. They may even need to run more. From the standpoint of both climate change and environmental justice, closing any one of the large fossil-fuel plants in New York City, or avoiding construction of CPV and CVE, would have been a more responsible and scientifically sound decision than prematurely shutting down Indian Point. Without a credible plan for a future that includes zero-emission nuclear power, the same calamity will play out upstate.

With a dedicated effort by government leaders and agencies, it is still possible for New York to meet its goals of carbon-free electricity, deep decarbonization, and environmental justice. But the only way of accomplishing this is by expanding the scope of its focus to include nuclear power. Renewables have a role to play. However, understanding the practical limitations of intermittent sources and storage, as well as the negative impacts of biomass and other forms of combustion-based generation, is essential to developing an energy plan that is truly capable of achieving CLPA climate and justice goals. As the beneficial electrification of other sectors—transportation, heating, and industry—occurs, statewide demand for electricity will grow, which makes the

availability of abundant energy-dense nuclear power even more important. Successful implementation of the CLCPA and decarbonization of New York's grid require that the PSC and state agencies recognize zero-emission nuclear power as a key component of the state's energy portfolio, both today and in the decade ahead.

To this end, we urge the PSC to consider the following by amending the Clean Energy Standard or through actions pursuant to a future proceeding:

1. **Extend or expand Tier 3 of the CES to ensure that New York's existing reactors can remain economically viable through at least 2040 and encourage their relicensing in a timely manner.**

2. **Encourage the development of next-generation advanced nuclear power projects, including Gen III+ and Gen IV designs that utilize passively safe technology, increase fuel efficiency, or support flexible load following. This could be achieved through expansion of Tier 3, development of a separate tier, or similar mechanism.**

3. **Create a new tier within the CES or a separate attribute structure which specifically recognizes the additional value of "firm" carbon-free generators of electricity, meaning generators capable of providing continuous or dispatchable carbon-free electricity.**

4. **Support a straight-forward "carbon fee and dividend" program that places a rising cost on fossil fuels so that carbon-free sources of electricity, including nuclear power, are better able to compete in the marketplace.**

> "Cries for a new green movement are hollow political rhetoric if not combined with aggressive goals and a realistic plan on how to achieve them… Even in today's chaos of political pandering and hyperbole there are still facts, data and evidence…"
>
> *– Governor Cuomo, July 2019*

Relevant comments by parties to 15-E-0302

7/27/20 – Preliminary comments NYECA and Nuclear NY on CES white paper
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={A0DBEE42-299C-46C8-8935-C2222DC12CBB}

7/27/20 – Preliminary comments by Keith Schue on CES whitepaper
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={573C2C65-FC44-41ED-8ECD-387CA6AB944B}

7/27/20 – Preliminary comments by Dr. Dietmar Detering on CES whitepaper
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={BD81F5DF-029B-4441-BC65-FFD0C1343365}

7/29/20 – Preliminary comments by Isuru Seneviratne on CES whitepaper
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={6D29341D-42E6-49BE-8884-4EA0AB6F65D2}

8/11/20 – Dennis Higgins: *"All Renewable" Not Viable Alternative to Fossil Fuels*
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={15009636-6E99-43FD-A61D-EC4DE83D5F55}

8/11/20 – Keith Schue and Gary Krellenstein: *The Inconvenient Truth: We Need Nuclear*
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={FC7FD28F-5B5C-45A2-9157-97C041366654}

8/28/20 – Comments by Dennis Higgins on CES white paper
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={4E39EA85-87E1-44C1-8375-D9BCF3DD6154}

8/28/20 – Comments by NYECA on CES white paper
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={668E58CA-12F3-44DF-A4C8-23D6F4B79BD8}

8/28/20 – Supplemental comments by Keith Schue on CES white paper
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={03A19210-8006-4DBE-BF93-75D47B985EC4}

8/31/20 – Comments by Sustainable Otsego on CES white paper
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={7A6E2594-6AB3-4B5B-8090-C9F514A4B0C1}

9/1/20 – Isuru Seneviratne:
Impacts of Indian Point Nuclear Closure: Human Health, Climate Change, and Ecosystem Damages
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={3B2E625D-7B50-4B78-B6A3-ADC7BF564ADB}

9/16/20 – Comments by NYECA on E3 Pacific Northwest Zero-Emitting Resources Study
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={28915B98-B313-42B3-B649-0E6E722558EA}

9/16/20 – E3: *Pacific Northwest Zero-Emitting Resources Study*
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={940C85B6-2BC5-427A-A826-3A15E8305975}

9/16/20 – E3: *Pacific Northwest Zero-Emitting Resources Study Executive Summary*
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={C451910C-EAAC-461E-8E2A-1EECB3A6660D}

9/28/20 – Comments by NYECA and Sustainable Otsego on Brattle Group report
and Ontario Green Ribbon Panel report
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={F833765B-FA46-4925-A0C8-C38ED61F61DC}

9/28/20 – Brattle Group: *New York's Evolution to a Zero Emission Power System*
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={9254DC79-E4E8-487C-A8D7-32200DC830E9}

9/28/20 – Ontario Green Ribbon Panel: *Clean Air, Climate Change and Practical, Innovative Solutions to Grow the Economy and Reduce Greenhouse Gas Emissions in Ontario* (filed by NYECA and Sustainable Otsego)
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={ECACA022-8CF5-4295-A9F3-3B148D343567}

10/26/20 – Comments by Jan Mulroy on PSC Order Modifying the CES
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={C7E2CFFF-26AF-4032-9757-3DF530F78CA1}

10/28/20 – Comments by Isuru Seneviratne on PSC Order Modifying the CES
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={CDF5B4E6-0148-4C4A-91F3-35FC9DFB7B02}

10/28/20 – Comments by NYECA on PSC Order Modifying the CES
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={2E7EAC06-3F24-45FE-9F93-8500C0E6140C}

12/1/20 – Comments by NYECA, Footprint to Wings, Stop Cricket Valley Energy, Protect Orange County, Verdansa, Sustainable Otsego, Concerned Citizens of Oneonta, and Compressor Free Franklin in response to comments by New York City
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={FFC14466-A26B-44D3-ACDD-D6F66948F943}

12/10/20 – American Nuclear Society: *For the Environment, Keep Indian Point Open*
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={C6F615FF-7F39-499D-B0BA-C01F473FE1E6}
(also filed on 2/4/21)

12/10/20 – Dennis Higgins: *Without Nuclear, It's Back to Gas in NY*
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={720BD7E2-72E0-4540-93B1-25E06BBC21B7}

12/15/20 – Comments by NYECA and parties in response to comments by Renewable Heat Now
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={2188495A-FD50-47CD-9AAB-64D221606336}

2/4/21 – Duncan Bryer: *Environmental Justice, Clean Energy, and the Truth about Indian Point*
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={7E56461E-F9C6-4BD1-85EE-401720FC7E92}

2/4/21 – China's First Hualong One nuclear reactor begins operation
http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={D82A3569-F383-4FD9-AA17-AE559CBAF7D8}

In addition to the above, the following letter was submitted by Dr. James E. Hansen and others to the NYS Climate Action Council on 6/24/20 on the importance of nuclear power:
letter-to-CAC-on-importance-of-nuclear-power.pdf

New York Energy and Climate Advocates
310 W. 86th St. #6B, New York, NY 10024

CLIMATE COALITION
www.climatecoalition.org

Nuclear New York
Independent Advocates
for Reliable Carbon-Free Energy
3961 47th St, Sunnyside, NY 11104
www.NuclearNY.org

Protect Orange County
www.protectorangecounty.org

FOOTPRINT TO WINGS
www.fp2w.org *

STOP CVE

STOPCRICKETVALLEY.ORG
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CONCERNED CITIZENS OF ONEONTA

Mohawk Valley Keeper

COMPRESSOR FREE FRANKLIN
PO Box 885 Franklin, NY 13775
www.compressorfreefranklin.org

* Footprint to Wings became a signatory on April 7, 2021 following initial submission of these comments to the Power Generation Panel Working Group.

New York Energy & Climate Advocates • Climate Coalition
Nuclear New York • Footprint to Wings • Protect Orange County
Concerned Citizens of Oneonta • Compressor Free Franklin
Mohawk Valley Keeper • StopCricketValley.org

April 7, 2021

Dear members of the Climate Action Council, Power Generation Panel, and Public Service Commission:

We are writing to inform you of a recently issued report that is of particular relevance to implementation of the Climate Leadership and Community Protection Act (CLCPA). Also addressed are several other reports that support the same conclusions.

On many occasions, through the participation of parties in New York's Clean Energy Standard proceeding (15-E-0302) and in public comments to the state's Power Generation Panel, engineers, scientists, and concerned citizens have warned that an undue emphasis on intermittent generation over other forms of carbon-free electricity will lead to failure of the state to achieve its climate and justice goals, an unreliable grid, and costly infrastructure to the detriment of rate payers.

A recent publication titled ***"California Needs Clean Firm Power, and so Does the Rest of the World"*** confirms this reality.[1] Coordinated by the Clean Air Task Force and Environmental Defense Fund, the 2021 report brings together experts from Princeton University, Stanford University, and the consulting firm Energy and Environmental Economics (E3) to model the feasibility and cost of various scenarios for achieving California's stated goal of carbon-free electricity by 2045. This includes evaluating the physical implications of building a decarbonized grid. Although each ran separate models, their findings are remarkably similar: **A 100% renewable solution focused on the widespread deployment of wind, solar, and storage will not do the job.**

<u>Findings from the California Report</u>

As discussed in the team's report, meeting California's goal of carbon-free electricity by 2045 with wind and solar would require many hundreds of gigawatts of additional carbon-free generating capacity and many hundreds of gigawatt-hours of storage:

> *…reliably generating the electricity needed in 2045 from wind and solar power would require building up to nearly 500 gigawatts of power-generating capacity (along with 160 gigawatts and 1000 gigawatt-hours of new storage). This is roughly half the capacity of the entire U.S. electricity generating system today and about six times the current total generating capacity now serving California (about 80 gigawatts), including nuclear, gas and coal generating stations,*

[1] Long, Baike, Jenkins, et al. *California needs clean firm power, and so does the rest of the world: Three detailed models of the future of California's power system all show that California needs carbon-free electricity sources that don't depend on the weather,* Environmental Defense Fund, Stanford University, Princeton University, Energy & Environmental Economics, Clean Air Task Force, UC San Diego, The Brookings Institution. https://www.edf.org/sites/default/files/documents/SB100%20clean%20firm%20power%20report%20plus%20SI_clean.pdf See also: Issues in Science & Technology, *Clean Firm Power is the Key to California's Carbon-Free Energy Future*, March 24, 2021. https://issues.org/california-decarbonizing-power-wind-solar-nuclear-gas/

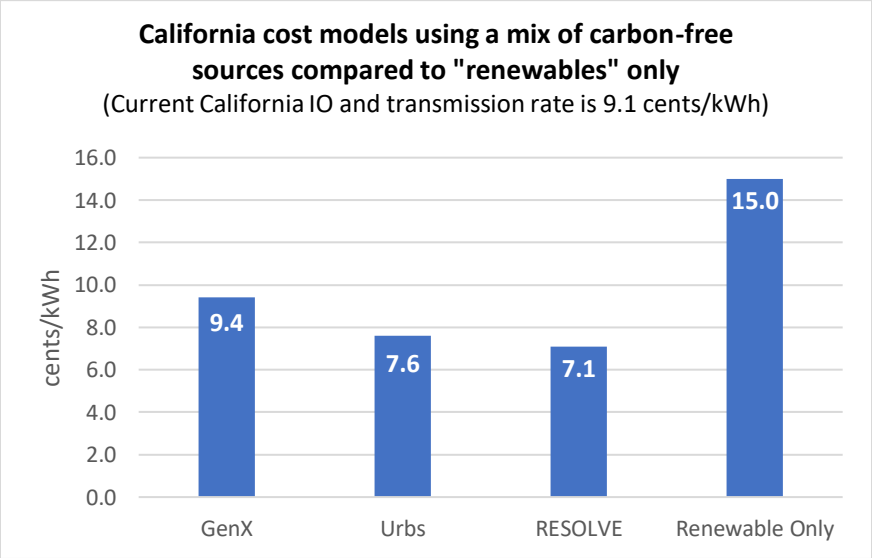
hydroelectric dams, and everything else. ….getting to nearly 500 gigawatts by 2045 would require expanding solar capacity at a rate 10 times higher than has ever been done before. There may not be enough people, supplies, or land to do this.

While contemplating this scale of expansion may be an interesting thought experiment, the fossil fuel industry knows that it has little to fear if California decides to put all its eggs into the "wind-and-solar basket".

Although New York uses less electricity than California, proportionally it can expect similar hurdles, heightened by the fact that the CLCPA promises carbon-free electricity by 2040—five years sooner than California. In addition, New York is saddled with its own particular set of challenges. For example, photovoltaic solar panels have a capacity factor of about 14% in New York State, about half of that in California. This means that for every solar panel installed in California, New York would need two to produce the same annual amount of electricity—and even doing so, the useful availability of that electricity would be cut in half. Also, California possesses large swaths of dry brown desert that the public might otherwise consider disposable. However, blanketing New York with wind turbines and solar panels would consume green rolling hills, forests, and agricultural land—causing many folks to start seeing red both emotionally and politically.

Aside from the shear physical challenges involved, the California report reveals that selecting a carbon-free energy portfolio focused entirely on "renewables" is simply not cost effective. Authors write:

All of this excess capacity would be expensive. We estimate that wholesale electricity rates would increase by about 65% over today if currently available renewable energy and storage technologies alone were to be utilized to meet demand in 2045. It may not be possible to build wind and solar facilities at this scale, even if consumers were willing to pay that premium.



Source: California report (For Gen X, Urbs, and Resolve, the "All" model is shown, which uses a mix of clean firm power and renewables.)

Whether in California or New York, intermittency becomes an increasingly formidable barrier as more wind and solar resources are deployed since the supply of such resources depends on the time of day, season, and daily

weather—factors which are often orthogonal with respect to demand. Discussing the impacts of intermittency on cost, authors of the California report write:

> *On a dollar per kilowatt hour basis, wind and solar power are now cheaper than carbon-intensive sources of electricity like coal or even gas. …But if wind and solar are pushed to do all of the heavy lifting themselves, the system requires a lot of excess generating capacity and storage (most of which is seldom used) to provide reliable electricity and completely drive out greenhouse emissions. As a result, this strategy ends up being much more expensive than it might appear at first glance.*

While storage can help, it also has serious limitations. Authors write:

> *Increasingly better batteries play a key role in a carbon-free grid, but like all resources, forcing them to play roles they are ill-suited to adds cost and challenge. Batteries provide flexibility on hourly and diurnal time scales…But in none of these solutions do batteries economically fill the entire need for clean firm resources. Batteries make sense for shorter duration uses (e.g, shifting solar from midday into the evening) but cannot cost-effectively sustain discharge for weeks at a time…Long duration storage technologies, such as electrolysis and underground storage of hydrogen or advances in ultra-cheap metal-air batteries could potentially provide storage for longer than a few days. [However] Modeling for this study and other recent work indicates these resources play their best role as partial substitutes or even complements, rather than true alternatives to clean firm power; they provide another useful arrow in the quiver, but systems with clean firm power remain meaningfully less expensive.*

Significantly, the California report makes a technically sound case, based on extensive modeling, that decarbonization of the electricity sector cannot realistically occur by relying on intermittent sources alone. Cost-feasible scenarios require a meaningful contribution from generators of **clean firm power.** As explained in the report:

> ***"Clean firm power" [is] defined as zero-carbon power that can be relied on whenever it is needed for as long as it is needed. Clean firm resources do not depend on the weather like solar and wind do, and these resources do not have limitations in how long they can produce power, as batteries do.***

Included among such resources is nuclear power, which already supplies a significant portion of the nation's carbon-free electricity—critical baseload generation that would otherwise come from fossil fuels. As discussed in the report:

> *Nuclear power can provide very large amounts of energy steadily in a small footprint; ongoing advances in nuclear technology could allow the deployment of lower cost, much-diminished accident risk with less waste.*

Further, with respect to modeling the dynamics of carbon-free generation:

> *…nuclear power would act as a "flexible base" power source, generally providing a steady amount of electricity but reducing output during the height of solar output, enabling nuclear plants to conserve their fuel for longer refueling cycles.*

Importantly, authors of the California report also found that portfolios with clean firm power require dramatically less installed transmission infrastructure:

> *Including clean firm power also reduces the need for millions of megawatt-miles of transmission lines. California currently has approximately 15 million megawatt-miles of transmission. All portfolios that include clean firm power add 2-3 million megawatt-miles of new in-state transmission lines to meet the goal of zero emissions by 2045. Some of this might be built along existing right of ways, but any siting and permitting this amount of transmission for timely build out will present challenges. Eschewing new clean firm power could at least triple this need to 9 million megawatt-miles even with West-wide coordination of electricity supplies.*

Notably, a generator with a megawatt of nameplate capacity requires a megawatt of installed transmission to carry electricity from the site, regardless of how often that generator actually produces electricity. With a 90% capacity factor, nuclear power can provide reliable baseload electricity nearly continuously. However, a solar farm in New York operates at a capacity factor of merely 14%, thereby requiring a significant amount of transmission infrastructure that will almost always be underutilized.

The following is a summary of findings, comparing the impacts of implementing a carbon-free grid in California in which clean firm power constitutes a part of the total generation portfolio, to the impacts of attempting to implement a carbon-free grid without clean firm power.

Issue		With Clean Firm Power	Without Clean Firm Power
Costs for generation and transmission *California transmission and distribution costs are currently about 9 cents/kWh*		~9 cents/kWh	~15 cents /kWh
Solar and Wind Capacity *Entire U.S. electric generating capacity is ~1100 GW*		25 – 200 GW	470 GW
New Storage* *Largest battery facility now being built is 0.3 GW /1.2 GWh.* *CA expects to have 2 GW battery capacity in 2021*	**New short-term battery capacity**	20 -100 GW	160 GW
	New Energy storage	100-800 GWh	1000 GWh
Land Use *CA land area is ~164,000 sq miles*		625- 2500 sq miles	6250 sq miles
Transmission *CA currently has ~ 15 million MW-miles (26,000 circuit miles) of transmission*		2 – 3 million MW-Miles	~9 million MW Miles

**Energy storage beyond existing pumped hydro*

Source: California report

The California report concludes:

> *An ambitious but achievable investment in clean firm power, on the order of California's existing gas fleet could, on the upside, eliminate the need for ten times that amount of renewable energy and thus help keep generation and transmission costs in line with today, cut the land area needed for utility scale solar facilities and energy storage by a factor of ten, and reduce transmission infrastructure needs by a factor of four by 2045. These advantages will help increase the likelihood of achieving climate goals in California.*

From the standpoint of material investments in capacity, transmission, storage, and land—all of which also translate to cost—the need for clean firm power is clear. Authors suggest that California seek firm carbon-free power comparable to the amount of gas-fired generation in the state today. Currently, California relies on natural gas to meet about 40% of its electricity needs, which is also about the same as New York. Prior to the premature closure of Indian Point, nuclear power provided approximately a third of New York's electricity. **Thus, retaining the state's existing fleet of reactors and investing in advanced nuclear technology would give New York a fighting chance of achieving its 2040 goal of carbon-free electricity.**

Consistency with Other Studies:

The above findings should not come as a surprise. They are consistent with objective analyses throughout the country.

Like New York and California, Washington State hopes to achieve a carbon-free grid. A 2020 Pacific Northwest study prepared by E3 found that Washington's existing nuclear plant, Columbia Generating Station, should be relicensed for the state to achieve its climate goals. E3 further determined that advanced nuclear technology, particularly Small Modular Reactors (SMRs) would help the state avoid gas-fired generation, noting the distinct performance, cost, and safety advantages they offer.[2] Significantly, E3 found the contribution of nuclear power to firm carbon-free electricity critical to full decarbonization even though Washington receives most of its electricity from baseload hydropower and has achieved 70% renewable penetration.

Similarly, Ontario recently prepared *a Green Ribbon Panel* report for the purpose of identifying ***"Clean Air, Climate Change and Practical, Innovative Solutions to Grow the Economy and Reduce GHG Emissions***."[3] Nuclear power is responsible for a significant reduction in emissions from Ontario's electricity sector. However, the Canadian report found that much of this gain will be lost if its Pickering Nuclear Generating Station is replaced with gas-fired generation. The Ontario report determined that sustaining and refurbishing Ontario's nuclear capacity will be essential to achieving its 2030 greenhouse gas reduction goals while increasing the amount of electricity required to meet demand. It also found retaining and upgrading nuclear capacity essential to managing cost:

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[2] *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/

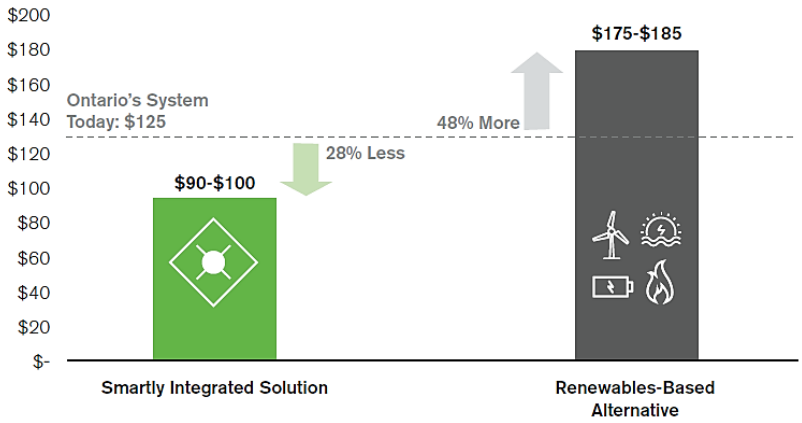
[3]Green Ribbon Panel, *Clean Air, Climate Change and Practical, Innovative Solutions to Grow the Economy and Reduce Greenhouse Gas Emissions in Ontario,* September 2020. http://s34294.pcdn.co/wp-content/uploads/2020/09/200062_GreenReport_ClimateChange-FINAL-SEPT-10.pdf

As a reliable, flexible, and low-cost source of low carbon electricity, nuclear can form the backbone of an integrated electrification solution… Not only will these refurbishments provide an economic boost to Ontario and Canada as a whole but, as stated in 2017 by Ontario's Financial Accountability Officer, "there are currently no alternative generation portfolios that could provide the same supply of low GHG emissions baseload electricity generation at a comparable price to the Base Case Nuclear Refurbishment Plan".

By intelligently integrating firm carbon-free energy sources, including nuclear power, with renewables, the Ontario report determined that greenhouse gas reduction can be achieved for half the cost of plans focused on renewables only. Discussing the common practice of backing up renewables with gas, the Green Ribbon Panel found:

As the demand for electrification increases, Ontario has two choices. On one hand, we could choose to rely on a predominantly renewables-based alternative with natural gas back-up which, given the high cost of the intermittency of renewables, will be 48 per cent more costly than Ontario's current electricity system. Or, on the other hand, we could pursue a smartly integrated solution that could, ***thanks to the extensive use of nuclear generation,*** *be up to 28 per cent less costly than Ontario's system today and* ***half the costs of the renewables-based alternative****. This solution would smooth out demand for electricity, increase the efficient use of all assets, including storage, enhance system flexibility, and ultimately result in less generation, distribution and transmission costs.*

Ontario Comparison of Electricity Energy Costs ($/MWh)



Source: Ontario Green Ribbon Panel Report

The above chart from the Green Ribbon Panel's report, which compares a mix of carbon-free generation to a renewable-only approach, reveals an even greater difference in cost than found in California. Ontario and New York have similar climates, similar energy portfolios, and similar per-capita energy use. Therefore, it would be appropriate for New York policy to be informed by research of its northern neighbor.

Finally, comprehensive analysis by New York's own Independent System Operator (NYISO) resoundingly confirms the need for firm carbon-free generation. In September 2020, NYISO released ***Phase II*** *of a* ***Climate Change Impact and Resiliency Study*** which modeled potential future grid scenarios in which New York achieves

carbon-free electricity by 2040.[4] The beneficial electrification of vehicles, heating systems, and other end-use sectors will be critical to meeting greenhouse gas reduction goals of the CLCPA, so the Phase II study also included scenarios that reflect this increased demand.

NYISO understands that its job it is to ensure that the lights don't go out; that electricity is available across the state every hour of every day throughout the year. Therefore, its stark assessment of the challenges created by relying heavily on intermittent wind and solar resources to satisfy New York's demand for reliable electricity is sobering. With respect to the rate of deployment, the Phase II report states:

> *The pace of development required to meet the capacity requirements for each resource set is historically unprecedented in New York. …[T]he resource mix within New York has not changed much from 2011 through 2020. According to the NYISO Gold Books, between 2011 and 2020, the total summer capability of grid-connected renewable generation increased from 1,342.5 MW to 1,770.5 MW (an increase of 47.6 MW/year on average). The only grid-connected Solar PV power plants in New York are the Long Island Solar and Shoreham Solar Farms, and wind generation has modestly increased from 2011 to 2020.*
>
> *…[In] order for the system to have the quantities of renewable generation in nameplate capacity developed for the CLCPA resource set (56,263 MW), wind nameplate capacity will need to grow by 2,714 MW per year for the next 20 years.* ***This would*** *be* ***a thirty-fold increase in wind capacity.*** *Solar capacity will need to grow by 1,960 MW per year to reach the CLCPA resource set quantity of 39,262 MW,* ***for a more than thousand-fold increase in solar capacity.*** *The pace of development is much the same for the other resource sets presented in this study, and each will require large sustained increases in renewable capacity through 2040.*

Required Pace of Development to Meet 2040 Resource Set Quantities

	Nameplate Capacity (MW)		Required 2020-2040 Nameplate Capacity Growth Rate (MW/yr)	
	Wind (Land-based and Offshore)	Grid-Connected Solar	Wind (Land-based and Offshore)	Grid-Connected Solar
Existing Resources (2020)	1,985	57		
Climate Phase II Reference Case Resource Set (2040)	39,962	34,354	1,899	1,715
Climate Phase II CLCPA Scenario Resource Set (2040)	56,263	39,262	2,714	1,960
Grid in Transition Reference Case Resource Set (2040)	23,522	30,043	1,077	1,499
Grid in Transition CLCPA Scenario Resource Set (2040)	48,357	31,669	2,319	1,581
Historical Nameplate Capacity Growth Rate (2012-2020, MW/yr)			**71.4**	**3.1**

Source: NYISO Climate Change Impact and Resiliency Study Phase II

[4] Analysis Group, *Climate Change Impact and Resilience Study - Phase II: An Assessment of Climate Change Impacts on Power System Reliability in the United States. Long-Term Load Impact*, September 2020. https://www.nyiso.com/documents/20142/16884550/NYISO-Climate-Impact-Study-Phase-2-Report.pdf

Notably, the above quantities apply to scenarios that rely not only on "renewables", but also other carbon-free sources of electricity—existing sources of firm carbon-free power and unspecified new sources.[5] Without these existing and future firm carbon-free sources, making deep cuts in greenhouse gas emissions from the electricity sector will be impossible. **Significantly, all models considered viable enough to evaluate in NYISO's Phase II report included the retention of nuclear power.**

Many other findings of the NYISO Phase II report are consistent with findings by the California, Washington, and Ontario studies:

- ***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.*** *… [F]urther 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.*

- ***Battery storage resources help to fill in voids created by reduced output from renewable resources, but periods of reduced renewable generation rapidly deplete battery storage resource capabilities.*** *[This] includes the development and operation of over 15,600 MW (124.8 GWh) of new storage resources, configured as eight-hour batteries, and distributed throughout the state to maximize their ability to time shift excess generation from renewable resources. …While this represents a substantial level of assumed growth in battery storage within New York, the contribution of storage is quickly overwhelmed by the depth of the gap left during periods of time with a drop off in renewable generating output over periods of a day or more.*[6]

- ***The current system is heavily dependent on existing fossil-fueled resources to maintain reliability, and eliminating these resources from the mix will require an unprecedented level of investment in new and replacement infrastructure, and/or the emergence of a zero-carbon fuel source for thermal generating resources.*** *A power system that is effectively free of GHG emissions in 2040 cannot include the continued operation of thermal units fueled by well-based natural gas. …This is the fundamental challenge of the power system transition that will take place over the next two decades. Indeed, this transition must take place at the same time that electricity demand in the state will grow significantly if electrification of other economic sectors, such as transportation and heating, is needed to meet the economy-wide GHG emission reduction requirements.*

<u>The Practical Need for Carbon-Free Nuclear Power</u>

The California report and others discussed above clearly demonstrate the need for firm carbon-free sources to balance intermittent generation from renewables. However, for New York to achieve its goal of carbon-free electricity, it must also place proper emphasis on solutions with the greatest potential for success. Several combustion-based alternatives are frequently promoted by the fossil fuel industry: biofuels, renewable natural

[5] NYISO refers to unspecified new generators of firm carbon-free electricity as "DE" resources: resources compliant with the CLCPA's zero-emission requirement and generally dispatchable, meaning available whenever needed.
[6] It should be noted that this represents significantly more battery capacity than arbitrarily identified in the CLCPA. The CLCPA mandates only 3000MW, and specifies no requirement on actual energy storage, measured in watt-hours.

gas, and hydrogen. Although some appear to satisfy the definition of firm carbon-free generation, many have serious flaws or limited applicability, which distracts from meaningful action.

For example, it has been suggested that today's large gas-fired plants should continue operating, and perhaps even more should be built, because one day they might burn landfill biogas, renewable natural gas, or hydrogen. In reality, the amount of recoverable landfill gas and biogas from agriculture is very small. Furthermore, hydrogen or synthetic methane are not raw fuel sources, but instead inefficient storage mechanisms that require a tremendous amount of input energy and infrastructure to produce. Likewise, carbon capture and sequestration (CCS) of power plant emissions is a largely unproven concept that has never been implemented at scales remotely sufficient to power a state. **The fossil fuel industry knows that if New York banks on unrealistic, unscalable solutions, we will be burning fracked gas far into the future.**

Similarly, the biomass lobby would like to burn New York's forests for electricity. But this is also not a credible solution for tackling climate change due to the significant amount of time required to recapture carbon through plant growth. From a public health standpoint, biomass combustion is nearly as bad a coal.

NYRenews recently issued a report titled "False Solutions" which discusses the defects, or limited value, of various combustion-based concepts.[7] Significantly, the report found:

> *[The] production of these alternative fuels is often carbon-intensive--compared to fossil fuels, some of these false solutions literally add more greenhouse gas emissions than they reduce. Second, many of these fuels must be combusted to produce energy, which leads to more local pollution. Environmental justice communities will not see adequate reductions in toxic pollution, and thus adverse public health impacts, as long as we continue to combust fuels for energy. Third, some of the alternative fuels with a legitimately cleaner footprint are not economically viable for even marginally replacing fossil fuels in our economy. Fourth, reliance on "bioenergy" diverts land use from food to energy, depletes the earth's ability to recycle carbon, and contributes to water pollution.*

Nuclear power, on the other hand, is a firm carbon-free source of energy that does not require combustion. It is also notable that all three of New York's upstate nuclear plants remain operational through 2040 in the Phase II model by NYISO which relies *least* on the set of false solutions identified by NYRenews.

Due to its very high energy density, nuclear power has an extremely small ecological footprint, extremely small carbon footprint, and extremely small waste stream. Furthermore, nuclear power—unlike the fossil fuel industry—contains its waste instead of dumping it into the atmosphere. Statistically, it is also remarkably safe, on par with renewables and far safer than fossil fuels based on an objective assessment of all forms of energy.[8]

Perhaps most compelling, nuclear power represents proven, scalable technology capable of meeting energy needs of a growing world. France successfully decarbonized its electric grid years ago in a little over a decade with nuclear power. Moreover, the United Nations Intergovernmental Panel on Climate Change (IPCC) includes nuclear in every viable pathway to avoiding the worst impacts of global warming. Here in New York, nuclear

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[7] *False Solutions: How the Fossil Fuel Industry is Holding Back and Just Transition,* NYRenews. https://static1.squarespace.com/static/58ae35fddb29d6acd5d7f35c/t/603439d9ed60e8504b71e849/1614035420779/False+Solutions+Report+-+FINAL.pdf

[8] *What are the Safest and Cleanest Sources of Energy*, Our World in Data, February 2020. https://ourworldindata.org/safest-sources-of-energy

power is responsible for nearly a third of all electricity generation. It has supplied the state with reliable carbon-free electricity for years and should be allowed to continue doing so.

Needless to say, the mantra of "100% renewables" has become a popular rallying cry and campaign slogan for several NGOs. However, slogans are not a plan, they will not keep the lights on, and they will not ensure reliable affordable electricity. In a recent action alert, one such NGO declared that for New York to meet its climate and energy goals, "we *simply need to build more wind power and solar power projects*." The reports discussed herein conclusively demonstrates this to be false. There is nothing simple about the immense challenges ahead, and meeting those challenges will require a suite of carbon-free resources.

Existing and advanced nuclear power, hydropower, and rational amounts of wind, solar, and storage, all have roles to play in meeting the goal of *carbon-free* electricity. If New York is serious about the climate crisis, reducing air pollution, and decarbonizing its electric grid, nuclear must be in the mix.

Contact: Dr. Leonard Rodberg, lensqc@infoshare.org , 917-601-0186
Dr. Dietmar Detering, ddetering@gmail.com , 917-251-2235
Isuru Seneviratne, isuru@radiantval.com , 646-462-9018
Keith Schue, keithschue@gmail.com , 407-470-9433
Dennis Higgins, higgindm@gmail.com , 607-988-9647

August 24, 2021

Commissioner John Howard
New York State Public Service Commission
Three Empire State Plaza – 20th Floor
Albany, NY 12223

Dear Commissioner Howard,

A number of state and local elected officials signed a letter dated July 30, 2020, which has been filed in proceedings of the Public Service Commission (Case 20-G-0131, Case 19-G-0309, and Case 19-G-0310) concerning the consideration of new gas infrastructure projects. Asserting that the Climate Leadership and Community Protection Act (CLCPA) calls for New York to rapidly reduce greenhouse gas emissions and wean itself of fossil fuels, the letter states:

> **There is no reason any new fossil fuel project should even be on the table this late in the game.**

The letter then concludes with a demand:

> **We are calling for a plan for National Grid customers and New Yorkers across the state that will align with the CLCPA and get New York off gas and on to renewable options in a timely, orderly, and affordable manner.**

We share sentiments expressed by elected officials regarding the inconsistency of expanding fossil fuel infrastructure with trying to meet objectives of the CLPCA. However, we believe demands are only useful if coupled with an appreciation of how they can be met. To that end, we wish to clarify several issues for signers of the letter, the PSC, and committees currently crafting policies intended to meet state energy and climate goals. Although the letter appears to focus on activities within National Grid's territory downstate, in reality, utilities throughout New York have proposed and/or obtained PSC approvals to expand gas infrastructure. Therefore, our comments speak to energy planning statewide.

A recent analysis by New York's Independent System Operator (NYISO) provides a useful starting point for assessing the efficacy of plans being considered. California and Germany also offer glimpses into what New York's future may hold. Contrary to expectations of the July 30th letter, a strategy involving the buildout of predominantly intermittent renewable sources will not be cheap, will not reliably power the state's grid, and will not achieve the objective of carbon-free electricity. Respectfully, if energy policy advocates and government leaders truly wish to "get New York off gas," then it's time to understand how the electric grid actually works, learn from "experiments" elsewhere, and reexamine popular beliefs.

NYISO's Phase 2 Climate Change and Resiliency Study

New York's Independent System Operator is singularly detached from slogans and political rhetoric, and to some extent, from the crafting of energy policy. In deliberations of the state Climate Action Council, it has but one voice among many. However, NYISO must keep the lights on, and in that effort serves a purpose that is in the interest of constituents represented by signers of the referenced letter and the public at large. NYISO recently

released a *Phase 2 Climate Change Impact and Resilience Study* which examines critically what would be needed to achieve the CLCPA's goal of carbon-free in 2040 while ensuring system reliability if a plan is pursued that focuses on the expansion of intermittent renewables (wind and solar).[1] Importantly, the study was not a thought-experiment ignoring the real-world dynamics of intermittency or transmission. Rather, NYISO performed a complex analysis, modeling New York's actual grid.

Let's look carefully at NYISO's findings in the following chart from the study's Executive Summary.

Table ES-1: Generation Capacity, CCP2-CLCPA Resource Set

Nameplate Capacity by Zone, MW	A	B	C	D	E	F	G	H	I	J	K	Total
Land-based Wind	10,815.9	1,566.9	7,726.2	7,774.5	7,316.4	-	-	-	-	-	-	**35,200.0**
Offshore Wind	-	-	-	-	-	-	-	-	-	14,957.8	6,105.2	**21,063.0**
Solar (Behind-the-meter)	1,408.5	436.4	1,192.8	138.2	1,345.5	1,653.4	1,367.3	121.2	179.4	1,343.1	1,692.2	**10,877.8**
Solar (Grid Connected)	11,496.0	1,312.0	7,170.0	-	4,536.0	9,322.0	5,272.0	-	-	-	154.0	**39,262.0**
Hydro Pondage	2,675.0	-	-	856.0	-	-	41.6	-	-	-	-	**3,572.6**
Hydro Pumped Storage	-	-	-	-	-	1,170.0	-	-	-	-	-	**1,170.0**
Hydro Run-of-River	4.7	63.7	70.4	58.8	376.2	282.5	57.1	-	-	-	-	**913.4**
Nuclear	-	581.7	2,782.5	-	-	-	-	-	-	-	-	**3,364.2**
Imports	-	-	-	1,500.0	-	-	-	-	-	1,310.0	-	**2,810.0**
Storage	4,232.0	20.0	3,160.0	4,168.0	2,296.0	292.0	84.0	-	-	1,096.0	252.0	**15,600.0**
Price Responsive Demand (Summer)	949.9	205.2	510.1	357.7	211.1	433.9	246.3	58.6	134.9	1,940.8	187.6	**5,236.0**
Price Responsive Demand (Winter)	619.0	133.7	332.4	233.1	137.5	282.7	160.5	38.2	87.9	1,264.7	122.3	**3,412.0**
DE Resources	465.4	674.2	1,513.4	370.0	312.7	3,390.4	6,887.2	79.8	-	11,848.1	6,595.4	**32,136.6**

In a renewable-focused approach, NYISO estimates that New York would need to install 21,000 megawatts (MW) of offshore wind by 2040, more than twice what the state has proposed for 2035.[2] At 10 MW per installation, this corresponds to 2,100 offshore turbines. The state would also need to install 35,000 MW of onshore wind. At 5 MW each, this would require 7000 land-based turbines—a new turbine erected somewhere upstate every single day for the next 20 years. With typical 50-acre spacing, this would require a million-and-a-half acres of land, or an area roughly the size of St. Lawrence County, the largest county in New York. Additionally, the state would have to deploy 39,000 MW of grid-connected solar. At four acres per megawatt, this would consume hundreds of square miles, equivalent to blanketing an area the size of Binghamton with a sheet of glass and metal each year until 2040. Nearly 11,000 MW of behind-the-meter solar would be needed as well. At 6KW per installation, this corresponds to nearly two million roofs.

Ironically, since adoption of the CLCPA in 2019, not a single wind turbine has been installed in New York. In fact, NYISO points out that the state added on average only 71.4 MW of wind and 3.1 MW of grid-based solar each year between 2012 and 2020. Yet according to its Phase 2 report, the state needs to install 2714 MW of new wind (offshore and land-based) and 1960 MW of grid-based solar annually.[3] This amounts to ***hundreds*** of wind turbines and ***thousands of acres*** of solar panels each and every year for the next two decades—sustained deployment that ought to be already underway. It is no surprise that authors of NYISO's report express little confidence that New York will achieve the immense scale of renewable infrastructure contemplated.

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

[2] The CLCPA calls for 9000MW of offshore wind by 2035.

[3] Phase 2 report, Executive Summary, Table ES-4.

But it doesn't end there. To compensate (somewhat) for the inherent intermittency of wind and solar, NYISO finds that New York would also need to install 125 GWh of storage—a hundred times more storage than California's 1.2 GWh Moss Landing facility, currently the largest battery in the world.[4] Pumped storage could be an alternative, but this would require the construction of terraforming hydro projects ten times more massive than the state's Blenheim-Gilboa plant located in New York's Catskill Mountains.

Significantly, even if such an immense, costly, build-out of intermittent low-energy-density renewables and storage were to happen, NYISO finds in its Phase 2 study that New York would still need 32,000 MW of generation capacity from 'firm' *non-intermittent*, carbon-free sources to ensure reliability. **This exceeds the capacity of New York's entire existing fleet of fossil-fuel power plants.** Some suggest that today's gas-fired power plants might one day burn biogas or hydrogen. However, achieving 32,000MW of firm capacity this way would not only require retaining all of those plants (large and small), but also expanding them, converting them to burn alternative fuels, and maintaining them in perpetuity—ostensibly for only occasional use. The logistic and economic problems with this should be self-evident.

NYISO's Phase 2 report makes several other observations concerning intermittency, storage, demand, and back-up generation that should be further warning as to the problems of such a strategy:

> **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.** … [F]urther 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. *(Phase 2 report, page 83)*
>
> **Battery storage resources help to fill in voids created by reduced output from renewable resources, but periods of reduced renewable generation rapidly deplete battery storage resource capabilities.** *(Phase 2 report, page 83-84)*
>
> **The current system is heavily dependent on existing fossil-fueled resources to maintain reliability, and eliminating these resources from the mix will require an unprecedented level of investment in new and replacement infrastructure, and/or the emergence of a zero-carbon fuel source for thermal generating resources.** A power system that is effectively free of GHG emissions in 2040 cannot include the continued operation of thermal units fueled by well-based natural gas. …This is the fundamental challenge of the power system transition that will take place over the next two decades. Indeed, this transition must take place at the same time that electricity demand in the state will grow significantly if electrification of other economic sectors, such as transportation and heating, is needed to meet the economy-wide GHG emission reduction requirements. *(Phase 2 report, page 84)*

Finally, it should be noted that NYISO's analysis assumes the continued operation of New York's upstate nuclear plants to provide reliable baseload electricity. Today, nuclear power constitutes a quarter of statewide generation, so losing these major sources of 'firm' carbon-free energy would further widen New York's carbon-free deficit and compound the challenges of intermittency that create the need for back-up generation.

[4] This is significantly more battery capacity than identified in the CLCPA, which mandates only 3000MW, and specifies no requirement for actual energy storage, measured in watt-hours.

A Recipe for Failure

Upon reading NYISO's Phase 2 report, it is impossible not to draw a sobering conclusion: **New York is embarking on a strategy that cannot realistically succeed. Indeed, the CLCPA is in danger of not only failing; it is in danger of failing miserably.**

California and Germany provide real-world examples of how this expensive experiment plays out. California has managed to increase non-hydro renewables to about a third of electricity generation. While this might seem like progress, it has solidified the state's dependence on gas-fired generation to compensate for frequent periods when renewable supply does not meet demand. It has also introduced system-wide inefficiencies, for example by relying on backup generation from simple-cycle plants that respond rapidly to renewable intermittency but burn more gas per kWh; by running plants in "hot standby" (burning gas even when not making electricity); and by curtailing (dumping) electricity during periods of excess supply. Such antics may help achieve a "renewable" quota, but accomplish little for the climate. Due to the premature retirement of nuclear power, California relies on fossil gas for 40% of its electricity, a proportion that has changed very little over the past two decades.

In 2010, Germany undertook "Energiewende," once described as the most ambitious energy revolution by an industrialized nation. However, the country simultaneously decided to eliminate its nuclear reactors, wiping out carbon-free energy that had generated over a quarter of its electricity. Despite half a trillion Euros invested in wind, solar, and other efforts, Germany is increasingly dependent on foreign gas, and in 2020 even fired-up a new coal plant.[5] Now Chancellor Merkel wants a pipeline under the Baltic Sea to receive Russian gas, as well as liquified natural gas (LNG) from the United States. Under the pretense of "renewable energy", Germany also burns wood from forests that had previously sequestered carbon, and crops from farmland that could have fed people. Perhaps most ironic is that Germany continues to import electricity from nuclear power plants in France to balance its grid. Meanwhile France, which receives almost all of its electricity from nuclear, has among the lowest carbon emissions and cleanest air in Europe—a success achieved years ago in little over a decade.

California and Germany have boxed themselves into a corner by focusing on "renewables" instead of emission reduction. As electric rates skyrocket and resiliency falters, neither is close to achieving a carbon-free grid.

What might failure look like in New York? Initially, it looks like the persistence of new or existing gas-fired power plants to "partner" with wind and solar. Perhaps these will be justified as "temporary." Perhaps they will be deemed insignificant based on a belief or claim that they will be needed just a few days in a year. However, as the logistic and financial realities associated with widespread deployment of wind and solar become apparent, as the technical barrier of intermittency limit their penetration, and as opposition to industrial wind and solar across the state mounts, those few days of burning gas will become most of the time. Needless to say, those in the fossil fuel industry know what failure in New York looks like because they are banking on it.

The recent construction of power plants like Cricket Valley Energy Center and CPV Valley Energy Center, along with proposals like Danskammer, Gowanus, and Barrett, all point to investor expectations that the future of gas in New York remains secure, despite CLCPA goals. Electricity generation from fossil fuels in the state had begun to fall from its peak in 2016. However, that trend reversed in 2020 following shutdown of just one of Indian Point's two reactors. As explained by NYISO in its 2017 Generator Deactivation Assessment, the reason that downstate New York can maintain reliability without Indian Point is because new gas-fired facilities, along with

[5] https://www.spiegel.de/international/germany/german-failure-on-the-road-to-a-renewable-future-a-1266586.html

existing fossil fuel plants in the region, have capacity to burn more gas.[6] Sadly, several of those existing plants are located within environmental justice communities of New York City which will have to suffer more combustion emissions because nuclear power was shut down instead of fossil fuels. In all, about 129 billion cubic feet of natural gas, along with 10 to 15 million tons of greenhouse gas emissions (measured in CO_2 equivalents), as well as co-pollutants, could have been avoided each year if Indian Point had remained in service.

What to do

New York ought to learn from failed experiments rather than repeat them. Renewable generators such as wind and solar pose two fundamental challenges that threaten decarbonization efforts: (1) low energy density, which affects the sheer volume of materials, land, and infrastructure required to produce electricity that society needs to function; and (2) intermittency, which impairs the delivery of energy when it is needed and makes integration of such sources into the grid increasingly difficult as more are deployed. Both deficiencies are downplayed by renewable energy advocates. However, **the greatest mistake that New York could make would be to underestimate the difficulty that these two factors present.**

The fact is that no major economy anywhere has built a grid that relies predominantly on wind and solar. Only two nations are powered exclusively with renewables, Iceland and Costa Rica—both of which have abundant hydropower and volcanic geothermal resources that produce 'firm' carbon-free electricity. Likewise, the ability of nuclear power to produce 'firm' carbon-free electricity is what has allowed countries like France and Sweden to decarbonize their grids. Relating to this, reliance on *fuel* should not be seen as a handicap. Fundamentally, **fuel is energy storage**. Whether in the form of combustible hydrocarbons, fissionable material, or water behind a dam, *fuel* allows for the optimal use of generation capacity to deliver electricity when needed--either continuously to serve baseload or dispatched in response to changing load. Of course, to achieve the goal of carbon-free electricity, it is also important that fuel consumption not produce greenhouse gas emissions.

Multiple studies referenced in prior testimony to the PSC and Climate Action Council reach the same conclusion: **When looking at system-level implementation, a strategy for grid decarbonization that utilizes a balance of carbon-free sources is far more feasible and cost-effective than one which attempts to rely predominantly on intermittent renewables.**

In *Renewables and Decarbonization: Studies of California, Wisconsin and Germany*, Brick and Thernstrom compare the feasibility and costs of achieving an 80% renewable portfolio standard (RPS) to a balanced portfolio of carbon-free sources.[7] In each case, they found that a balanced portfolio employing 25% intermittent renewables could achieve greater greenhouse gas reduction with far less investment in new generation and infrastructure than the 80% RPS scenario. They also found that achieving the same amount of greenhouse gas reduction with intermittent renewables would cost three to four times more per ton of CO_2 reduction (even when assuming falling costs of wind and solar, and increasing costs of nuclear.)[8] In another study coordinated by

[6] Generator Deactivation Assessment: Indian Point Energy Center, NYISO, December 2017. https://www.nyiso.com/documents/20142/1396324/Indian_Point_Generator_Deactivation_Assessment_2017-12-13.pdf

[7] Brick, Thernstrom. *Renewables and decarbonization: Studies of California, Wisconsin and Germany*; Elsevier, The Electricity Journal (2016) 6-12. Renewables and decarbonization: Studies of California, Wisconsin and Germany (core.ac.uk)

[8] Claims that the widespread development of wind and solar will make electricity cheaper are based on a misinterpretation of Levelized Cost of Electricity (LCOE). The LCOE metric is useful in assessing the competitiveness of an individual generator, but it does not address the value that different technologies add to the grid at various levels of penetration, which impacts total system-level costs that rate ratepayers ultimately bear.

the Clean Air Task Force, experts from Princeton, Stanford, and the consulting firm Energy & Environmental Economics (E3) evaluated various scenarios for achieving California's 2045 goal of carbon-free electricity, each using separate models.[9] Their report, titled *California Needs Clean Firm Power, and so Does the Rest of the World,* found that to reliably meet electricity needs in 2045 with wind and solar, California would require capacity equal to half the total generating capacity of the country and six times the current capacity of all sources (fossil fuel, nuclear, hydro, etc.) serving the state today. As an alternative, authors determined:

> An ambitious but achievable investment in clean firm power, on the order of California's existing gas fleet could, on the upside, eliminate the need for ten times that amount of renewable energy and thus help keep generation and transmission costs in line with today, cut the land area needed for utility scale solar facilities and energy storage by a factor of ten, and reduce transmission infrastructure needs by a factor of four by 2045. These advantages will help increase the likelihood of achieving climate goals in California.

If New York's goal is to maximize the build-out of industrial wind and solar projects across the state regardless of environmental consequences, cost, or grid stability, then focusing on low-energy-density, intermittent renewables might make sense. However, if the goal is to reduce greenhouse gas emissions, combat climate change, ensure reliability, and avoid fossil-fuel pollution, then it is time to reconsider current plans.

Rather than attempting to design an inherently inefficient system that relies on underutilized firm generation to back-up an enormous amount of low-energy-density renewables, a much more effective strategy would be for New York to encourage the development of firm, carbon-free resources that operate as much as possible.

As previously discussed, NYISO has determined that to ensure reliability, New York will need to provide additional capacity from firm carbon-free generators that exceeds the total capacity of the state's existing fleet of gas-fired power plants. This is even if those generators are hardly ever used. So, instead of just relying on firm, carbon-free capacity as occasional back-up to an enormously overbuilt network of intermittent sources, if some of those additional firm, carbon-free generators actually ran more—as baseload facilities or load-following plants—then New York would be in a far better position to achieve CLCPA goals. This would ensure a much more efficient use of firm carbon-free assets, storage (useful for peaking), and transmission infrastructure. Moreover, such an approach would limit intermittent resources (wind turbines and solar farms) to levels that are realistically attainable, ecologically responsible, and respectful of upstate communities.

Nuclear power is well-suited for this purpose. The high energy-density of nuclear fuel means that very little of it is needed to produce a lot of electricity over an extended period of time. Indeed, a pound of uranium contains as much energy as three million pounds of coal. On the other hand, proposals for firm generation that might rely on the combustion of biomass, RNG, hydrogen, or synthetic methane are severely limited by the availability of their respective fuels. The amount of RNG from agriculture is inadequate for anything other than small-scale or occasional use. Likewise, biomass has extremely low energy density, meaning that a tremendous amount of wood or other plant material is required to produce a tiny amount of electricity. Further, air pollution from

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[9] Long, Baike, Jenkins, et al. *California needs clean firm power, and so does the rest of the world: Three detailed models of the future of California's power system all show that California needs carbon-free electricity sources that don't depend on the weather,* Environmental Defense Fund, Stanford University, Princeton University, Energy & Environmental Economics, Clean Air Task Force, UC San Diego, The Brookings Institution.
https://www.edf.org/sites/default/files/documents/SB100%20clean%20firm%20power%20report%20plus%20SI_clean.pdf
See also: Issues in Science & Technology, *Clean Firm Power is the Key to California's Carbon-Free Energy Future*, March 24, 2021.
https://issues.org/california-decarbonizing-power-wind-solar-nuclear-gas/

biomass combustion is about as harmful as coal. Both hydrogen and synthetic methane require significantly more energy to produce than is recovered upon their combustion, and, because that input energy would presumably require additional renewables, this limits their applicability. [10]

This leads to an obvious, yet important conclusion: **Nuclear power must remain a meaningful part of New York's energy portfolio.** The reactors at Ginna, Fitzpatrick, and Nine Mile Point have supplied the state with reliable baseload electricity for years. Their licenses should be extended so that they can continue doing so. However, in order to realistically achieve the 2040 goal of carbon-free electricity, even as demand grows statewide, New York must also invest in advanced next-generation technology.

Nuclear power plants, like other thermal plants, are capable of gradual load-following.[11] However, generation IV designs, including Small Modular Reactors (SMRs) or reactors with thermal storage, will be able to respond even more rapidly to changes in load—a feature complementing renewables.[12] Additionally, the very high capacity-factor of nuclear gives it a small ecological footprint, which translates to less land, concrete, steel, and other materials per watt-hour than any other carbon-free source of energy. Nuclear power—unlike fossil fuel combustion—also has an extremely small waste stream which it contains instead of dumping into the atmosphere. Furthermore, nuclear waste is highly recyclable either through reprocessing, like France has done for years, or as fuel in next-generation reactors. Significantly, air pollution caused by fossil fuel combustion contributes to eight million deaths annually.[13] Yet over the entire lifetime of commercial nuclear power, stored nuclear waste has harmed no one. Statistically, nuclear power is remarkably safe, on par with renewables and far safer than fossil fuels based on an objective assessment of all forms of energy by Oxford.[14] By displacing fossil fuels, nuclear power saves lives.[15]

Importantly, the United Nations Intergovernmental Panel on Climate Change (IPCC) includes nuclear in every viable pathway to avoiding the worst impacts of global warming.[16] This is underscored in a recent article and technology brief by the United Nations Economic Commission for Europe, *Global Climate Objectives Fall Short Without Nuclear Power in the Mix*.[17] Analysis by the International Energy Agency also finds that in addition to providing grid stability, extending the operation of nuclear facilities with refurbishment is a very cost-effective means of generating carbon-free electricity.[18]

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[10] These are basically inefficient forms of storage. Ironically, there is a way to make the large-scale production of hydrogen or synthetic hydrocarbons viable, but it is with high-temperature nuclear power. The Navy is exploring this to produce jet fuel on nuclear aircraft carriers, and in the future, it could have practical applications as net-zero fuel for vehicles.

[11] It is a misconception that nuclear plants must run at full load. In France, where nuclear is responsible for most electricity generation, load-following is commonplace.

[12] An example of this is TerraPower's sodium-cooled Natrium reactor currently under development. https://natriumpower.com

[13] https://www.seas.harvard.edu/news/2021/02/deaths-fossil-fuel-emissions-higher-previously-thought

[14] *What are the Safest and Cleanest Sources of Energy*, Our World in Data, Oxford Martin Programme on Global Development, February 2020. https://ourworldindata.org/safest-sources-of-energy

[15] P. Kharecha, J. Hansen, *Prevented Mortality and Greenhouse Gas Emissions from Historical and Projected Nuclear Power*, NASA Goddard Institute for Space Studies and Columbia University Earth Institute, Environmental Science & Technology, 2013. https://pubs.acs.org/doi/pdf/10.1021/es3051197

[16] *Special Report: Global Warming of 1.5 C*, IPCC, Figure SPM.3B. https://www.ipcc.ch/sr15/chapter/spm/spm-c/spm3b/

[17] *Global Climate Objectives Fall Short Without Nuclear Power in the Mix: UNECE*, United Nations—UN News. August 11, 2021. https://news.un.org/en/story/2021/08/1097572 ;
UNECE technology brief: https://unece.org/sites/default/files/2021-08/Nuclear%20power%20brief_EN_0.pdf

[18] *Projected Costs of Generating Electricity, IEA*, NEA, OECD, December 2020.
https://www.iea.org/reports/projected-costs-of-generating-electricity-2020

Conclusion

The denial of climate science by politicians has undermined efforts to curb greenhouse gas emissions for decades. However, today the most significant impediment to action on climate change may be the denial of *applied* science—the rejection of solutions to the climate crisis which are known to work.

California and Germany provide examples of how to spend a tremendous amount of money on wind and solar while accomplishing little. Unless elected leaders believe that New York can and will deploy the immense scale of renewable infrastructure, storage, transmission, and carbon-free backup generation described by NYISO in its Phase 2 report, they must acknowledge that a plan focusing predominantly on intermittent renewables will fail. Moreover, unless decision-makers are willing to consider alternatives, they must concede that New York will remain dependent on fossil fuels far into the future.

Making demands that are not grounded in reality may serve a political purpose, but political posturing will not address energy needs of the state or effectively tackle climate change. Renewables can help replace fossil fuels, but they cannot do it alone. New York can successfully decarbonize its electric grid. However, it will require a rational approach to energy that recognizes the value of all carbon-free sources, including nuclear power.

Respectfully,

James E. Hansen, PhD, Columbia University Earth Institute and former Director of NASA's Goddard Institute
Leonard Rodberg, PhD, Professor Emeritus of Urban Studies, Queens College/CUNY, NY Energy & Climate Advocates
Meredith Angwin, author of *Shorting the Grid: The Hidden Fragility of Our Electric Grid*
Gary Kahanak, Climate Coalition
Dietmar Detering, PhD
Gary A. Abraham, Esq
Dennis Higgins
Keith Schue
Ethan Bodnaruk

cc: The Honorable Kathy Hochul, Governor of New York

cc: July 30, 2021 letter signers

STATE OF NEW YORK
PUBLIC SERVICE COMMISSION

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

RESPONSE TO PETITION OF INDEPENDENT POWER PRODUCERS OF NEW YORK, INC., NEW YORK STATE BUILDING AND CONSTRUCTION TRADES COUNCIL AND NEW YORK STATE AFL-CIO RELATING TO THE ESTABLISHMENT OF A ZERO EMISSIONS ENERGY SYSTEMS PROGRAM UNDER THE CLEAN ENERGY STANDARD*

I. INTRODUCTION

The undersigned parties submit the following testimony in qualified support of the Petition dated August 18, 2021 by Independent Power Producers of New York, the New York State Building and Construction Trades Council, and the New York State AFL-CIO ("Petitioners") to establish a zero-emissions energy systems program under the Clean Energy Standard. As we discuss, it will be important that the Commission pursue actions that have the greatest potential to successfully decarbonize the state's electric grid by 2040. This requires valuing sources of 'firm' carbon-free electricity not defined as "renewable". It also requires recognizing the importance of such generators not simply as backup to a widespread deployment of intermittent generation, but on their own right as valuable sources of bulk energy.

II. RELEVANCE OF PETITION

The aforementioned petition requests that the New York State Public Service Commission (PSC, or "the Commission"), establish:

> a new competitive program or tier under the Clean Energy Standard ("CES") to encourage the development of zero emitting electric generating facilities that are not renewable energy systems, as defined in the Climate Leadership and

> Community Protection Act ("CLCPA") pursuant to paragraph (b) of subdivision 1 of Section 66-p of the New York Public Service Law ("PSL").

Elaborating on this, Petitioners state:

> …to assist meeting the CLCPA's target of having the statewide electrical demand system be zero emissions by 2040, the Commission should establish, after an appropriate notice and comment period, a competitive program to encourage private sector investment in a minimum of one gigawatt ("GW") of zero emissions energy systems that would commence commercial operation by 2030. The Commission should define "zero emissions energy systems" as systems, other than renewable energy systems, that generate electricity or thermal energy through the use of technologies that do not lead to a net increase in greenhouse gas emissions into the atmosphere at any time in the process of generating electricity.

Further, in their request for relief, Petitioners correctly note that the Commission has been reticence to act upon the CLCPA's 2040 zero-emission mandate:

> The Commission's CES Modification Order established policies and mandates to achieve the 70 by 30 Target but was silent on how the State should achieve the 2040 Zero Emission Target or even designate the types of resources that could be used to meet such target. Nor did the Commission state in the CES Modification Order when it would consider establishing policies to achieve the 2040 Zero Emission Target.
>
> The Commission's silence on these matters creates uncertainty in the electricity market and investment community, thereby potentially delaying, unnecessarily, the development of resources that are both zero emitting and capable of meeting electric system needs that cannot be met fully by renewable energy systems due to their intermittence.

We strongly agree with each of the above points and are grateful to Petitioners for raising them. As filed by parties to this proceeding and supported by analyses of the electric grid in

California and elsewhere, 'firm' generation capacity is critical for reliability[1]. Moreover, ample analyses from numerous research groups confirm that decarbonization plans involving a balanced set of carbon-free generators are more economical and technically feasible than those focused on renewables only.[2]

Petitioners bolster their argument further by citing specific analysis by New York's Independent System Operator (NYISO), which in its Phase 2 Climate Impact Study found that the state would require more than 30,000 Megawatts (MW) of 'firm' carbon-free capacity as backup generation in a scenario involving the widespread deployment of intermittent sources:[3]

> Because wind, solar, and limited-duration energy storage resources will be insufficient to meet electric demand in 2040, the Phase II Climate Study determined that removal of all the existing fossil-fueled generating resources by 2040 in compliance with the CLCPA's 2040 Zero Emission Target will require as much as 30,000 MW of installed capacity of new flexible and dispatchable resources to provide the necessary reliability services that have historically been provided by fossil-fueled generating resources.

Significantly, 30,000 MW exceeds the total capacity of all fossil-fuel power plants in the state today.[4] It is also important to note that this 'firm' carbon-free capacity is in ***addition*** to firm generation already provided by existing hydropower and nuclear power, which NYISO's

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[1] NYECA filing, March 5, 2021.

[2] Long, Baike, Jenkins, et al. *California needs clean firm power, and so does the rest of the world: Three detailed models of the future of California's power system all show that California needs carbon-free electricity sources that don't depend on the weather,* Environmental Defense Fund, Stanford University, Princeton University, Energy & Environmental Economics, Clean Air Task Force, UC San Diego, The Brookings Institution. https://www.edf.org/sites/default/files/documents/SB100%20clean%20firm%20power%20report%20plus%20SI_clean.pdf ; Issues in Science & Technology, *Clean Firm Power is the Key to California's Carbon-Free Energy Future*, March 24, 2021. https://issues.org/california-decarbonizing-power-wind-solar-nuclear-gas/ ; Denholm, Arent, et al. *The challenges of achieving a 100% renewable energy system in the United States*, National Renewable Energy Laboratory, U.S. DOE, May 19, 2021. https://www.osti.gov/biblio/1804705

[3] *Climate Change Impact and Resilience Study – Phase II: An Assessment of Climate Change Impacts on Power System Reliability in New York State*, Final Report, Analysis Group for NYISO, September 2020. https://www.nyiso.com/documents/20142/16884550/NYISO-Climate-Impact-Study-Phase-2-Report.pdf Note that petitioners refer to 30,000 MW of additional firm carbon-free capacity. However, in its Phase 2 report, NYISO actually specifies 32,136.6 MW of dispatchable emission-free (DE) capacity in the CLCPA case.

[4] https://www.nyiso.com/power-trends

model assumes are retained as baseload contributors to the state's electric generation portfolio through 2040.

As Petitioners have, we find the analysis performed by NYISO in its Phase 2 study valuable. However, we must add that the scope and value of NYISO's Phase 2 report goes beyond simply establishing the need for additional firm capacity. NYISO's report reveals significant risk in pursuing a strategy that relies predominantly on an unrealistic deployment of intermittent resources. **We maintain that attention to the full set of sobering findings contained in NYISO's report is vital if the Commission and state policy-makers hope to make sound decisions regarding the <u>type</u> of firm generation to pursue and how its use should be optimized.**

III. AN UNREALISTIC BUILDOUT

In its analysis, NYISO admits that the quantity of additional installed capacity needed in a renewable-centric approach is immense. As seen in Table ES-1 of NYISO's report below, a total of 163,000 MW of deployed capacity would be required from all sources: approximately 147,500 MW of generation and 15,600 MW x 8 hours of storage.[5] Of this, 106,000 MW would be wind and solar according to NYISO's model. For reference, New York's total generation capacity in 2020 from all sources was just a little over 41,000 MW, of which only 4,400 MW was wind or solar.

Table ES-1: Generation Capacity, CCP2-CLCPA Resource Set

Nameplate Capacity by Zone, MW	A	B	C	D	E	F	G	H	I	J	K	Total
Land-based Wind	10,815.9	1,566.9	7,726.2	7,774.5	7,316.4	-	-	-	-	-	-	35,200.0
Offshore Wind	-	-	-	-	-	-	-	-	-	14,957.8	6,105.2	21,063.0
Solar (Behind-the-meter)	1,408.5	436.4	1,192.8	138.2	1,345.5	1,653.4	1,367.3	121.2	179.4	1,343.1	1,692.2	10,877.8
Solar (Grid Connected)	11,496.0	1,312.0	7,170.0	-	4,536.0	9,322.0	5,272.0	-	-	-	154.0	39,262.0
Hydro Pondage	2,675.0	-	-	856.0	-	-	41.6	-	-	-	-	3,572.6
Hydro Pumped Storage	-	-	-	-	-	1,170.0	-	-	-	-	-	1,170.0
Hydro Run-of-River	4.7	63.7	70.4	58.8	376.2	282.5	57.1	-	-	-	-	913.4
Nuclear	-	581.7	2,782.5	-	-	-	-	-	-	-	-	3,364.2
Imports	-	-	-	1,500.0	-	-	-	-	-	1,310.0	-	2,810.0
Storage	4,232.0	20.0	3,160.0	4,168.0	2,296.0	292.0	84.0	-	-	1,096.0	252.0	15,600.0
Price Responsive Demand (Summer)	949.9	205.2	510.1	357.7	211.1	433.9	246.3	58.6	134.9	1,940.8	187.6	5,236.0
Price Responsive Demand (Winter)	619.0	133.7	332.4	233.1	137.5	282.7	160.5	38.2	87.9	1,264.7	122.3	3,412.0
DE Resources	465.4	674.2	1,513.4	370.0	312.7	3,390.4	6,887.2	79.8	-	11,848.1	6,595.4	32,136.6

[5] This does not include demand response or imported electricity, both of which would be in addition to the 160,000 MW of capacity identified by NYISO.

NYISO acknowledges that achieving statewide greenhouse gas reduction goals will require the substantial electrification of end-user systems, but this only partly accounts for the tremendous increase in generation capacity that NYISO predicts would be necessary.[6] The overarching reason that NYISO's model arrives at such a large amount of wind and solar is because of the very low capacity-factors of those sources and the stochastic nature of intermittency itself. This also makes the integration of intermittent sources into the grid increasingly difficult as more are deployed. Unlike firm generators, the nameplate capacities of intermittent sources are not additive. Because wind and solar cannot be simply dispatched whenever needed, their individual nameplate capacities cannot be summed together to match worst-case peak loads. Indeed, the amount of total power available from a set of wind and solar resources to serve demand at any given time is a complex function of how such resources align in real-world conditions affected by weather, time-of-day, and season. Likewise, the extent to which some of the electricity produced by intermittent sources can be saved for later use depends upon the real-time dynamics and duration of loads, intermittent supply, and the depletion of energy from facilities with finite storage capability.

To its credit, NYISO's Phase 2 modeling and its resource selections begin to reflect this complex level of analysis. However, NYISO does not paint a reassuring picture of what can be realistically achieved if the state were to pursue a strategy primarily focused on the deployment of intermittent resources. A deeper dive into that buildout is warranted.

In its Phase 2 analysis, NYISO estimates that New York would need 21,000 MW of offshore wind by 2040, more than twice what the state has proposed for 2035.[7] At 10 MW per installation, this corresponds to 2,100 offshore turbines. So far, New York has none. The state would also need to install 35,000 MW of ***onshore*** (land-based) wind. At 5 MW each, this would require 7,000 land-based turbines—corresponding on average to a new turbine erected somewhere upstate ***every single day*** for the next 20 years. Applying an estimated average deployment of 10 MW per square mile, this would occupy more than 2 million acres of land, or

[6] Taking into account beneficial electrification necessary to meet statewide greenhouse gas reduction goals, NYISO estimates that New York will require over 221,000 GWh of electricity (including demand met by behind-the-meter solar) in 2040, compared to approximately 158,000 GWh in 2019. This represents a 40% increase in demand. However, NYISO predicts the need for 163,000MW of capacity in 2040 compared to 41,000MW in 2020, nearly a 300% increase in capacity.

[7] The CLCPA calls for 9000 MW of offshore wind by 2035.

an area larger than St Lawrence County, the largest county in New York.[8] Additionally, the state would need to deploy 39,000 MW of grid-connected solar. At four acres per megawatt, this would consume hundreds of square miles, equivalent to blanketing an area the size of Binghamton with a sheet of glass and metal each year from now until 2040. Nearly 11,000 MW of behind-the-meter solar would be needed as well. At 6 kW per installation, this corresponds to nearly two million roofs.

The amount of electricity generation by wind in New York has barely changed since 2014, and not a single wind turbine has been installed since adoption of the CLCPA.[9] In fact, NYISO points out that the state added on average only 71.4 MW of wind and 3.1 MW of grid-based solar each year between 2012 and 2020. Yet according to its Phase 2 report, New York would need to install 2,714 MW of new wind (offshore and land-based) and 1,960 MW of grid-based solar annually.[10] This amounts to ***hundreds*** of wind turbines and ***thousands of acres*** of solar panels each and every year for the next two decades—sustained deployment which, ostensibly, should be already underway.

In addition to the above, NYISO finds that New York would need 125 GWh of storage—a ***hundred times*** more storage than California's 1.2 GWh Moss Landing facility, currently the largest lithium-ion battery in the world.[11] Pumped storage could be an alternative, but this would require the construction of terraforming hydro projects ten times more massive than the state's Blenheim-Gilboa plant located in New York's Catskill Mountains.

It is no surprise that authors of NYISO's report express little confidence that New York will achieve the immense scale of renewable infrastructure contemplated. Saying that New York's CLCPA is on a collision course with reality is an understatement. **Pursuing a plan unduly fixated on intermittent renewables, it is abundantly clear that the CLCPA will not meet its decarbonization commitments.**

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[8] Typically wind turbines are spaced at a distance of at least 7 times the rotor diameter, although studies indicate that performance is improved with greater spacing. In a survey of 172 large-scale wind power projects, NREL found an average of 10 MW per square mile. https://sciencing.com/much-land-needed-wind-turbines-12304634.html

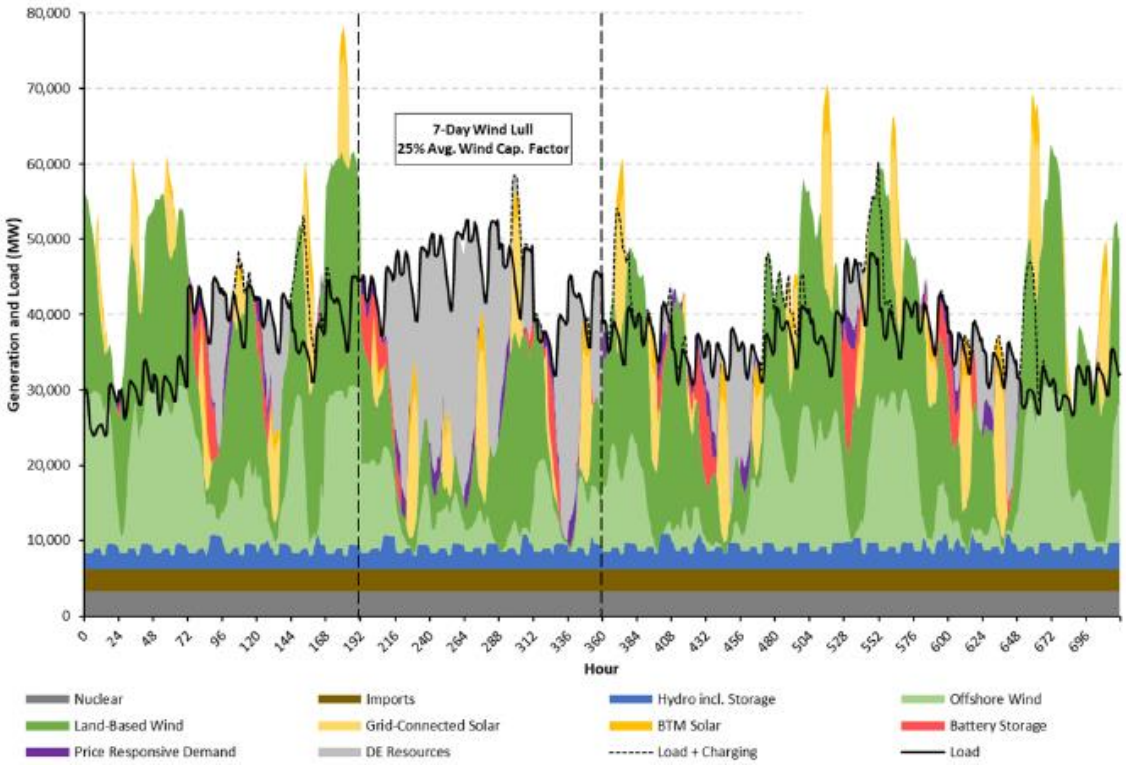
[9] 2021 Load and Capacity Data: Gold Book, NYISO. https://www.nyiso.com/documents/20142/2226333/2021-Gold-Book-Final-Public.pdf ; see figures III-4a and III-4b.

[10] Phase 2 report, Executive Summary, Table ES-4.

[11] This is significantly more battery capacity than identified in the CLCPA, which mandates only 3000 MW, and specifies no requirement for actual energy storage, measured in watt-hours.

Significantly, except for existing baseload hydropower and nuclear power which its model retains, all of the in-state 'firm' capacity that NYISO incorporates into its CLCPA case essentially serves as "backup" generation for the overbuilt deployment of intermittent sources. In an unrealistic scenario where all of those intermittent sources are built, the 30,000MW of additional 'firm' carbon-free generation specified by NYISO would be extremely under-utilized. On the other hand, if the enormous level of renewable buildout of wind and solar modeled by NYISO does not occur, then firm generators—carbon-free or not—would need to operate much more. This is readily apparent by examining Figure ES-2 of NYISO's Phase 2 report which depicts how various sources of power generation and storage would serve demand during a month in winter.

Figure ES-2: Hourly Load/Generation Balance, CCP2-CLCPA Winter Wind Lull Case



As seen above and explained in NYISO's report, battery storage (shown in red) can help fill voids caused by reduced output from renewables, but that stored energy is rapidly depleted. Periods during which additional 'firm' carbon-free capacity (DE resources) must operate because both renewable generation and storage are inadequate appear in gray. According to NYISO,

those firm resources would need to supply 10% and 4% of total energy delivered during the winter and summer respectively.[12]

However, now let us imagine that New York successfully deploys all of the offshore wind, all of the solar, and all of the storage identified by NYISO in its model, but that it installs very little land-based wind (arguably the least popular of renewable resources). If that were to happen, then firm (DE) resources would also need to operate most of the time where land-based wind (shown as dark green) appears in the above figure. This would make much more of the area under the load curve gray. According to NYISO's CLCPA model, land-based wind provides 33% and 23% of total energy serving demand during the winter and summer respectively.[13]

The technical, logistic, financial, environmental, and political barriers to deploying the amount of energy infrastructure described above and the potential cumulative harm to rural communities, forests, agricultural land, and scenic natural parts of the state are profound. We do not doubt that New York will install more wind turbines and solar panels in the future. However, it is virtually certain that the state will *not* deploy the enormous amount of renewable capacity identified in NYISO's Phase 2 model. For this reason, **the Commission and state policy-makers ought to encourage the development of 'firm' carbon-free generators of electricity that can function as more than just occasional backup.** Absent this, New York will continue burning fossil gas for electricity far into the future.

IV. LIMITATIONS OF "BACKUP" GENERATION

Importantly, the key attribute that makes a source of electricity 'firm' is *fuel*. Whether in the form of combustible hydrocarbons, fissionable material, or water behind a dam, *fuel* constitutes **stored energy** that allows for the optimal use of installed capacity to generate electricity when needed—either continuously to serve baseload or dispatched in response to changing load conditions. Of course, to achieve the goal of carbon-free electricity, consuming fuel must not produce greenhouse gas emissions.

While fuel is essential to firm generation, its availability and usefulness varies considerably from one source to another. This is an important factor that Petitioners do not address. In fact, many of the 'firm' carbon-free alternatives named by Petitioners are inherently

[12] Figures 31 and 33 of NYISO Phase 2 study.

[13] Figures 31 and 33 of NYISO Phase 2 study.

fuel-constrained. For example, the volume of "renewable" natural gas (RNG) recoverable from landfills, sewage, and agricultural processes is inadequate for anything more than small-scale or occasional use. Likewise, biomass has extremely low energy density, meaning that a tremendous amount of wood or other plant material is required to produce a tiny amount of electricity. Unless New York intends to build massive incinerators or engage in large-scale deforestation, burning wood for electricity will do little to satisfy the state's need for firm capacity. Moreover, from a public health standpoint, air pollution from biomass combustion is about as harmful as pollution from coal.[14]

Hydrogen has also been suggested as a fuel source. However, unlike oil or fossil gas, it is not a raw material that can be simply extracted from the environment. Because hydrogen must be produced, it should really be thought of as a *carrier*, rather than *source*, of energy. Moreover, the process of making "green" hydrogen from water—electrolysis—is energy intensive. Producing hydrogen through electrolysis requires two to three times as much electrical energy as can be retrieved during its combustion. Thus, except for small-scale or limited applications, consuming "green" hydrogen derived from low-energy-density renewables will not be a realistic solution for firm carbon-free generation either.

On the front end, Carbon Capture and Sequestration (CCS) is not "fuel-constrained" *per se* because the supply of fossil gas that is available to power plants in New York continues to be abundant. However, CCS is severely constrained on the *back-end* by the sheer volume of underground storage that would be required to sequester the emissions created by fuel combustion. Significantly, for every ton of methane (CH_4) that is extracted from the earth and burned, 2.75 tons of carbon-dioxide (CO_2) would need to be forcibly sequestered deep underground for the process to be carbon-free.[15] Notably, all CCS projects to date are experimental. The technology has yet to be demonstrated as viable or scalable.

Due to these fuel-related constraints, each of the firm carbon-free sources of energy described above has limited value. Moreover, **any strategy involving them becomes incredibly risky since their *occasional* use would be dependent on the immense scale of intermittent**

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[14] The benefit of biomass combustion is also doubtful from a climate standpoint. Burning trees for energy produces substantial carbon emissions in a very short amount of time, whereas it takes many years for a planted sapling to recapture carbon through growth. Logging and transporting large volumes of low-energy-density wood is also a very carbon-intensive process.

[15] This is a derived directly from the molecular weights of methane, CH_4 (16) and carbon dioxide, CO_2 (44).

infrastructure previously discussed actually being deployed. Simply put, for anything other than small-scale, experimental, or occasional use, RNG, biomass, hydrogen, and CCS cannot do the job.

Finally, policy-makers should recognize that it may not even be economically feasible to construct and maintain large generators of firm carbon-free electricity merely for occasional use. Ironically, this is basically how small peaker-plants function today. (Peakers are inefficient facilities that the state would like to phase out.) Trying to set aside 30,000 MW of firm generation for this purpose—more than the capacity of New York's entire fleet of fossil fuel power plants—would not only represent a tremendous waste of underutilized infrastructure, but on its face defies common sense.

V. NUCLEAR POWER IS WELL-SUITED TO MEET INCREASED CARBON-FREE CAPACITY THAT NEW YORK NEEDS

Fortunately, there is a source of firm carbon-free energy that is proven, scalable, and capable of meeting New York's demand for electricity even when the state fails to deploy the massive amounts of intermittent wind and solar identified by NYISO in its Phase 2 analysis. That source of energy is **nuclear power.**

Unlike other types of carbon-free generation advocated by Petitioners, nuclear power relies on an extremely compact, energy-dense source of fuel that lasts a long time. Indeed, one pound of uranium has the energy content of three million pounds of coal.[16] Nuclear plants in the United States today operate at a capacity factor of 90% or higher and only need to be refueled once every year or two.[17]

Nuclear power's status as proven technology is evidenced by the fact that it has already provided New York with decades of reliable carbon-free electricity, available 24/7 regardless of the weather or time of day. Needless to say, losing any of New York's upstate plants—Ginna, Fitzpatrick, or Nine Mile Point—would further widen the state's carbon-free deficit, compound the challenges of intermittency, and require the deployment of even more new carbon-free

[16] https://www.britannica.com/science/uranium; https://www.nasa.gov/sites/default/files/atoms/files/ns_kilopower_fs_180111.pdf

[17] In 2019, nuclear power plants in the United States had a capacity factor of 93.5%, by far the highest of any electricity source. https://www.energy.gov/ne/articles/what-generation-capacity

generation. As in Virginia, Florida, and Pennsylvania where plant licenses have been renewed more than once, **New York's upstate reactors should be relicensed so that they can continue producing electricity well beyond 2040**.[18] Analysis by the International Energy Agency confirms that refurbishing existing nuclear facilities in order to extend their operation is an extremely cost-effective means of procuring carbon-free electricity.[19]

Still, as seen by any rational interpretation of NYISO's Phase 2 analysis, simply retaining existing nuclear and hydro facilities for baseload generation while hoping for an unrealistic buildout of wind, solar, and storage (along with dubious sources of "backup" generation) is not a winning strategy. **To achieve the CLPA's 2040 goal, the Commission ought to incentivize the construction of new reactors, including those utilizing advanced next-generation technology.** Moreover, those new plants should be incorporated into a grid architecture that maximizes reliability, minimizes environmental impact, and minimizes total system cost.

Instead of just relying on additional firm, carbon-free capacity as occasional backup to an enormously overbuilt network of intermittent sources, New York will be in a far better position to achieve its goal of grid decarbonization by deploying new reactors as baseload facilities and load-following plants. This would ensure a much more efficient use of firm carbon-free assets, storage, and transmission infrastructure. Moreover, such an approach would limit the buildout of intermittent resources to levels that are realistically attainable, ecologically responsible, and respectful of upstate communities.

Whether it is a generator, transmission network, or any other type of built infrastructure, an investment becomes more economical by using it. Indeed, from a system-level standpoint, this is why nuclear power constitutes a more efficient utilization of resources than generators with inherently low capacity-factors. Still, it is a misconception that nuclear plants are only useful for baseload generation. Like other thermal plants, nuclear power plants are capable of gradual load-following. In fact, in France where nuclear is responsible for 70% of electricity generation, load-following is commonplace. Having said this, new designs, including Small Modular Reactors

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[18] https://www.nei.org/advocacy/preserve-nuclear-plants/second-license-renewal ; https://news.dominionenergy.com/2020-09-04-Dominion-Energy-Announces-Nuclear-License-Renewal-Application-for-North-Anna-Power-Station-Supports-Dominion-Energys-Net-Zero-Commitment ; https://www.neimagazine.com/news/newsus-turkey-point-licensed-to-operate-for-80-years-7551852

[19] *Projected Costs of Generating Electricity, IEA*, NEA, OECD, December 2020. https://www.iea.org/reports/projected-costs-of-generating-electricity-2020

(SMRs) or reactors with thermal storage, will be able to respond even more rapidly to changes in load—a feature complementing renewables.[20] As confirmed by previously cited analysis, nuclear power allows for system-level optimization, whereby all carbon-free assets, including renewables, are able to function most effectively in the roles to which they are best suited.

In addition to the above benefits, the high energy density and capacity factor of nuclear gives it a small ecological footprint, which translates to less land, concrete, steel, and other materials per watt-hour than any other carbon-free source.[21] Nuclear power—unlike fossil fuel combustion—also has an extremely small waste stream which it contains instead of dumping into the atmosphere. Furthermore, nuclear waste can be recycled, either through reprocessing, like France has done for years, or as fuel in next-generation reactors. Significantly, air pollution caused by fossil fuel combustion contributes to eight million deaths globally each year.[22] Yet over the entire lifetime of commercial nuclear power, stored nuclear waste has harmed no one. Statistically, nuclear power is remarkably safe, on par with renewables and far safer than fossil fuels based on an objective assessment of all forms of energy by Oxford.[23] By displacing fossil fuels, nuclear power saves lives.[24]

Finally, it should be noted that nuclear energy has beneficial applications beyond power generation, including applications that further contribute to greenhouse gas reduction. Fuel is a relatively small contributor to the cost of nuclear power. Therefore, running plants at capacity can be an economical method of providing energy (electricity and/or heat) for other processes when not needed to supply baseload electricity for the grid. For example, using surplus electricity and/or heat from a nuclear reactor, hydrogen can be produced in a manner that is truly

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[20] Examples of these are NuScale's Small Modular Reactor, which has received NRC design approval, https://www.nuscalepower.com , and TerraPower's sodium-cooled Natrium reactor with thermal storage, currently under development, https://natriumpower.com .

[21] https://nca2014.globalchange.gov/sites/report/files/images/web-large/Figure-10.6-hi.jpg ; https://www.brightnewworld.org/media/2021/1/27/materials-use-project ; https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions

[22] https://www.seas.harvard.edu/news/2021/02/deaths-fossil-fuel-emissions-higher-previously-thought

[23] *What are the Safest and Cleanest Sources of Energy*, Our World in Data, Oxford Martin Programme on Global Development, February 2020. https://ourworldindata.org/safest-sources-of-energy

[24] P. Kharecha, J. Hansen, *Prevented Mortality and Greenhouse Gas Emissions from Historical and Projected Nuclear Power*, NASA Goddard Institute for Space Studies and Columbia University Earth Institute, Environmental Science & Technology, 2013. https://pubs.acs.org/doi/pdf/10.1021/es3051197

scalable.[25] Similarly, nuclear power can be used to produce non-fossil synthetic hydrocarbons at scale that have a net-zero carbon footprint, thus making the ultimate goal of economy-wide decarbonization much more feasible.[26]

Importantly, the United Nations Intergovernmental Panel on Climate Change (IPCC) includes nuclear in every viable pathway that limits global warming to 1.5° Celsius.[27] This is underscored in a recent article and technology brief by the United Nations Economic Commission for Europe, *Global Climate Objectives Fall Short Without Nuclear Power in the Mix.*[28] With respect to cost, building a new reactor in the United States is comparable to offshore wind per watt-hour, but without the additional burden of excessive storage or transmission.[29] With respect to the pace of deployment, France and Sweden successfully decarbonized their grids using nuclear power in a little over a decade.[30]

Recognizing that it was at risk of losing a third of its carbon-free electricity if two nuclear plants closed, the state of Illinois very recently included support for nuclear power within a climate plan which also increases support for renewables and calls for the reduction of fossil fuels.[31] **New York should have courage to do the same by establishing long-term support for nuclear power—existing plants as well as new ones—within its zero-emissions program.**

Nuclear power is proven technology. Unlike with intermittent renewables or several proposed 'firm' solutions that present genuine technical challenges to large-scale deployment,

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[25] https://www.fchea.org/in-transition/2020/5/11/using-nuclear-power-to-produce-green-hydrogen ; https://www.yahoo.com/now/why-hydrogen-needs-nuclear-power-220000655.html ; https://www.energy.gov/ne/articles/could-hydrogen-help-save-nuclear
A hydrogen demonstration project is also underway at Exelon's Nine Mile Point nuclear plant: https://www.ans.org/news/article-3180/nine-mile-point-picked-for-hydrogen-demonstration-project/

[26] Forsberg, Nuclear hydrogen for Production of Liquid Hydrocarbon Transport Fuel, Oak Ridge Laboratory, Nov 2005. https://technicalreports.ornl.gov/cppr/y2001/pres/124286.pdf . Similar concepts are being explored by the U.S. Navy for the production of jet fuel aboard nuclear-powered aircraft carriers.

[27] *Special Report: Global Warming of 1.5 C*, IPCC, Figure SPM.3B. https://www.ipcc.ch/sr15/chapter/spm/spm-c/spm3b/

[28] *Global Climate Objectives Fall Short Without Nuclear Power in the Mix: UNECE*, United Nations—UN News. August 11, 2021. https://news.un.org/en/story/2021/08/1097572 ; UNECE technology brief: https://unece.org/sites/default/files/2021-08/Nuclear%20power%20brief_EN_0.pdf

[29] https://www.lazard.com/perspective/levelized-cost-of-energy-levelized-cost-of-storage-and-levelized-cost-of-hydrogen/

[30] https://environmentalprogress.org/big-news/2017/11/7/the-power-to-decarbonize

[31] https://www.washingtonexaminer.com/policy/energy/illinois-legislature-saves-at-risk-nuclear-plants

the barriers to nuclear power relate only to politics and perception. If New York hopes to meet its climate goals, it will need to rise above those.

VI. WHAT DOES FAILURE LOOK LIKE?

It is important that New York learn from mistakes that have been made elsewhere. California is perhaps a decade ahead of New York in terms of renewable deployment. The state has managed to increase non-hydro renewables to about a third of in-state electricity generation, but in doing so has solidified its dependence on fossil gas to compensate for frequent periods when intermittent supply cannot meet demand. It has also introduced system-wide inefficiency, for example by relying on backup generation from simple-cycle plants that respond rapidly to renewable intermittency but burn more gas per kWh; by running plants in "hot standby" (burning gas even when not making electricity); and by increasingly curtailing ("dumping") electricity from intermittent sources during periods of excess supply.[32] Running a grid this way may help achieve "renewable" quotas, but it does little to reduce greenhouse gas emissions.

Due in part to the premature closure of its San Onofre nuclear plant, California still relies on fossil fuels for nearly half of its in-state electricity generation, a proportion that has changed little over the past two decades.[33] Losing nuclear has also made the state more vulnerable to uncertain supplies. In an attempt to avoid rolling blackouts—like those that occurred last year when electricity imports were unavailable—California recently authorized construction of five new gas-burning power plants, and has even requested permission from federal regulators to violate limits on air pollution.[34] Meanwhile, fires and drought continue to threaten the state's fragile grid as electricity rates skyrocket. If California follows through on plans to prematurely shut down its remaining nuclear plant at Diablo Canyon, matters will likely become even worse.[35]

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[32] California's curtailments of solar electricity generation continue to increase - Today in Energy - U.S. Energy Information Administration (EIA)

[33] California Energy Commission, record of electrical energy generation 2001-present: https://www.energy.ca.gov/media/4001; https://www.energy.ca.gov/sites/default/files/2020-06/California_Electrical_Energy_Generation_2001-Current_ADA.xlsx

[34] California Approves 5 Temporary Gas Plants as Drought Cripples Hydropower (gizmodo.com) ; https://www.yahoo.com/news/record-heat-approaches-dust-bowl-155627220.html

[35] Battle Brewing About California's Role in Diablo Canyon Nuclear Plant Retirement (powermag.com)

Although California is far from attaining a carbon-free grid, it is already encountering serious system-level problems by unduly focusing on intermittent generation. Furthermore, research indicates that electric rates could jump another 65% if the state continues to pursue a strategy involving the buildout of excessive renewable capacity.[36]

Having said this, the challenges facing New York, should it decide to follow in California's footsteps, are even more daunting. Photovoltaic solar in New York has an annual capacity factor of only 14% (and nearly zero in the winter), making it half as effective as in sunny California. This not only doubles the number of solar panels needed to produce the same amount of energy; it also narrows the window during which that electricity is available, compounding problems of storage. Similarly, NYISO's CLCPA analysis reveals that land-based wind would need to supply a large portion of New York's electricity—despite the fact it is one of most unpopular forms of renewable energy. If deployed at scales approaching the many thousands of turbines identified in its NYISO model, land-based wind could severely damage the ecological integrity and scenic value of the state.

Importantly, the Commission should recognize that we are not California. Unlike some western states, New York does not possess large swaths of dry brown desert that the public might otherwise consider disposable. Blanketing the state with wind turbines and solar panels would consume green rolling hills, forests, mountain tops, and agricultural land, fragmenting ecosystems and causing more New Yorkers to see red, emotionally and politically.[37] Indeed, this is already occurring as a growing number of upstate communities react to New York's new accelerated siting law. Promoted by former Governor Cuomo, the new 94-C permitting process seeks to fast-track industrial wind and solar projects, sidestep local rules, limit public input, and skirt proper environmental review. Various towns and wildlife conservation organizations are already legally challenging the new process and related projects.

So, one might ask what failure looks like in New York. Initially, it looks like the persistence of new or existing gas-fired power plants to "partner" with wind and solar as seen in California. Perhaps these will be justified as "temporary." Perhaps they will be deemed insignificant based on a belief or a claim that they will be needed just a few days out of the year. However, as the logistic and financial realities associated with widespread deployment of wind

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[36] Long, Baike, Jenkins, et al. *California needs clean firm power, and so does the rest of the world.*

[37] https://www.manhattan-institute.org/html/green-new-deal-isnt-green

and solar become apparent, as the technical barrier of intermittency limit their penetration, and as opposition to industrial wind and solar across the state mounts, those "few days" of burning gas will become *most of the time*. There is little doubt that the fossil fuel industry knows what the failure of energy policy in New York looks like. Recently built and newly proposed gas projects currently under review suggest that they are banking on it.

In many ways, California is a poster child for how to squander resources, make electricity expensive, and accomplish little on climate change. If New York expects a different outcome, it must learn from those mistakes rather than repeat them.

VII. GOOD JOBS FOR A CARBON-FREE GRID

Petitioners emphasize that a zero-emissions energy systems program for the state should include well-paying jobs and labor provisions that will "promote successful project delivery and facilitate a just transition for the energy workforce." We agree and would add that the nuclear power industry in New York already exemplifies this.

Notably, nuclear plant workers have the highest quality, best paying jobs in the power sector, on average earning 50% more than those employed by other forms of electricity generation. Typically, a nuclear power plant creates $40 million in labor income annually and employs between 500 and 800 workers.[38] The Ginna and Fitzpatrick plants employ 600 workers each and Nine Mile Point employs over 900. Sitting on only 240 acres, recently shuttered Indian Point—which generated 2,000 MW of reliable power at a capacity factor of 93%--provided quality jobs to over 1,000 people. Furthermore, among all energy sources, nuclear power plants have the highest levels of labor union membership.

By comparison, wind and solar farms may offer temporary, often low-skilled, construction work for out-of-state contractors, but tend to create few permanent jobs. The proposed 30,000-acre Alley-Catt wind farm in Cattaraugus, NY is expected to generate only 13 permanent jobs. The 180 MW North Side Energy project in Massena, NY will consume 1,600 acres and create just three or four jobs. Reputed to be the largest solar farm in the world, the 550 MW Topaz installation in California occupies 9.5 square miles of land, yet provides only 14 permanent jobs.

[38] https://www.nei.org/advantages/jobs

Significantly, the International Brotherhood of Electrical Workers (IBEW) represents more than 15,000 workers at over two-thirds of nuclear plants in North America. IBEW also operates the National Utility Industry Training Fund (NUITF), a training and apprenticeship program for new employees.[39] Petitioners' request for zero-emission system operators to comply with provisions of PSL Section 66-r and Section 224-d of state Labor Law, and to utilize registered apprenticeship programs is consistent with IBEW objectives, will help to ensure the successful delivery of projects, and facilitate a just transition as required by the CLCPA. We also support IBEW's position regarding the importance of nuclear power, including the deployment of new reactors, as crucial to deep decarbonization and the provision of abundant, reliable electricity essential to a vibrant economy.[40] In a recent joint statement titled *Nuclear Energy Ensures Clean Energy Jobs for Working Americans*, IBEW President Lonnie Stephenson and Steven Nesbit of the American Nuclear Society wrote:

> America's electric utility workers and nuclear engineers are ready to work together to help rapidly decarbonize and electrify the economy…However, climate change requires we do more than preserve existing reactors and correct market flaws, we must expand nuclear energy as well…Any attempt at decarbonizing America's power grid by 2035 and our economy by 2050 using renewables alone would require the development of massive amounts of land for hosting solar panels and wind turbines…The redevelopment of fossil fuels into energy-dense advanced reactors or SMRs would help prevent up to 200 million acres across the U.S. – or twice the size of California – from unnecessary development…Factory-built, prefabricated SMRs can come online faster to supplement renewables than any other dispatchable clean energy source…
>
> By siting reactors at shuttered power plants, the Biden administration can make smart use of the existing power grid to meet the future clean energy needs of

[39] https://dailyenergyinsider.com/news/7614-one-third-nuclear-energy-industry-workers-affiliated-labor-unions-survey-finds

[40] L. Stephenson and S. Nesbit, *Nuclear Energy Ensures Clean Energy Jobs for Working Americans*, September 1, 2021 http://www.ibew.org/media-center/Articles/21Daily/2109/210901_ANS_IBEW_OpEd

> America's heartland and cities. This includes supplying electricity for charging the growing fleet of electric vehicles and industrial process heat for manufacturing hydrogen, fuels, fertilizers, steel, plastics and other chemicals. The redevelopment of fossil fuel [power plants] into nuclear plants would tap into the power industry's existing networks and supply chains to recruit, train and provide a qualified workforce for nuclear projects…In a decarbonizing economy, nuclear energy offers a new career path for the U.S. electric power generation sector's 210,000 fossil fuel workers…Employment in the nuclear energy industry means higher earnings, decades-long job security and a pathway to the middle class.

VIII. CONCLUSION

We want New York to succeed in its efforts to combat climate change, and therefore support the establishment of a zero-emissions program under the state Clean Energy Standard. The Independent Power Producers of New York, the New York State Building and Construction Trades Council, and the New York State AFL-CIO correctly identify the provision of 'firm' carbon-free generation as essential to meeting the CLCPA's mandate of grid decarbonization by 2040. Citing relevant sources, Petitioners legitimately contend that inaction by the Commission to advance solutions not strictly defined as "renewable" threatens the realization of CLCPA goals. We assert, however, that successfully meeting CLCPA goals will also require special focus on zero-emission generators that are capable of contributing ample, reliable electricity to the state's grid, and which are not inextricably tied to strategies that rely on an unrealistic deployment of intermittent sources or serve merely as "backup" to those sources. We urge the Commission to incorporate long-term support for New York's existing nuclear power plants and incentives for new reactors, including those utilizing advanced technology, as integral components of a robust zero-emissions energy systems program.

Dated: September 17, 2021

Respectfully submitted by the following parties to this proceeding,

Dietmar Detering

Dietmar Detering, PhD

Dennis Higgins

Dennis Higgins

William Kish

William Kish

Leonard Rodberg

Leonard Rodberg, PhD

Keith Schue

Keith Schue

Isuru Seneviratne

Isuru Seneviratne

Herschel Specter

Herschel Specter

STATE OF NEW YORK
PUBLIC SERVICE COMMISSION

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

COMMENTS FROM PARTIES RELATING TO RECOMMENDATIONS BY JOINT UTILITIES AND THE NEW YORK INDEPENDENT SYSTEM OPERATOR FOR A TECHNICAL CONFERENCE IN RESPONSE TO THE PETITION OF INDEPENDENT POWER PRODUCERS OF NEW YORK, INC., NEW YORK STATE BUILDING AND CONSTRUCTION TRADES COUNCIL AND NEW YORK STATE AFL-CIO RELATING TO THE ESTABLISHMENT OF A ZERO EMISSIONS ENERGY SYSTEMS PROGRAM UNDER THE CLEAN ENERGY STANDARD

I. INTRODUCTION

The undersigned parties respectfully submit these comments relating to recommendations by Joint Utilities and the New York Independent System Operator (NYISO) for a technical conference hosted by Department of Public Service (DPS) staff to consider issues raised by Independent Power Producers of New York, the New York State Building and Construction Trades Council, and the New York State AFL-CIO ("Petitioners") in a petition requesting the creation of a zero-emissions energy systems program under the Clean Energy Standard. This follows our initial response to said petition on September 20, 2021.[1] The purpose of these additional comments is to support the organizing of a technical conference, and to further identify and discuss critical performance attributes necessary for zero-emissions technologies to realistically achieve the state's goal of decarbonizing New York's electricity sector.

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[1] Case 15-E-0302; Detering, et al., *Response to Petition of Independent Power Producers of New York, Inc., New York State Building and Construction Trades Council and New York State AFL-CIO Relating to the Establishment of a Zero Emissions Energy Systems Program Under the Clean Energy Standard*, dated September 17, 2021, refiled with correction on September 20, 2021.
https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7BA0ADE7FC-5CCC-485A-96E3-06300E6C2A90%7D

II. VALUE OF A TECHNICAL CONFERENCE

On August 18, 2021, Petitioners filed a request in this proceeding that the Public Service Commission ("Commission") establish a new program to secure the development of at least 1 GW of zero-emission generation capacity from sources not defined as "renewable" by the Climate Leadership and Community Protection Act (CLCPA). Petitioners argued that while the Commission has modified the state's Clean Energy Standard with policies and mandates in support of the CLCPA's 70% by 2030 target for electricity from "renewables", it has taken no action to meet the Act's broader goal of carbon-free electricity by 2040. Further, Petitioners identified important analyses performed by NYISO, as well as the state's own consultant E3, which demonstrate that substantial "firm" flexible and dispatchable zero-emission capacity will be needed to ensure reliability if intermittent renewables such as wind and solar comprise a significant portion of the state's energy portfolio.

Various testimony and comments were subsequently filed by parties and members of the public representing industry and labor in support of Petitioners' request. Comments were also submitted by several parties and non-party entities objecting to the petition, which included a letter urging the Governor to inappropriately intervene in this proceeding by directing the Commission to deny it.[2] Our response, filed as parties, offered qualified support of the petition, while emphasizing the system-level value of firm carbon-free generation that can function not simply as backup to a massive deployment of intermittent sources, but as a reliable and versatile source of energy over a range of operating conditions.

It should be noted that we actually agree with several concerns raised by petition objectors. For example, in its filing dated November 15, 2021, National Resources Defense Council (NRDC) discusses problems associated with the efficacy and scalability of technologies such as biomethane and Carbon Capture, Utilization, and Storage (CCUS).[3] We express similar concerns in our previously filed comments. Nonetheless, we reject the notion that any action in pursuit of firm carbon-free sources of electricity is "premature" or otherwise ill-advised,

[2] Letter dated September 24, 2021 to Governor Hochul from Sierra Club, et al.; filed as a record in the Case 15-E-0302 proceeding on October 1, 2021.

[3] Case 15-E-0302, National Resources Defense Council, *Response of Natural Resources Defense Council to the Petition of Independent Power Producers of New York, Inc., New York State Building and Construction Trades Council and New York State AFL-CIO for the Establishment of a "Zero Emissions" Energy Systems Program Under the Clean Energy Standard,* November 15, 2021.

especially considering that building such technologies at scale cannot occur overnight. According to NYISO, New York may require more than 30 GW of additional firm carbon-free generation capacity by 2040.[4] Indeed, in light of this, a program aimed at merely demonstrating 1 GW of capacity by 2030 may be too small.

While NRDC acknowledges that firm generation capacity will likely be necessary in the future, others do not. In their letter to the Governor, various objectors concede that multi-day and seasonal storage is not available, yet incongruently suggest that because the 2030 mandate of 70% electricity from renewable sources is a *minimum* requirement, consideration of non-renewable generation is simply not needed. We respectfully submit that proverbially sticking one's head in the sand is not a solution. If state policy-makers acquiesce to a mythos that New York can satisfy a growing demand for electricity with renewables alone, choose to ignore credible analysis from NYISO—whose job it is to ensure reliability—and consequently fail to address the substantial need for firm carbon-free capacity in the not-too-distant future, there can be only one outcome: failure of the state to meet its climate goals and the persistence of carbon-intensive fossil fuel combustion far into the future.

As discussed in out prior testimony, California serves as a warning of what New York can expect if it pursues a narrow, ideologically-driven energy policy that puts inordinate focus on intermittent sources, ignores the practical realities of grid operation, and neglects the importance of reliable carbon-free capacity. Despite a tremendous investment in renewables, following closure of its San Onofre nuclear plant, California is burning about as much gas for electricity as it did a decade ago while ratepayers suffer with an unstable grid and high electric bills. To restore reliability, the state is now having to build more gas-fired power plants and obtain air quality waivers from the federal government to run them.[5] Germany faces a similar dilemma where an ideologically-driven closure of nuclear plants will cause a billion tons of unnecessary emissions to enter the atmosphere.[6] Throughout the country, opposition is growing to a

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

[5] *California Wants Air Pollution Rules Suspended to Burn More Natural Gas*, Bloomberg, in WorldOil Magazine, September 9, 2021. https://www.worldoil.com/news/2021/9/10/california-wants-air-pollution-rules-suspended-to-burn-more-natural-gas

[6] Partanen, et al. *One Billion Tons: CO2 Reductions and a Faster Coal Exit in Germany*, Think Atom Ltd., Oekomoderne. https://www.onebilliontons.org/

proliferation of wind and solar farms that, coupled with the loss of nuclear, has made electricity rates skyrocket, prolonged coal-fired power plants and mining, and rendered the country increasingly dependent on Russian gas.[7] Sadly, whether deploying any more renewables can help reduce Germany's domestic consumption of fossil fuels will depend largely on the extent to which neighboring European countries can compensate with firm generation, carbon-free or not.

On November 15, 2021, Joint Utilities filed a letter in this proceeding with the recommendation that DPS staff convene a technical conference to consider issues raised by Petitioners.[8] This was followed by comments from NYISO on November 18, 2021 in support of that proposal.[9] Respecting the value of this evidence-based proceeding and the importance of crafting a plan that can succeed, we find the concept of a technical conference to be a prudent recommendation.

We also agree with Petitioners, Joint Utilities, and NYISO that focus of the proposed technical conference should be on dispatchable and flexible generators of carbon-free electricity. However, we wish to emphasize that flexibility must include the ability of firm carbon-free sources to ensure that New York can meet its climate and energy goals over a range of scenarios reflecting real-world conditions.

In its Phase II Climate Change and Resiliency Study, NYISO found that a plan which is based predominantly on low-energy-density intermittent renewables would require a herculean buildout of industrial wind farms, solar farms, battery storage facilities, and transmission networks across New York at a scale that is globally unprecedented. Indeed, due to intermittency and the inherently-low capacity factor of wind and solar, New York would need to deploy

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[7] Thalman, Wehrmann, *What German Households Pay for Power*, Clean Energy Wire, October 15, 2021. https://www.cleanenergywire.org/factsheets/what-german-households-pay-power ; Bellamy, *Environmentalists in Dismay as Europe's Newest Coal-Powered Plant Opens in Germany*, Euronews, May 30, 2020. https://www.euronews.com/2020/05/30/environmentalists-in-dismay-as-europe-s-newest-coal-powered-plant-opens-in-germany ; Appunn, *Coal in Germany*, Clean Energy Wire, February 7, 2019. https://www.cleanenergywire.org/factsheets/coal-germany ; Kramer, *Putin Suggests Germany Approve Nord Stream 2 to Solve Energy Crisis*, New York Times, October 13, 2021, updated November 3, 2021. https://www.nytimes.com/2021/10/13/business/energy-environment/putin-nord-stream-germany.html

[8] Case 15-E-0302, National Grid, et al., *Joint Utilities' Response to Petition for Zero-Emissions Energy Resource Program*, November 15, 2021.

[9] Case 15-E-0302, New York Independent System Operator, *Comments of the New York Independent System Operator, Inc. on Petition of Independent Power Producers of New York, Inc., New York State Building and Construction Trades Council and New York State AFL-CIO for the Establishment of a Zero Emissions Energy Systems Program Under the Clean Energy Standard*, November 18, 2021.

163,000 MW of total carbon-free generation capacity by 2040, compared to less than 14,000 MW of carbon-free capacity and 41,000 MW of total capacity in the state today. As discussed in our prior comments and extrapolating from NYISO's analysis, to accomplish this New York would have to double its plans for offshore wind, install hundreds of land-based wind turbines annually, convert many square miles of farmland and forest into industrial solar facilities each year until 2040, and build a hundred times more storage than available at California's Moss Landing facility (the largest battery in the world).[10] These environmental and material challenges are deepened by the difficulty of delivering electricity from widely distributed, low-energy-density sources to demand centers.[11]

There is no doubt that New York will deploy more renewables in the future. However, based on any credible evaluation of logistics, manpower, supply chains, or cost, it should be intuitively obvious that attaining the mammoth levels of installed renewable capacity and storage described above is probably not feasible. Moreover, hinging the prospect of New York achieving its climate and energy goals on such an implausible, high-risk scenario would be profoundly irresponsible. Respectfully, if New York is serious about realistically decarbonizing its grid while simultaneously electrifying other sectors essential to meeting greenhouse gas reduction goals, **it should invest in generators of firm carbon-free electricity that can perform whether future levels of renewable capacity require that they be dispatched occasionally or a lot.**

As discussed in prior comments, several of the sources contemplated by Petitioners, including biogas, biomass, and CCUS are materially constrained by their fuel source or volume of emissions requiring sequestration. If the buildout of renewables and storage does not occur at

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[10] NYISO Phase II study (previously cited) https://www.nyiso.com/documents/20142/16884550/NYISO-Climate-Impact-Study-Phase-2-Report.pdf ;
The New York State Energy Research and Development Authority (NYSERDA) has also estimated quantities of generation and storage necessary to meet CLCPA goals as part of an "Integration Analysis" for the NYS Climate Action Council. https://climate.ny.gov/Climate-Resources
Although NYSERDA's estimates of wind, solar, storage, and dispatchable carbon-free generation are also formidable, the analysis by NYSERDA differs from that of NYISO in several ways. In an effort to reconcile the two methodologies, New York Energy & Climate Advocates submitted a letter to NYSERDA staff (Carl Mas) on October 14, 2021 questioning several aspects of its analysis (also filed as a document in this proceeding). As of the date of these comments, a response has not been received.

[11] This can be seen NYISO's analysis of low transmission security margins for New York City through 2031. *2021-2030 Comprehensive Reliability Plan*, NYISO, Draft Report, November 17, 2021. (See page 7.) https://www.nyiso.com/documents/20142/26119798/06_DraftReport.pdf/

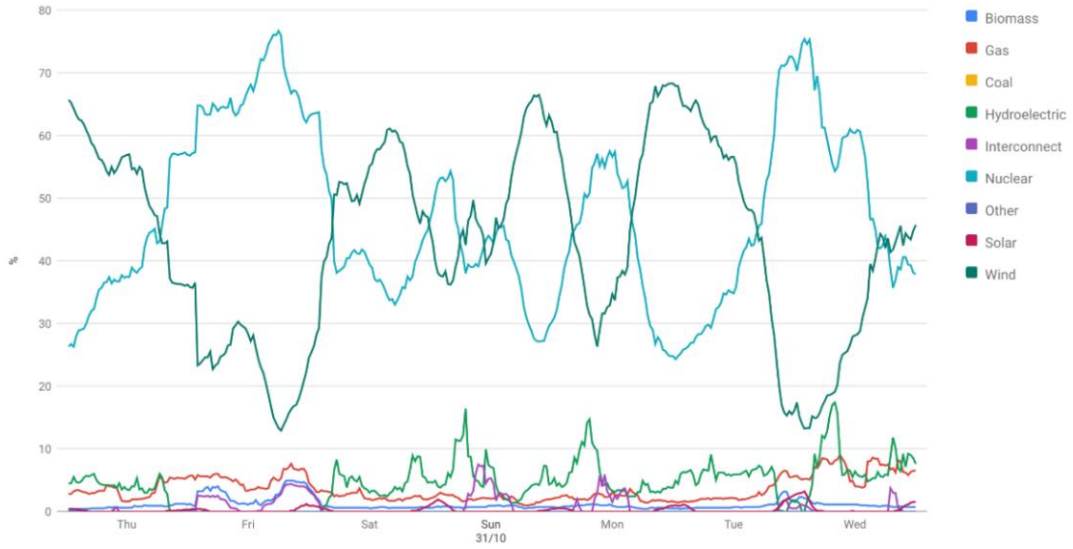
levels comparable to those previously discussed, such sources will not be able to meet demand over time *even if* a full 30 GW of firm carbon-free capacity is installed. Likewise, dispatching generators that consume hydrogen produced with electricity from renewables would require even more renewables, thereby compounding any shortfall of installed wind or solar capacity.

Nuclear power, on the other hand, is a versatile source of firm carbon-free electricity that can meet demand whenever needed, whether that is 5% of the time, 50% of the time, or all of the time (as occurs today for baseload generation). This makes it a valuable safeguard against New York failing to meet its climate goals when an unrealistic buildout of renewable capacity and storage does not materialize. Equally important, however, by integrating additional nuclear power into the ***backbone*** of New York's energy system so that it serves a meaningful portion of demand—instead of only providing ***back-up*** to intermittent sources—the state can ensure reliability while providing for a much less wasteful, more efficient, and more affordable system-wide allocation of generation capacity, storage, and transmission infrastructure. At the same time, this would help to facilitate a successful buildout of renewables that is realistic, ecologically responsible, and welcomed by the communities hosting them.

Of course, any type of installed capacity becomes more economical with use. When not needed to power the grid, nuclear energy (power and heat) can further contribute to greenhouse gas reduction by charging storage systems, creating process heat for industry, or producing hydrogen and other synthetic fuels for transportation, industry, or peak generation.[12] However, nuclear power is also dispatchable, capable of adjusting its output in response to demand similar to other thermal facilities. The chart below illustrates a week of operation for the electric grid serving this year's COP26 climate conference in Glasgow. As seen, the South Scotland grid is 90% carbon-free, relying predominantly on wind and nuclear power which complement each other extremely well. Load-following is also commonplace in France, where nuclear is responsible for 70% of electricity generation.

[12] Using the Fischer-Tropsch process, electricity and heat from nuclear power can produce non-fossil synthetic hydrocarbons with a net-zero carbon footprint, thereby avoiding various problems associated with using hydrogen gas as fuel. https://technicalreports.ornl.gov/cppr/y2001/pres/124286.pdf

South Scotland Grid: October 31, 2021
https://electricityproduction.uk/in/south-scotland/



While existing nuclear reactors are capable of gradual load following, advanced nuclear designs will be able to respond even more rapidly to changes in load. Examples of this include NuScale's Small Modular Reactor (SMR), which has received design approval from the Nuclear Regulatory Commission, and TerraPower's sodium-cooled Natrium reactor with thermal storage, currently being developed at the site of a former coal plant in Wyoming.[13] **Significantly, a plan which includes both renewables *and* nuclear power promotes s*ystem-level* efficiency, whereby all carbon-free assets are able to function most effectively in the roles to which they are best suited.[14]**

Over the past several months—at the United Nations Climate Conference in Glasgow; within countries like France and Great Britain that are making nuclear power a centerpiece of their energy plans; through bipartisan action taken to preserve the Dresden and Byron plants in Illinois; and through policy of the Biden administration in Washington—awareness is growing that nuclear power, existing and advanced, will be essential to fighting climate change while meeting energy needs of a global economy. In fact, in a recent COP 26 interview, U.S. Secretary of Energy Jennifer Granholm highlighted this enthusiasm for nuclear power, saying:

[13]See https://nuscale.com/ ; https://natriumpower.com/

[14] It is worth noting that when accompanied by modest amounts of storage, even larger nuclear plants can help to support rapid changes in load. By ensuring the availability of firm capacity to charge batteries, the combination of nuclear power and storage can enhance reliability by effectively eliminating periods of depleted storage (such as winter wind lulls) that otherwise occur in a scenario relying predominantly on intermittent renewables.

> *We are very bullish on these advanced nuclear reactors... These advanced nuclear reactors, and the existing fleet, are safe. We have the gold standard of regulation in the United States… The holy grail is to identify clean, baseload power. ... Nuclear is dispatchable, clean baseload power, so we want to be able to bring more on.*[15]

Today's renaissance toward reliable nuclear power is further reflected within infrastructure legislation that has been enacted and proposed this year with support of Democrats in Congress. Similarly, recent analysis by the U.N. Economic Commission for Europe confirms that nuclear power has the lowest carbon footprint per watt-hour of any energy source, including wind and solar, as well as the lowest lifecycle land use, mineral, and metal requirements of carbon-free technologies.[16]

The recommendation by Joint Utilities and NYISO that a technical conference be convened by DPS staff is timely in light of plans by the state Climate Action Council to complete an initial scoping plan in 2022. Further, it is apparent that the Council and its various working groups lack necessary technical expertise to address complex aspects of grid dynamics which will be key to designing a system that is efficient, carbon-free, and reliable. While nuclear power provides the largest amount of non-hydro carbon-free electricity in the state, representation of the nuclear industry has been conspicuously absent from the Council and its working groups. The proposed technical conference can help to rectify these deficiencies.

For years, nuclear power has played a vital role in supplying reliable electricity to New Yorkers and limiting greenhouse gas emissions from the electric sector. Moving forward, dispatchable and flexible advanced nuclear technology, along with renewables, will be essential to meet the state's aggressive climate goals and maintain reliability in the future as well. New York has an opportunity to learn from energy missteps elsewhere and position itself as a leader in firm carbon-free generation. Therefore, a technical conference in which opportunities are discussed is appropriate.

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[15] https://uk.finance.yahoo.com/video/energy-secretary-jennifer-granholm-says-101700201.html

[16] https://www.cityam.com/un-crowns-nuclear-as-lowest-carbon-electricity-source/ ; https://energyindustryreview.com/power/unece-nuclear-is-the-lowest-carbon-electricity-source/ ; full report: https://unece.org/sed/documents/2021/10/reports/life-cycle-assessment-electricity-generation-options ; see also https://medium.com/generation-atomic/will-surprising-un-findings-reignite-optimism-for-nuclear-power-d0b9d84a5bf7

III. CONCLUSION

The undersigned parties respectfully request that the Commission consider these comments. We support the recommendation by Joint Utilities and NYISO for a technical conference to consider issues raised by Petitioners and discussed herein.

Dated: December 8, 2021

Respectfully submitted,

/s/ Leonard Rodberg
Leonard Rodberg, PhD
on behalf of New York Energy & Climate Advocates
lensqc@infoshare.org
(917) 601-0186

/s/ Dietmar Detering
Dietmar Detering, PhD
on behalf of Nuclear New York
info@nuclearny.org
(917) 251-2235

/s/ Johanna Fallert
Johanna Fallert
jcfallert@gmail.com

/s/ Dennis Higgins
Dennis Higgins
higgindm@gmail.com

/s/ William Kish
William Kish
kish@browncow.com

/s/ Keith Schue
Keith Schue
keithschue@gmail.com

/s/ Isuru Seneviratne
Isuru Seneviratne
isuru@radiantval.com

/s/ Herschel Specter
Herschel Specter
mhspecter@verizon.net

New York Energy and Climate Advocates
310 W. 86th St. #6B, New York, NY 10024

December 9, 2021 VIA Electronic Mail to rohden@nyassembly.gov

Noah Rohde, Analyst
Assembly Committee on Environmental Conservation
Room 520 – Capitol
Albany, New York 12248

RE: Comments on Climate Change Expenditures by State Entities

Dear Mr. Rohde,

Our organization recently had the opportunity to review the recorded hearing on climate change expenditures by state entities that occurred on November 29, 2021 before the Assembly Committee on Environmental Conservation. It is also our understanding that the Assembly committee is accepting public comment on the subject through December 9th. We therefore thank you for accepting the following as part of the public record.

During the November 29th hearing, an assemblyman asked what resources the New York State Energy Research and Development Authority (NYSERDA) is committing to the development of advanced nuclear power. To our disappointment, the answer given was that the agency so far is doing nothing, instead waiting to see what might occur at the federal level. Respectfully, we find this answer to be inconsistent with the spirit of leadership to which New York and New Yorkers aspire.

As seen over the past several months—at the United Nations Climate Conference in Glasgow; within countries like France and Great Britain that are making nuclear power a centerpiece of future energy plans; through bipartisan action taken to protect nuclear plants in Illinois; through the development of next-generation reactors in other states, and through policy of the Biden administration—there is growing awareness that nuclear power, existing and advanced, is essential to fighting climate change while meeting energy needs of a global economy. In fact, in a recent COP 26 interview, U.S. Secretary of Energy Jennifer Granholm highlighted this enthusiasm at the federal level, saying:

> *We are very bullish on these advanced nuclear reactors... These advanced nuclear reactors, and the existing fleet, are safe. We have the gold standard of regulation in the United States… The holy grail is to identify clean, baseload power. ... Nuclear is dispatchable, clean baseload power, so we want to be able to bring more on.*[1]

[1] https://uk.finance.yahoo.com/video/energy-secretary-jennifer-granholm-says-101700201.html

This awakening is further reflected within infrastructure legislation enacted and proposed this year by Congress. Moreover, recent analysis by the U.N. Economic Commission for Europe confirms that nuclear power actually has the lowest carbon footprint per watt-hour of any energy source, including wind and solar, as well as the lowest lifecycle land use, mineral, and metal requirements of carbon-free technologies.[2]

We respectfully assert that, as the state agency charged with research and development of the energy sources New York will need to meet its ambitious climate goals, including full decarbonization of the state's electricity sector, NYSERDA ought to be at the leading edge of efforts to promote advanced nuclear technology—not on the sidelines.

Analyses by NYISO and NYSERDA show that a plan based predominantly on low-energy-density intermittent renewables would require a herculean buildout of industrial wind and solar farms, battery storage facilities, and transmission networks across New York at a scale that is globally unprecedented. The state would have to double its plans for offshore wind, install hundreds of land-based wind turbines annually, convert many square miles of farmland and forest into industrial solar facilities each year for decades, and build a hundred times more storage than available at California's Moss Landing facility (the largest battery in the world).[3] Moreover, even if somehow achieved, firm generation capacity comparable to today's existing fleet of fossil fuel power plants would still be needed to ensure reliability when the weather does not cooperate and storage is depleted.

There is no doubt that New York will deploy more renewables in the future. However, based on any credible evaluation of logistics, manpower, supply chains, or cost, it should be apparent that the mammoth levels of installed renewable capacity and storage contemplated above are unlikely to occur. Moreover, hinging the prospect of New York achieving its climate and energy goals on such an implausible scenario would be irresponsible.

Respectfully, if New York is serious about decarbonizing its grid while simultaneously electrifying other sectors, it should invest in generators of firm carbon-free electricity that can perform whether future levels of renewable capacity require that they be dispatched occasionally, or a lot. Unlike biogas and other potential types of firm generation, nuclear power is not constrained by the availability of fuel. Indeed, nuclear power requires very little fuel to produce a large amount of energy. It is a versatile, carbon-free energy source that can meet demand whenever needed, whether that is 5% of the time, 50% of the time, or all of the time. This makes it a valuable safeguard against

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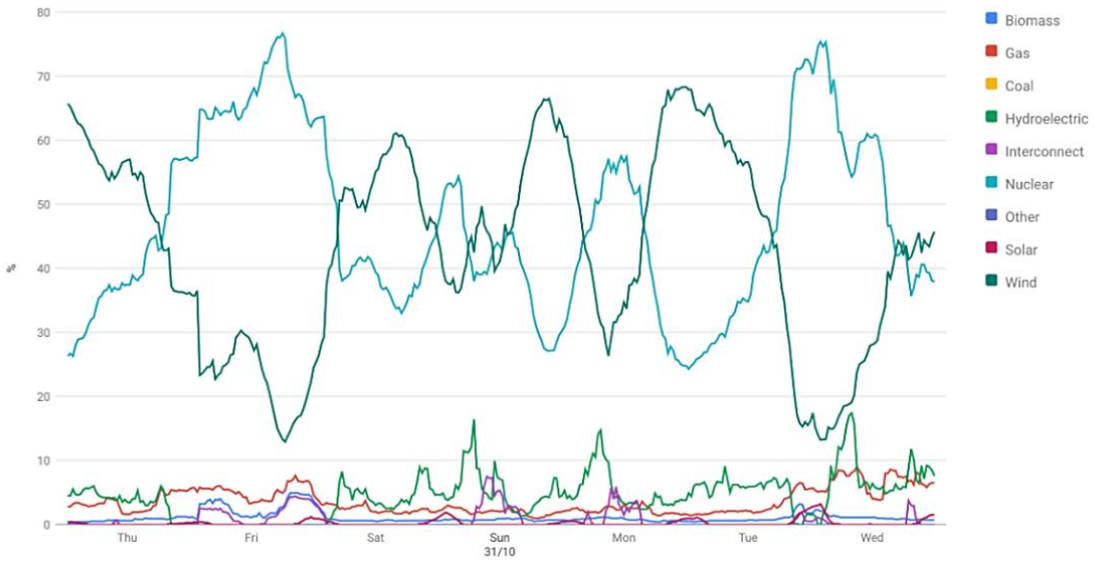
[2] https://www.cityam.com/un-crowns-nuclear-as-lowest-carbon-electricity-source/ ; https://energyindustryreview.com/power/unece-nuclear-is-the-lowest-carbon-electricity-source/ ; full report: https://unece.org/sed/documents/2021/10/reports/life-cycle-assessment-electricity-generation-options ; see also https://medium.com/generation-atomic/will-surprising-un-findings-reignite-optimism-for-nuclear-power-d0b9d84a5bf7

[3] *Climate Change Impact and Resilience Study – Phase II: An Assessment of Climate Change Impacts on Power System Reliability in New York State*, Final Report, Analysis Group for NYISO, September 2020. https://www.nyiso.com/documents/20142/16884550/NYISO-Climate-Impact-Study-Phase-2-Report.pdf
See also initial findings of the "Integration Analysis" by NYSERDA for the NYS Climate Action Council. https://climate.ny.gov/Climate-Resources
Although both NYISO and NYSERDA estimates of wind, solar, storage, and dispatchable carbon-free generation are extensive, they differ in several ways. In an effort to reconcile the two, we submitted a letter to NYSERDA staff on October 14, 2021 requesting answers to several aspects of its analysis. As of the date of these comments, a response has not been received.

New York failing to meet its climate goals when an unrealistic buildout of renewable capacity and storage does not materialize. Equally important, by integrating additional nuclear power into the ***backbone*** of New York's energy system so that it serves a meaningful portion of demand (instead of only providing ***back-up*** to intermittent sources), the state can ensure reliability while providing for a much less wasteful, more efficient, and more affordable system-wide allocation of generation capacity, storage, and transmission infrastructure. This in turn can help to facilitate a level of renewable buildout that is realistic, ecologically responsible, and welcomed by communities.

As seen below, nuclear power plants are able to adjust their output in response to demand similar to other thermal facilities. The South Scotland grid, which powered this year's COP26 conference in Glasgow is 90% carbon-free, thanks to nuclear power which effectively complements wind. Load-following is also commonplace in France, where nuclear is responsible for 70% of electricity generation. However, advanced nuclear designs will be able to respond even more rapidly to changes in load. Examples of this include NuScale's Small Modular Reactor, which has received design approval from the Nuclear Regulatory Commission, and TerraPower's sodium-cooled Natrium reactor with thermal storage, currently being developed at the site of a former coal plant in Wyoming.[4]

South Scotland Grid: October 31, 2021
https://electricityproduction.uk/in/south-scotland/



When not needed to power the grid, nuclear energy (power and heat) can contribute even further to greenhouse gas reduction by charging storage systems, creating process heat for industry, or producing hydrogen and other synthetic fuels for transportation and industry.[5] **Significantly, a plan which includes both renewables *and* nuclear power promotes s*ystem-level* efficiency, whereby all carbon-free assets are able to function most effectively in the roles to which they are best suited.**

[4] https://nuscale.com/ ; https://natriumpower.com/
[5] Using the Fischer-Tropsch process, electricity and heat from nuclear power can produce non-fossil synthetic hydrocarbons with a net-zero carbon footprint, thereby avoiding various problems associated with using hydrogen gas as fuel. https://technicalreports.ornl.gov/cppr/y2001/pres/124286.pdf

For years, nuclear power has played a vital role in supplying reliable electricity to New Yorkers and limiting greenhouse gas emissions from the electric sector. Moving forward, advanced nuclear technology, along with renewables, will be essential to meet the state's aggressive climate goals and maintain reliability in the future as well. New York has a unique opportunity to leader in that effort, so we encourage state agencies devote resources to the task.

Sincerely,

/s/ Leonard Rodberg
Leonard Rodberg, PhD
New York Energy & Climate Advocates
lensqc@infoshare.org
(917) 601-0186

/s/ Keith Schue
Keith Schue, technical advisor
New York Energy & Climate Advocates
keithschue@gmail.com
407-470-9433

New York Energy and Climate Advocates
310 W. 86th St. #6B, New York, NY 10024

December 7, 2021 ***VIA ELECTRONIC MAIL***

The Honorable Michelle L. Phillips
Secretary to the Commission
New York State Public Service Commission
Three Empire State Plaza
Albany, NY 12223

RE: Reconciliation of NYSERDA analysis with CES Proceeding

Dear Secretary Phillips,

On October 14, 2021, New York Energy & Climate Advocates (NYECA) submitted the attached set of questions to the New York State Energy Research and Development Authority (NYSERDA) relating to the agency's analysis of steps necessary to meet goals of the Climate Leadership and Protection Act (CLCPA). Our questions address NYSERDA's evaluation of renewables, storage, and firm carbon-free capacity necessary to meet electricity mandates of the CLCPA, including significant differences between the agency's analysis and modeling performed by the New York Independent System Operator (NYISO) in its *Phase II Climate Change and Resilience Study*—a document which has been referenced by several parties to this proceeding. In our view, both analyses reveal an unrealistic buildout of intermittent, low-energy-density, low-capacity factor sources and related infrastructure that warrants the consideration of alternatives if New York hopes to meet its climate goals. We also recommend better coordination between agencies involved in crafting energy policy and entities charged with maintaining the reliability of New York's electric grid.

We do not find discernable answers to the questions we have posed in our review of information at the Climate Action Council website associated with NYSERDA's analysis, https://climate.ny.gov/Climate-Resources . Nor do we see evidence that an effort has been made to reconcile NYSERDA's analysis with that of NYISO.

Having not received a response from NYSERDA (Carl Mas)[1], and recognizing the direct relevance of our inquiry to purposes of this proceeding, we respectfully submit the attached questions as interrogatories and request that NYSERDA, also a party, provide substantive answers within timeframes required by proceeding rules.

Sincerely,

/s/
Leonard Rodberg, New York Energy and Climate Advocates
lensqc@infoshare.org

[1] NYECA emailed Mr. Mas on three occasions (Oct 14, Oct 26, and Nov 22, 2021). Correspondences available upon request.

New York Energy and Climate Advocates
310 W. 86th St. #6B, New York, NY 10024

October 14, 2021 *(resubmitted Nov 22, 2021)* ***VIA ELECTRONIC MAIL***

Carl Mas
Director, Energy and Environmental Analysis
New York State Energy Research and Development Authority
17 Columbia Circle
Albany, NY 12203-6399

RE: Questions on Initial Results of Integration Analysis, NYSERDA presentation Oct 1, 2021

Dear Mr. Mas,

On October 1, 2021, you presented information on behalf the New York State Energy Research and Development Authority (NYSERDA) to the Climate Action Council (CAC) describing various scenarios for meeting objectives of the Climate Leadership and Community Protection Act (CLCPA). We are also familiar with the Phase 2 Climate Impact and Resilience Study prepared by the New York Independent System Operator (NYISO) earlier this year, which differs from NYSERDA's analysis in several ways. As an organization interested in seeing that New York is successful in meeting its energy and climate goals, and as a party to the Clean Energy Standard proceeding, we request that NYSERDA provide answers to the following questions:

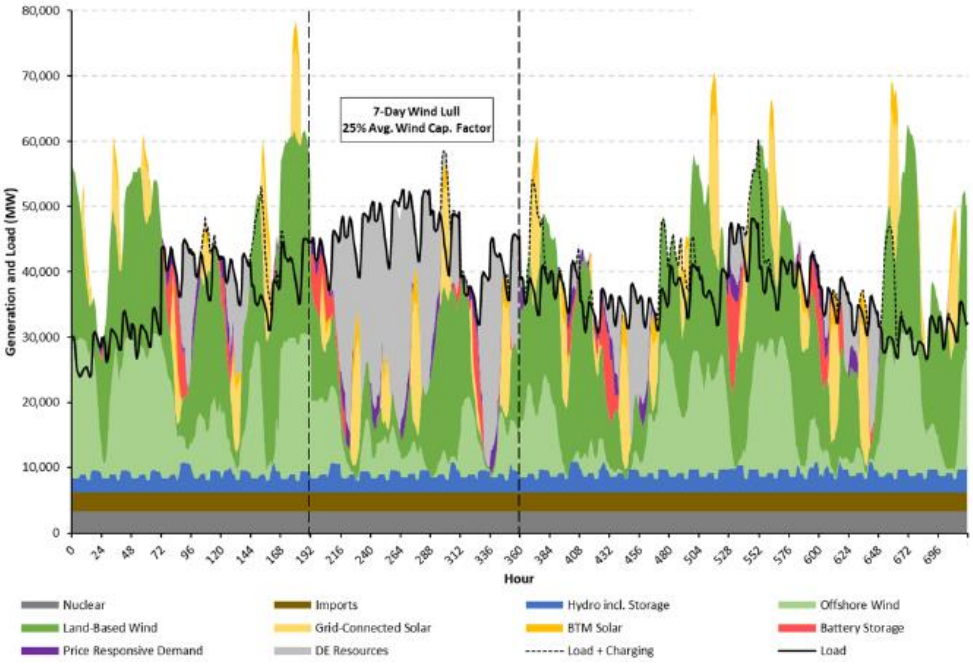
1. NYSERDA predicts between 62,691 MW and 66,215 MW of installed solar in 2050, and estimates annual generation 120,056 GWh and 126,047 GWh. This corresponds to a capacity factor of almost 22%. However, the capacity factor of solar PV in New York is poor, only 14% for fixed panel and only 20% for tracking panels. **How does NYSERDA explain this discrepancy**? Most large-scale solar projects are fixed panel installations, not tracking. **Does NYISO believe that all solar panels installed in New York will use mechanically tracking? Did NYSERDA inadvertently use capacity factor data for a different state?**

2. Notwithstanding the above, at a tight packing of 4 acres per MW, 66 GW of solar would consume 264,000 acres of land. (Taking into account access and support infrastructure, 6-7 acres per MW is more realistic.) Still, 264,000 acres is equal to 400 square miles, an area significantly larger than all five boroughs of New York City combined (302 square miles). Accounting for typical configurations and capacity factor, installing enough solar to generate 126,047 GWh of annual electricity generation could require blanketing an area larger than two or three New York Cities in glass, steel, and copper. About 20 square miles of land would have to be converted to electricity production, each and every year, starting immediately to achieve this level of solar production. **Does NYSERDA believe this to be a realistic or environmentally responsible buildout scenario?**

3. Comparing NYSERDA's four scenarios to the CLCPA case modeled by NYISO in its Phase 2 report, it appears that NYSERDA contemplates less land-based wind in exchange for more solar. However, even on just an annual generation basis, the amount of additional solar (12-15 GW) NYSERDA provides is insufficient to make up for the amount of wind lost (17-22 GW) in NYISO's model, especially considering that wind has twice the capacity factor of solar in New York, and considering that more generation should be necessary in 2050 than 2040. **How does NYSERDA explain this?** Notably, NYSERDA estimates the need for 149 to 158 GW of total capacity in (production and storage) in 2050, whereas NYISO predicts the need for 163 GW in 2040. **How does NYSERDA explain this?**

4. Examining NYISO's "CLCPA Winter Wind Lull Case" and considering differences between the two portfolios, it appears that NYSERDA's portfolio will have significant difficulty meeting demand, especially in the winter. As seen in NYISO's model below, wind comprises the vast majority of intermittent generation in the winter, and battery storage can do little to extend the usefulness of solar generation. Trading land-based wind capacity (dark green) for more solar would result in each of the solar peaks (yellow) being about 30% higher in magnitude. However, this does little to meet demand for electricity during the more evenly distributed periods of lost generation from wind. NYSERDA predicts the need for 19 GW to 23 GW of batteries, which it describes as providing "4- and 8-hour" storage. But this is only modestly more than the 15.6 GW of battery storage capacity called for by NYISO, and even if this were a full 8 hours of storage, it would do little to shift the delivery of excess solar generation to times where can help meet real-time demand. Solar and wind have very different seasonal characteristics. **Has NYSERDA performed real-time modeling of its proposed portfolio distribution, similar to the robust analysis by NYISO? Modeling scenarios, like the one shown here by NYISO should be made available.**

Figure ES-2: Hourly Load/Generation Balance, CCP2-CLCPA Winter Wind Lull Case



5. NYSERDA predicts between 10,997 MW and 13,239 MW of land-based wind installed within New York by 2050, and estimates annual generation between 31,224 GWh and 37,896 GWh. (This corresponds to a capacity factor of about 33%. This does not reflect typical performance of land-based wind. **How does NYSERDA justify this figure?** NYISO estimates a capacity factor of 26% for land-based wind. Assuming 5MW wind turbines (which are very large for land-based), this would require 2648 individual turbines. Achieving this buildout by 2050 would require installing two large-wind turbines somewhere within upstate New York every week for the next 28 years. **Does NYSERDA believe this to be a realistic or environmentally responsible buildout scenario?** (If needed to meet the state's 2040 goal of carbon-free electricity, an even faster deployment would be required.) In addition to the above, NYSERDA predicts 6,397 MW of imported electricity from wind. Based on its estimates of annual generation, those turbines would operate at a capacity factor of 44%. **What is the source of this number?**

6. NYSERDA predicts up to 21,063 MW of offshore wind in 2050. This is more than twice the amount of wind that the state has promised to install by 2035. In its Phase 2 model, NYISO also predicts the need for twice as much offshore wind, but NYISO calls for this to achieve carbon-free electricity by 2040. **How much offshore wind does NYSERDA believe must be installed by 2040 to achieve the 2040 goal? If not as much as predicted by NYISO, then please explain why. If NYSERDA estimates that this much offshore wind is needed by 2040, then please explain how 12,000 MW of offshore wind will be installed in the five years between 2035 and 2040.**

7. In its presentation, NYSERDA predicts that "firm, carbon-free resources" would be required to provide 1-2% of annual generation. This is substantially less than predicted by NYISO which estimates that "dispatchable emission-free resources" (DE) would be needed to provide 10% of winter generation and 4% of summer generation. (See figures 46 and 48 of NYISO's Phase 2 report.) **How does NYSERDA explain this significant difference, especially considering that its portfolio relies much more on solar, which is of little value in the winter?** In terms of capacity, NYSERDA estimates that between 14,603 MW and 23,294 MW of dispatchable firm generation will be needed, which is less than the 32,000 MW identified by NYISO. NYSERDA's portfolio relies on roughly the same amount of baseload capacity (large hydro + nuclear) as NYISO's portfolio. **So how does NYSERDA believe that it can suffice with significantly less additional firm dispatchable capacity to backup remaining intermittent generation?** Even at levels estimated by NYSERDA, the amount of firm carbon-free generation identified by NYSERDA corresponds to more than half of the total fossil fuel generation capacity in New York today. Fuel cells cannot be realistically scaled up to many thousands of megawatts. Therefore, without additional carbon-free nuclear power (which would have the additional benefit of serving baseload generation), this means that the state would need to retain most of its existing combustion-based power plants that currently burn gas (or build new ones) in the hope that they will be able to burn "green" hydrogen in the future (while continuing to incur co-pollutants such as NOx in the process). **How does NYSERDA reconcile this with the public's desire to shut down polluting combustion plants as soon as possible?**

8. NYSERDA states in its presentation that it assumes that 50% of hydrogen demand will be met by in-state electrolysis. **Why only 50%? Since the CLCPA requires attention to upstream greenhouse gas emissions, how does NYSERDA plan to track emissions associated with out-of-state hydrogen production? How much total hydrogen production does NYSERDA estimate will be necessary, and why would NYSERDA assume that other states have a surplus of "green" hydrogen that they do not need for themselves? How much hydrogen compression and storage does NYSERDA anticipate will be needed?** Typical "round-trip" power-to-hydrogen-to-power conversion efficiency is less than 50%. **What conversion efficiency does NYSERDA assume?** NYSERDA states in its presentation that "firm, zero-emission resources, such as green hydrogen or long-duration storage, will play an important role to ensure a reliable electricity system beyond 2040." **However, why does NYSERDA not view these as vital to meeting the state's goal of carbon-free electricity by 2040?**

9. NYSERDA's estimate of 19 GW to 23 GW of "4- and 8-hour" battery storage corresponds to anywhere from 80 GWh to 180 GWh of stored energy. This could be more or less than the 124.8 GWh (15.6 GW x 8 hours) of storage called for by NYISO. **How much total energy storage does NYSERDA actually estimate and what modeling has been performed to support this amount of storage?** The largest battery in the word today is the 1.2 GWh Moss Landing storage plant in California, yet NYSERDA is proposing a battery that may be 150 times bigger than this. **Does NYSERDA believe this to be a realistic or environmentally responsible solution?**

10. In its presentation, NYSERDA depicts nuclear power declining to 16,835 GWh of annual generation in 2050. Renewing the licenses of New York's nuclear power plants could allow them to operate for an additional 20-years. Furthermore, passively-safe advanced nuclear technologies, including molten salt reactors and small modular reactors with enhanced load-following capability, are under development elsewhere in the country and around the world. **Given its benefits as a provider of reliable carbon-free electricity, why has NYSERDA not included the expansion of nuclear power within its portfolio?**

We believe that answers to the above questions are essential for New York policy makers, including the Climate Action Council, to develop a successful, competent plan for energy in the future. Thank you for your attention to this request for information.

Sincerely,

Leonard Rodberg
Leonard Rodberg, New York Energy and Climate Advocates
lensqc@infoshare.org

CC: Climate Action Council