BEFORE THE 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

ORDER INITIATING PROCESS REGARDING ZERO EMISSIONS TARGET

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About the Author

I am a retired mathematics and computer science professor. I taught at St. Lawrence, Scranton, and, for over three decades, at State University of New York College at Oneonta. My wife and I have four daughters. Together, we are committed to addressing climate-change issues to the extent possible. We Higgins have installed 20KW of solar; we have a ground source heat pump system; we have electric stove and dryer; we drive an EV. I have been engaged in energy policy for over a decade, speaking at FERC and DEC hearings, participating in a NYSEG/RGE rate case, and organizing press events – most recently with Dr. James Hansen in Albany. I write frequently for papers statewide on environmental and energy issues. With colleagues over the last few years, I have been doing presentations on the serious problems with state energy policy: We have spoken to college physics classes, Rotary clubs, environmental and civic groups, town boards, and general audiences.

Introduction

In this proceeding, the Independent Power Producers of New York (IPPNY) and others raised the question whether intermittent resources could reliably power the state. The Public Service Commission (Commission) wisely determined that an order was appropriate to solicit information.

> ***This Order responds to the [IPPNY et. al.] Petition and initiates a process to identify technologies that can close the gap between the capabilities of existing renewable energy technologies and future system reliability needs, and more broadly identify the actions needed to pursue attainment of the Zero Emission by 2040 Target***.

As noted in the PSC Order,

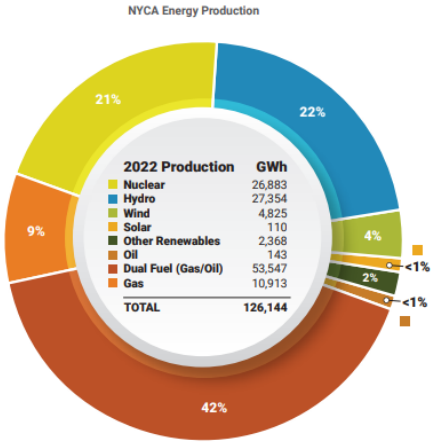
> ***"… several studies indicate that renewable energy resources may not be capable of meeting the full range of electric system reliability needs that will arise as fossil generation is replaced. These studies suggest that there is a gap between the capabilities of existing renewable energy technology and expected future system reliability requirements***."

The bearer of bad news is never welcome, but it is necessary for someone to say that New York State has no hope of honestly achieving the Climate Leadership and Community Protection Act's (CLCPA's) 70-by-30 goal. Only if the state abandons an energy scheme crafted from snappy slogans and feel-good press releases in favor of a plan based on engineering and science will there be any chance of decarbonizing the grid by 2040.

What is interesting is to consider how far, how quickly, and in the wrong direction, New York managed to go, and how, wrong-headedly, it insists on continuing down a path that will not economically, reliably power the grid. Albany seems determined to pursue a plan which will not only fail to relieve existing environmental justice (EJ) communities, but will create new ones across rural upstate. In 2019, the state grid was 61% carbon free (with 22% hydro, 33% nuclear, a small amount of solar and wind, and 39% fossil fuels.) If the state's goal had then been to achieve a 2030-70%-emission-free grid, we were almost there. However, that was not the plan. Instead, the state has shuttered emission-free resources and replaced them with gas power plants. In 2023, the state is now 52% powered by fossil fuels. The goal of a 70% renewably-powered grid means we would need to add 40% or more of state generation capacity in hydro, solar, or wind by 2030. Consider this figure from the New York Independent System Operator's (NYISO's) Power Trends 2023 showing energy production by source statewide[1]. A section larger than the entire brown 'gas' generation sector at the bottom would need to be labeled "solar and wind generation" to meet the state's goal.

[1] figure 20, page 38, NYISO's Power Trends 2023

FIGURE 20: **2022 ENERGY PRODUCTION (GWh) BY FUEL SOURCE - STATEWIDE, UPSTATE, & DOWNSTATE NEW YORK**



California has not managed to accomplish decarbonization following this path in over two decades, and Germany has failed with three decades of expense and effort. Hubris – or ignorance – rather than a technical understanding of energy or any real concern for environmental justice led to a plan which "requires" New York to expand its intermittent assets eight-fold in six years. Already, New York has had to deny rural upstate communities protection under home rule; the state has sidelined thorough implementation of the state's Environmental Quality Review Act (SEQRA) for large-scale solar and wind projects; NYPA has been authorized to use eminent domain for land seizure to run transmission; communities have been denied fair tax revenues for industrial projects they are forced to host; and NYISO has acknowledged that – thanks to state policy – EJ neighborhoods will continue to be targeted by peaker-plant emissions. The state has effectively guaranteed the need for fossil-fuel-generated electricity for decades to come. Perhaps, reflecting on this mess, the PSC has decided to review state policy.

Response to Questions

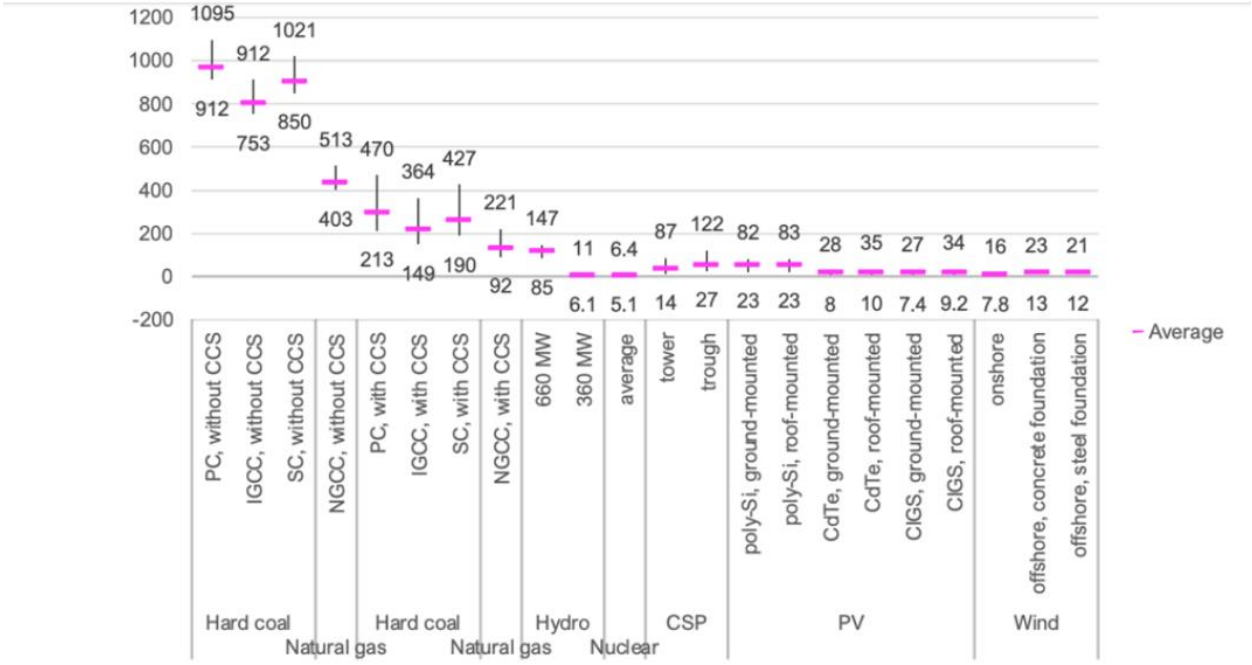
(1) How should the term "zero emissions," as used under PSL §66-p(2)(b), be defined?

All energy sources have associated emissions, whether in related mining, construction, decommissioning, or energy production. A new report by the United Nations Economic Commission for

Europe (UNECE) examined the lifecycle carbon produced by all technologies and indicates that nuclear power has fewer carbon dioxide emissions over its lifecycle than any other electricity source.[2]

Lifecycle greenhouse gas emission ranges for the assessed technologies

Lifecycle GHG emissions, in g CO_2 eq. per kWh, regional variation, 2020

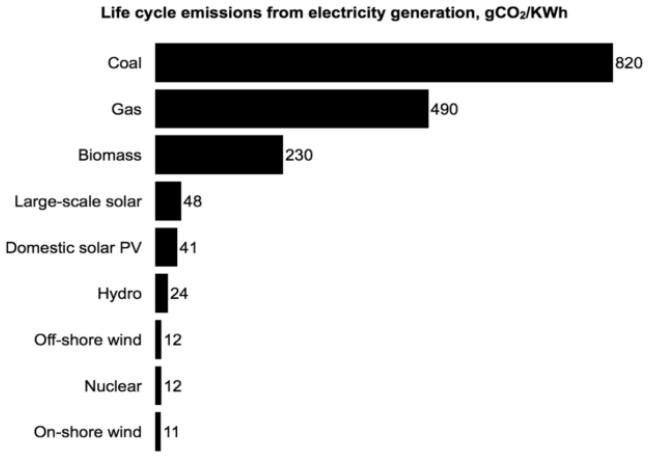


The Intergovernmental Panel on Climate Change (IPCC) has concluded that every path to avoiding the worst impacts of climate change will involve building more nuclear power plants. The IPCC determined that nuclear power's lifecycle emissions make it an ideal candidate for energy generation.

> **Nuclear power's full life cycle carbon emissions are considerably lower than those of solar, making it a crucial source of low-carbon energy… Nuclear is one of our most important sources of low-carbon energy, with a recent study describing it as having 'amazingly**

[2] https://energyindustryreview.com/power/unece-nuclear-is-the-lowest-carbon-electricity-source/

low' emissions. Its life-cycle emissions – that's the emissions you get when taking into account the building, maintaining and decommissioning of an energy source – are roughly a hundredth of those of coal power and are surprisingly lower than solar and hydro power. [3]



The EU Parliament recently recognized nuclear as a green technology.[4] New York would do well to consider studies by the IPCC, the United Nations Economic Commission for Europe (UNECE) and others in examining emissions from energy sources. New York might consider decarbonization efforts undertaken by Japan, Netherlands, France, China, and the European Union, rather than the catastrophic examples of California and Germany. As climate scientist Ken Caldeira says:

The atmosphere doesn't care whether the electricity came from a wind turbine or a nuclear reactor. It just cares about greenhouse gas emissions. Nuclear energy is extremely low carbon, with no emissions in operation. Its full life cycle emissions are comparable to onshore wind, and surprisingly, considerably cleaner than solar."[5]

[3] https://www.energyforhumanity.org/en/briefings/energy/nuclear-and-carbon-emissions-the-facts/

[4] https://www.europarl.europa.eu/factsheets/en/sheet/62/nuclear-energy

[5] https://www.energyforhumanity.org/en/briefings/energy/nuclear-and-carbon-emissions-the-facts/

It is possible that the Commission's inquiry into what constitutes zero-emissions is disingenuous. Tier 3 of the Clean Energy Standard (CES) includes existing Gen 2 nuclear. In that proceeding, the Commission's "ORDER INITIATING PROCESS REGARDING ZERO EMISSIONS TARGET" reads,

> **The CES embodies both a Renewable Energy Standard (RES) and a Zero-Emissions Credit (ZEC) requirement…The ZEC requirement, designated as Tier 3 of the CES, directs support to existing nuclear facilities. ZEC payments reflect the value of the potential damages caused by the carbon dioxide emissions those facilities avoid by continuing to operate.**

(2) Should the term "zero emissions" be construed to include some or all of the following types of resources, such as advanced nuclear (Gen III+ or Gen IV), long-duration storage, green hydrogen, renewable natural gas, carbon capture and sequestration, virtual power plants, distributed energy resources, or demand response resources? What other resource types should be included?

New York might listen to Energy.Gov:

> **NUCLEAR IS A ZERO EMISSIONS CLEAN ENERGY SOURCE It generates power through fission, which is the process of splitting uranium atoms to produce energy. The heat released by fission is used to create steam that spins a turbine to generate electricity without the harmful byproducts emitted by fossil fuels. According to the Nuclear Energy Institute (NEI), the United States avoided more than 14,000 million metric tons of carbon dioxide emissions between 1995 and 2016. That's the equivalent of removing 3 billion cars from the road. It also keeps the air clean by removing thousands of tons of harmful air pollutants each year that contribute to acid rain, smog, lung cancer and cardiovascular disease.[6]**

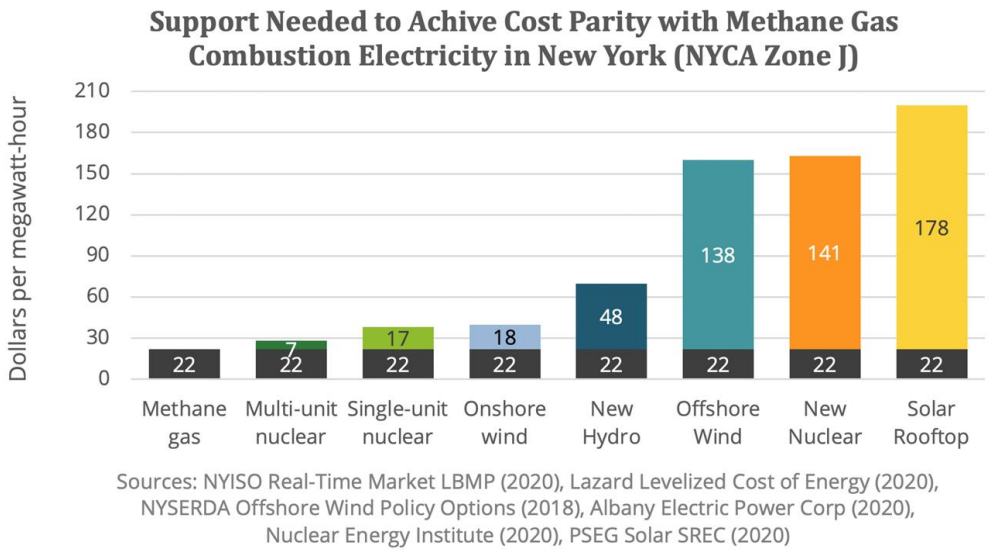
The same information is available from many sources.

[6] https://www.energy.gov/ne/articles/3-reasons-why-nuclear-clean-and-sustainable

> **We believe that nuclear energy can be an important way to fill the gaps on the desired pathway to a secure, affordable, clean-energy future. Nuclear power produces zero emissions, is a well-established technology that, with the right approaches, can scale and complement power sources such as wind and solar, and can drive clean energy directly through critical sectors like transport and buildings.[7]**

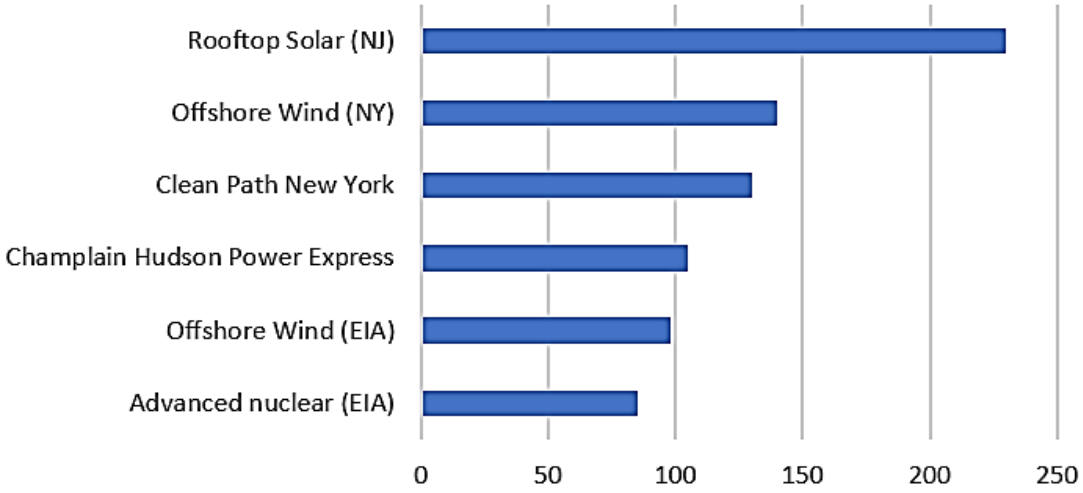
Whether we consider Gen II or Gen IV, all nuclear reactors are zero emission. Nuclear also has lower life-cycle emissions than solar, or wind. (See charts, Questions 1 and 7). The scoping document assumes that existing reactors in upstate New York will be kept online until 2040. What the document fails to do is recommend relicensing of upstate nuclear plants. The document does not recommend new nuclear construction. The scoping document fails rigorously to examine the full cost, EJ impacts, or reliability of its own recommendations. When simple-cycle gas backup generation costs are included; when hundreds of miles of transmission and dozens of gigawatt hours of storage are added in; when we figure the value of sacrificed farmland and forest; when the cost of panel replacement and landfill waste after 20 years are considered, solar and wind are not cheap. Consider the subsidies needed for resources to achieve cost parity with gas:

[7] https://www.mckinsey.com/capabilities/sustainability/our-insights/yes-nuclear-can-help-answer-the-climate-and-energy-security-challenge



Existing multi-unit and single unit nuclear plants are cheaper than onshore or offshore wind or rooftop solar. New nuclear is comparable to offshore wind and cheaper than rooftop solar.

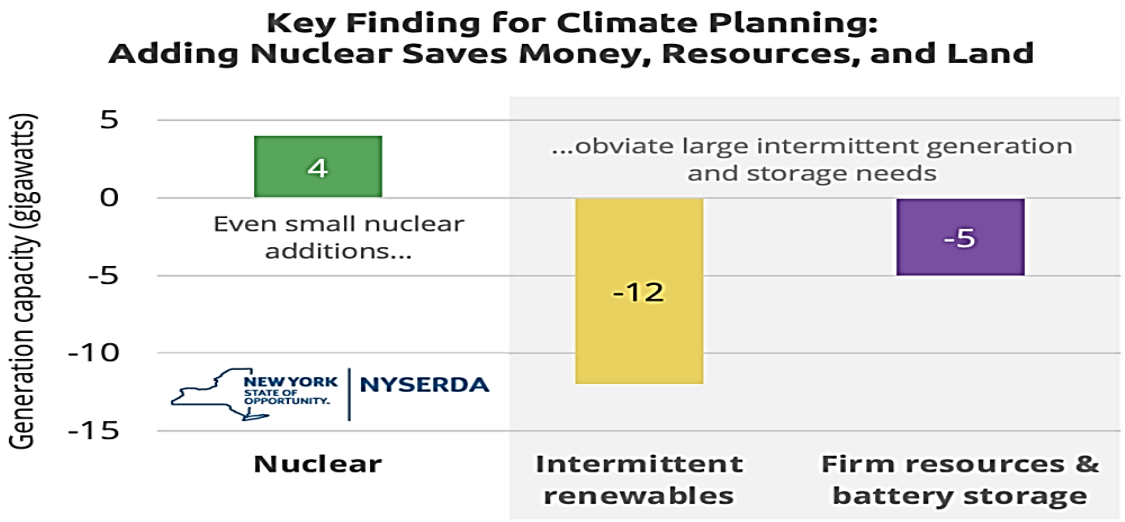
The levelized cost of energy (LCOE) is a misleading indicator, as the short lifespan of wind and solar, the new transmission, backup, and storage needed to make them work are not factored in. But in terms of LCOE in dollars per MWh, compared with the projects the state is currently pursuing, nuclear is cheaper than rooftop solar, Clean Path, Champlain-Hudson, and offshore wind:



(3) How should a program to achieve the Zero-Emission by 2040 Target address existing and newly constructed nuclear energy resources. Should the program be limited to specific types of nuclear energy technologies and exclude others?

New York's existing nuclear plants will help New York progress toward its 2040 carbon-free goal, but without new nuclear construction, existing plants will not be enough to enable the state to achieve it. If New York somehow manages to build out 20% of its capacity in solar and wind by 2040, even with existing hydro facilities, New York will still need about 60% of zero-emission dispatchable/baseload capacity. This could be accomplished with the construction of new nuclear plants – several large plants like Vogtle or small modular nuclear plants. NYISO and the State Energy Research and Development Authority (NYSERDA) both expect the state's energy demand to double. If state energy needs in 2040 are significantly greater than – perhaps 150% of – current needs, New York might need 12-16 GW of nuclear for a reliable grid. An intelligent plan would be to ensure that this development is underway now.

At one point, late in the review of the scoping plan, Carl Mas suggested the state might build 4GW of new nuclear. NYSERDA examined the impact on the need for intermittent and storage buildout for even this modest increment in baseload power.



Source: New York State Energy Research and Development Authority
Climate Action Council Meeting Presentation. November 2022

Although the redundant 12 GW of intermittent generation in the chart is not broken down into solar or wind, consider that New York's plan includes about 10 GW from onshore wind turbines. Based on historic data, as well as current state proposals, these may require 50 acres – or more – per megawatt. If we install 4GW of nuclear on 500 acres, then this investment in nuclear power would represent the saving – rather than the forfeiture -- of 750 square miles. There would be enough nuclear capacity left over to also eliminate 10GW of planned solar, saving another hundred square miles of farmland.

Most of NY's demand – about two thirds, is baseload. Of course, for efficiency of cost and engineering, carbon-free baseload should not be a backup to renewables, but should rather provide the backbone of the grid. The current plan will require 1,000 -- or more -- square miles of upstate farmland and forest: 750 square miles or more for 10GW onshore wind (at 50 acres per MW), and about 500 square miles for 50-60GW of industrial solar. On about 2,000 acres—or about 3 square miles -- New York could construct 16 GW of new nuclear. This calculation is based on older technology, like Indian Point, requiring 240 acres and generating 2,100 MW. Nuclear does not require a new transmission substructure, as do intermittent generators, but can use the existing grid. No storage would be needed. The state would not have to surrender wildlife habitat or farmland. New York would not have to create hundreds of new

EJ communities across rural upstate. Because solar and wind will need dispatchable backup, it is unlikely New York can shutter any fossil-fuel power plants, so the state plan is not likely to relieve EJ communities currently impacted by emissions. NYISO's Power Trends 2023 report, cited later in these comments, confirms this analysis. Since nuclear power does not require equivalent gas back-up capacity and provides baseload, the state could actually begin shuttering fossil-fuel power plants.

The projected need for 25GW-45GW (NYISO, NYSERDA) of zero-emission fast-ramping dispatchable power begs this question: if you had this scale of economical, reliable, carbon-free baseload, why would you also sacrifice a million acres to solar panels and wind turbines which mostly generate nothing at all?

(4) Should new measures adopted to pursue compliance with the Zero-Emission by 2040 Target focus exclusively on generation and resource adequacy, or should they also encompass a broader set of technologies that could be integrated into the transmission or distribution system segments, or installed and operated behind-the-meter?

An advantage of gas, hydro, and nuclear power is that significant transmission upgrades, storage, and backup generation are not required. For most of the developed world, hydro can't be appreciably expanded. Decarbonization, theoretically, means we should not build any more fossil-fuel power plants. We should not have shut down Indian Point and replaced it with two new gas power plants with almost 2,000 MW of capacity. We should not build any more gas pipelines or increase pipeline compression to move more gas, as Iroquois is proposing.

A critical disadvantage of solar and wind is their intermittency. This means these resources require a totally new grid – transmission and storage -- to support them. They also require maintenance of the existing grid for the dispatchable backup – some of which may also need to be built – which they need. Ultimately, the lack of sufficient long-term storage, the absence of any season-to-season storage, means

that even if we are willing to host colossal intermittent buildout, as well as the necessary transmission and backup capacity, our efforts will fail, however much money we throw at the doomed project.

> **The widespread diffusion of cleaner technologies in the energy sector is currently hindered for three main reasons. First, renewable technologies recently witnessed dramatic decreases in costs, but they are not yet fully cost-competitive with fossil-based power generation, except in favorable geographical locations. Second, the energy sector is sticky and a change in the paradigm of electricity production faces multiple challenges: the need to upgrade infrastructure (i.e., the electricity grid) and the considerable sunk costs in existing, less efficient power plants. Third, renewable energy sources such as wind and solar, which today are the most cost-competitive options, are intermittent and non-dispatchable. Increasing the penetration of these energy sources in the system is particularly challenging given the current lack of cheap large-scale storage technologies. Indeed, this last issue may prove the most crucial, as it would challenge the deployment of renewables even if these were cost competitive and old fossil-based capital vintages were close to the end of lifetime.** [8]

Building carbon-free baseload makes engineering sense. It makes economic sense. It reduces land and material needs by orders of magnitude and therefore makes better sense in terms of broader environmental impacts and achieving environmental justice. Building nuclear would not necessitate overriding home rule and neutering SEQRA in order to cover 1000 square miles with industrial solar and wind installations.

[8] https://www.nber.org/system/files/working_papers/w22454/w22454.pdf

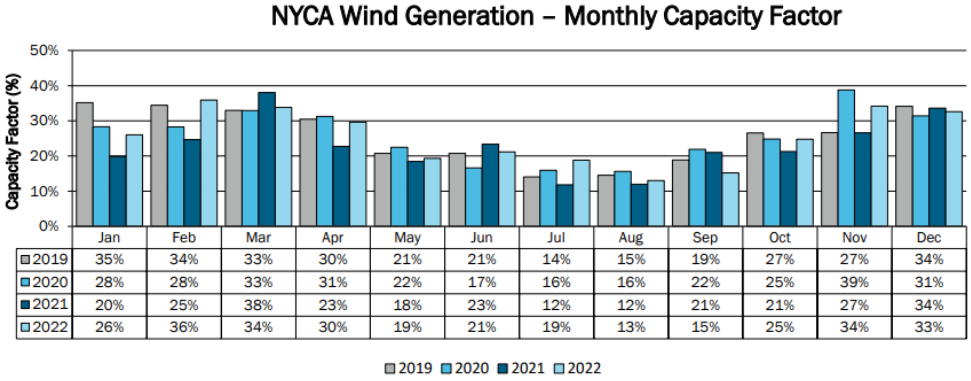
The only large economies to effectively decarbonize did it with hydro, nuclear, or both. This is the only approach which, historically, has ever worked. Those economies stubbornly determined to decarbonize with solar and wind are, after decades and many billions of dollars, still burning lots of fossil fuels and suffering with unreliable, expensive electricity. An intelligent approach to decarbonization would examine what has worked and what has failed elsewhere. An intelligent approach would not first re-invent and then doggedly pursue, a flawed plan.

(5) Should a program to achieve the Zero-Emission by 2040 Target specify subcategories of energy resources based on particular characteristics, such as ramp rates, the duration of their operational availability, or their emissions profile with respect to local pollutants?

There is certainly reason to review the state's current path. Intermittent resources have low power density, meaning that New York must sacrifice a million acres of farmland and forest for their buildout. NYISO follows generator capacities. [9]

NY Wind Capacity Factors

Annual Wind Capacity Factor			
2019	2020	2021	2022
26%	26%	23%	25%



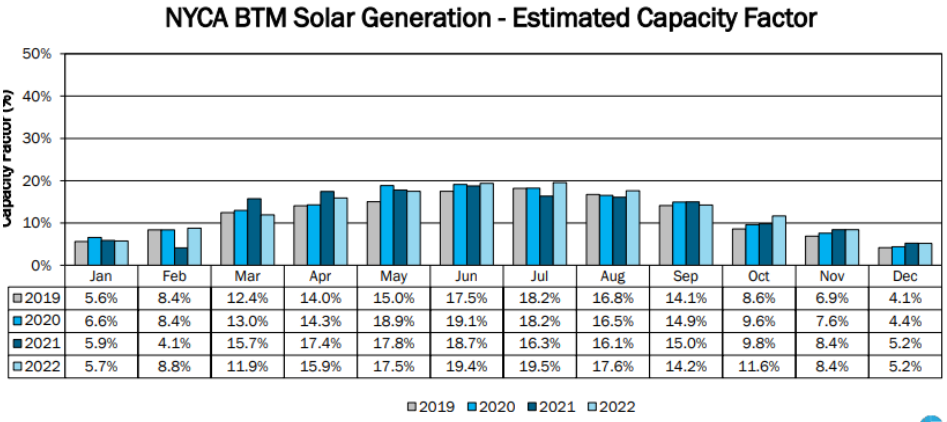
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	35%	34%	33%	30%	21%	21%	14%	15%	19%	27%	27%	34%
2020	28%	28%	33%	31%	22%	17%	16%	16%	22%	25%	39%	31%
2021	20%	25%	38%	23%	18%	23%	12%	12%	21%	21%	27%	34%
2022	26%	36%	34%	30%	19%	21%	19%	13%	15%	25%	34%	33%

[9] https://www.nyiso.com/documents/20142/36845856/2022%20NYCA%20Renewables%20Presentation%20FINAL.pdf/65f48ad8-cf06-4a7f-8d1a-2cd716380063

While last year's onshore wind capacity factor was 25%, 2022 had a 23% capacity factor. We should expect that the best sites will be taken first and, in the future, we should expect lower, not higher, capacity factors. A projected 10 GW of onshore wind will require 750-1000 square miles but may only generate average power of 2.3 GW. Here are NYISO's data on behind-the-meter solar capacity factors.

NY BTM Solar Capacity Factors

Annual BTM Solar Capacity Factor			
2019	2020	2021	2022
11.8%	12.6%	12.5%	13.0%

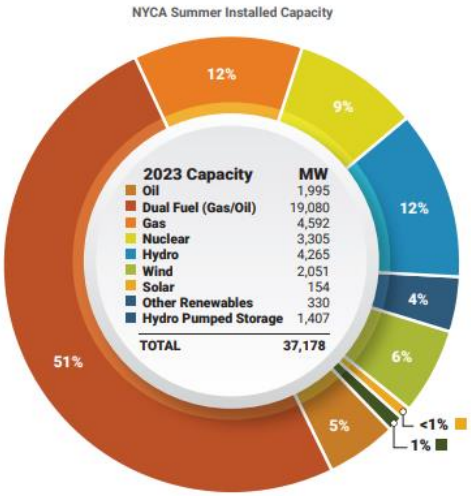


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2019	5.6%	8.4%	12.4%	14.0%	15.0%	17.5%	18.2%	16.8%	14.1%	8.6%	6.9%	4.1%
2020	6.6%	8.4%	13.0%	14.3%	18.9%	19.1%	18.2%	16.5%	14.9%	9.6%	7.6%	4.4%
2021	5.9%	4.1%	15.7%	17.4%	17.8%	18.7%	16.3%	16.1%	15.0%	9.8%	8.4%	5.2%
2022	5.7%	8.8%	11.9%	15.9%	17.5%	19.4%	19.5%	17.6%	14.2%	11.6%	8.4%	5.2%

New York ISO | ISO

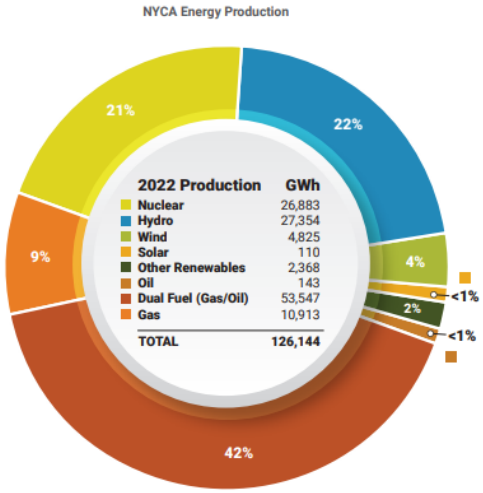
2023 Power Trends provides both installed capacity and generation for all resources. Solar installed capacity is 154MW.

FIGURE 19: **SUMMER 2023 INSTALLED CAPACITY (MW) BY FUEL SOURCE - STATEWIDE, UPSTATE, & DOWNSTATE NEW YORK**



Here NYISO shows resource generation.[10] Assuming NYISO got their numbers right, the capacity factor of all solar **statewide** is almost too pathetic even to record. I get just over 8%.

FIGURE 20: **2022 ENERGY PRODUCTION (GWh) BY FUEL SOURCE - STATEWIDE, UPSTATE, & DOWNSTATE NEW YORK**



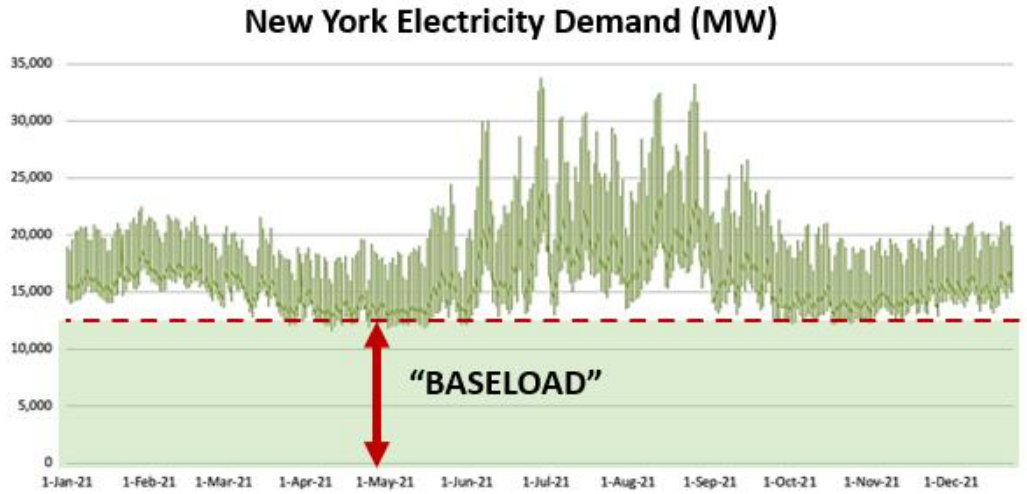
Clearly, we should not expect solar to have higher than 13% capacity factor, and it may be significantly lower. The 500 square miles of solar panels required for 50 GW capacity, would, optimistically, have average power of 6.5 GW. Frankly, it is important to acknowledge that much of the time these resources would generate little, or nothing at all. This is what happens when people who have not taken Physics 101 and who do not know the difference between power and energy, between megawatts and megawatt hours, are allowed to design an energy system expected to support a large economy and 19 million people. The instructor receiving the scoping plan as a physics project would have to fail the Climate Action Council students in the course. It is not clear who should be liable for deaths and injuries incurred in future power outages which competent engineering would have avoided.

The Wall Street Journal headline for July 27th reported on the US's largest energy grid, **"PJM Interconnection LLC has declared a level one emergency for the 13-state eastern US grid and called on all power plants to operate at full capacity Thursday during a heat wave."** During future polar vortices, in future heat waves, will New York instruct its intermittent fleet to crank up the power?

[10] NYISO Power Trends 2023 figures 20,21 page 38

About two-thirds of state energy demand is baseload. This chart is from NYISO data, 2021.

Much of New York total electricity demand is 24 x 7



Source: NYISO 2021

For backup, according to NYISO, the state plan will require as much as -- but possibly almost double – New York's current fossil-fuel fleet's capacity. It would need to be paid for, built, maintained, and used some fraction of the time. An engineer making this proposal at any corporation would be laughed out of the room and then fired. What is worse, judging from literature as well as the experience of California and Germany, this plan doesn't work. An efficient engineering plan would use carbon-free baseload as the backbone of the grid. Such an approach would require a fraction of the renewable buildout planned by the state and orders of magnitude less land.

If New York is intent on fiscally and environmentally irresponsible solar and wind buildout, it should be noted that nuclear can be load-following. North Scotland is an example of a grid in which nuclear follows wind generation. Some next generation nuclear allows for heat storage which can provide peaking support. If New York is intent on building 400 miles of hydrogen-grade pipeline, hundreds of gigantic fuel-cell plants, and large salt cavern storage, it should be noted that nuclear can provide the reliable

energy for hydrogen production which solar and wind cannot. Indeed, this is already being pursued in New York State using existing nuclear power.

Particular concerns with increasing penetration by intermittent resources are cost, environmental impacts (including mining and mineral use, wildlife habitat fragmentation, low energy density requiring the sacrifice of lots of land), degradation of quality of life in rural communities, supply chain issues (as most of the world's solar panels come from China and offshore wind contractors are not US based), and reliability. This last, reliability, is discussed in NYISO Power Trends 2023 cited elsewhere in this filing. This issue is also considered in the Energy Policy Research Foundation study of the IEA net zero by 2050 report. This criticism supports development of nuclear power's zero-emission baseload support.

> **Replacing significant shares of the baseload power provided by coal, natural gas, and coal with intermittent, or inverter-based, resources like solar and wind risks creating a large imbalance. This is echoed in the North American Electric Reliability Corporation's (NERC) recent longterm reliability assessment, which points to four resource mix trends posing major challenges to grid reliability: integration of inverter-based resources (i.e., solar and wind); increasing levels of distributed resources (home solar systems, etc.); the pace of retirement of nuclear, coal-fired, and natural gas generators; and the need for more robust planning approaches to ensure that solar and wind have "the capability to support voltage, frequency, and dispatchability." In other words, an aggressive push to net zero grids will very likely lead to serious damage to the electric system unless all the above conditions are met.**[11]

11 https://assets.realclear.com/files/2023/06/2205_a_critical_assessment_of_the_ieas_net_zero_scenario_esg_and_the_cessation_of_investment_in_new_oil_and_gas_fields.pdf

(6) What role does technology innovation need to play to meet the CLCPA's Zero-Emission by 2040 Target?

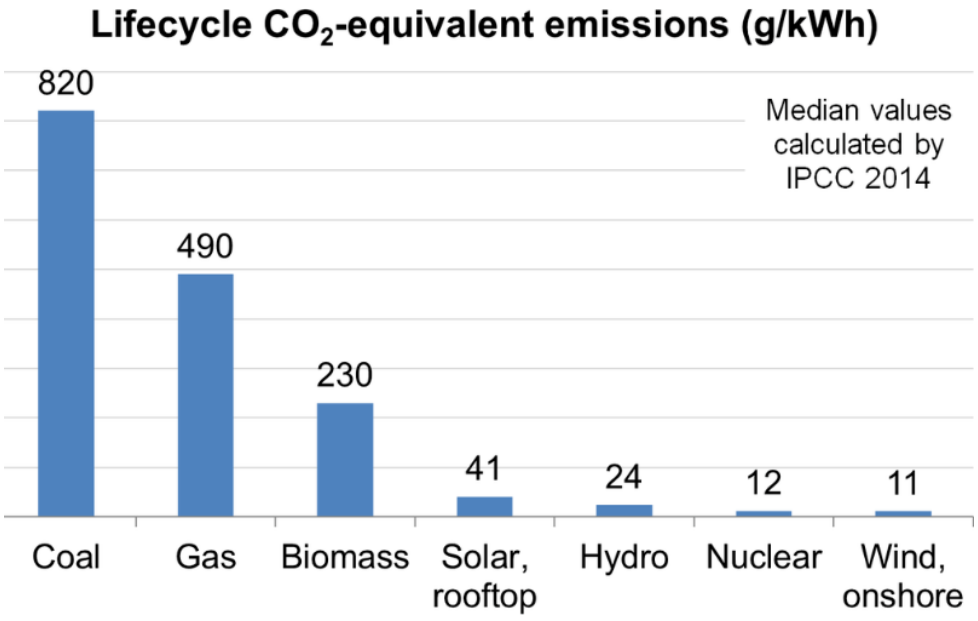
As many have noted, it would be foolish to pin the success of decarbonizing the state grid – or the nation, or planet -- on technology breakthroughs. New technology can take many decades to be perfected and widely available. There is little hope for green hydrogen at scale. Intermittent generators will provide at best an unreliable energy supply and over 50% of the energy is lost in the electricity+H_2O-to-hydrogen-to-electricity process. Hundreds of miles of new hydrogen-grade pipeline, hundreds of fuel-cell plants, as well as salt-cavern storage, would also be needed to support a hydrogen-based storage/dispatchable-energy resource. Carbon capture and sequestration is currently a lab experiment unlikely to be available at scale to solve New York's CO_2 problems. Note that 'long-duration' storage means 'day-to-day', not 'week-to-week', and definitely not 'month-to-month' storage. There is no season-to-season storage. New York might build another dozen Blenheim-Gilboa plants for 'long duration' storage. We need to check with Catskill residents to see if they will support this, or whether land can be seized by NYPA under eminent domain.

> **The IEA has an extensive database of 503 individual clean energy technologies at various stages of Technology Readiness Levels (TRLs).93 The IEA's 11 TRLs are divided into five main groups: Concept (1–3), Prototype (4–6), Demonstration (7–8), Early Adoption (9–10), and Maturity (11). Of the 503 technologies, 326 (almost 65%) are at the "demonstration" or lower stages. A total of 116 technologies (23%) are "in commercial operation in relevant environment" but need "evolutionary" improvement to be competitive. Only 29 technologies (less than 6%) at TRL 10 (one level below maturity) have achieved some commercial competitiveness. There are 32 mature technologies, including large-scale light-water nuclear, hydropower, pumped storage, and fossil-based CCUS for ammonia production... It takes many**

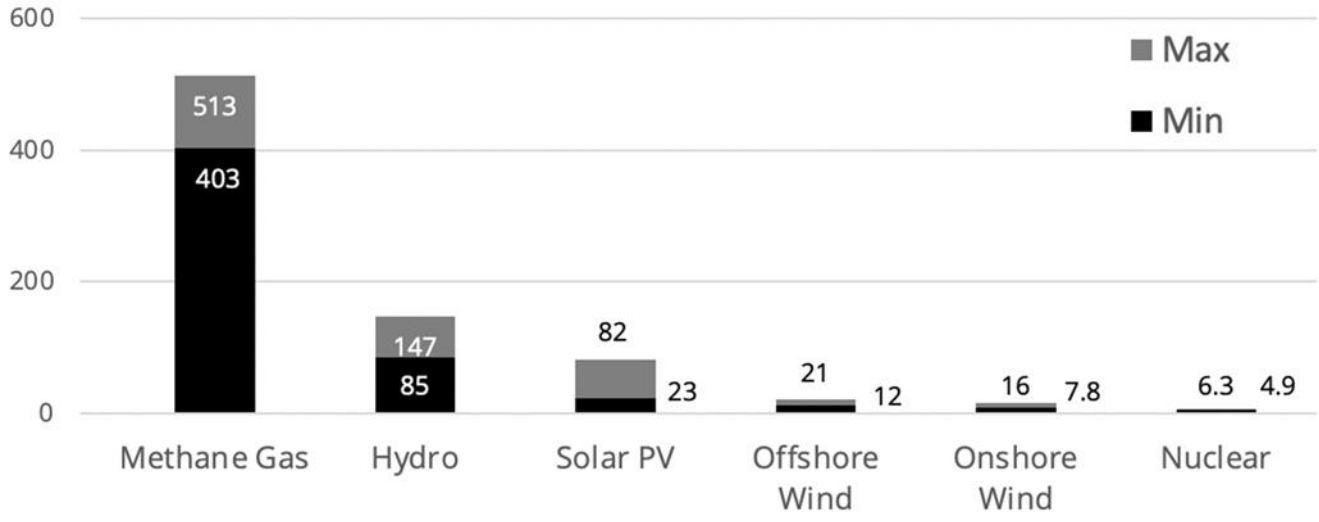
years to move from one TRL to another (and 20–70 years from prototype to commercialization, according to the IEA), and it is common for new technologies to stagnate into long periods of no progress and, in many cases, never become commercially competitive. ETP-2023 asserts that it is necessary to shorten innovation cycles to close this gap in the NZE scenario.[12]

(7) **Should life-cycle emissions impacts be considered when characterizing energy resources? If so, how?**

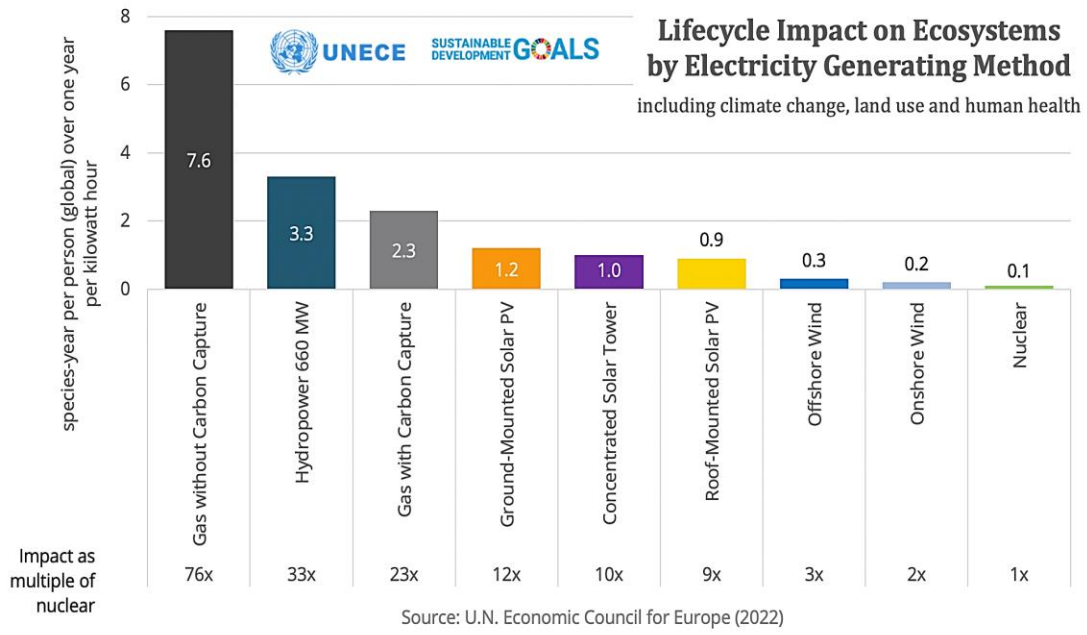
Consideration of life-cycle emissions is critical in selecting suitable 'zero-emission' resources. Here is the IPCC chart showing nuclear near the bottom, between hydro and onshore wind for lifecycle emissions. The UNECE and others have also examined emissions from different energy resources.



12 https://assets.realclear.com/files/2023/06/2205_a_critical_assessment_of_the_ieas_net_zero_scenario_esg_and_the_cessation_of_investment_in_new_oil_and_gas_fields.pdf



If we are willing to sacrifice farms and forests – and, consequently, rural quality of life as well as the lost food generation from farmland and lost carbon sequestration from woodlands -- in our effort to cut emissions, New York should really scrutinize the efficacy of its plan more carefully. A plan structured around Big-Green talking points may prove neither fiscally nor technically sound. On the other hand, if our goal is to save farmland and forest, and minimize the quality-of-life impacts on host communities of our energy decisions, we might note that the UNECE determined that nuclear generation has the lowest lifecycle impacts of any energy source.



According to the US Dept of Energy (DOE), nuclear generation requires no more material than renewables, and in many cases much less.

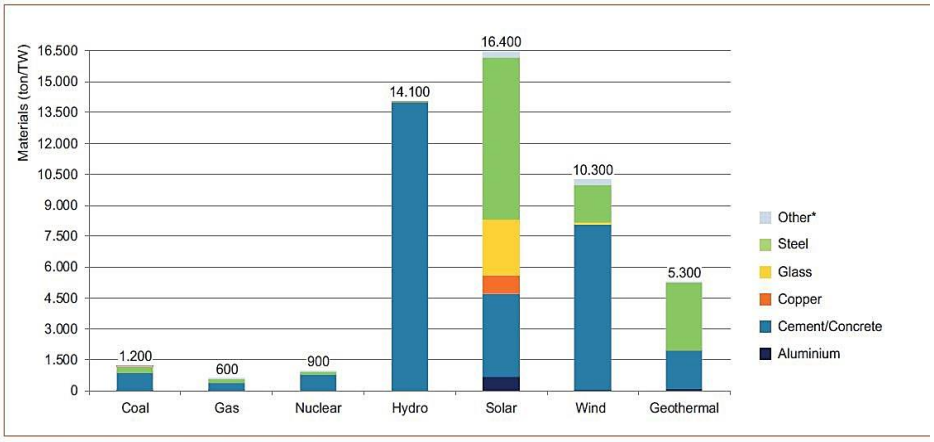
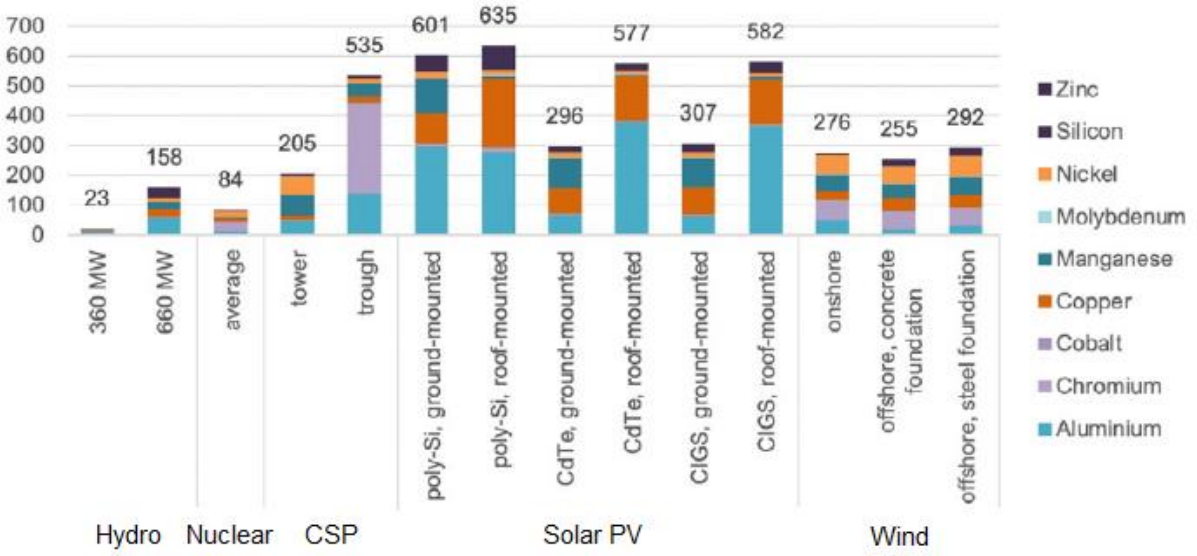


Figure 4: Base-Material Input per 1 TW Generation
Note: Other includes iron, lead, plastic, and silicon.; Schernikau assumes this is based on average US capacity factors
Source: Adapted from DOE 2015, Table 10.4, p390

And again, according to the UNECE, nuclear power generation requires less rare mineral content than nearly any other energy source.



UNECE SUSTAINABLE DEVELOPMENT GOALS

Source: Life Cycle Assessment of Electricity Generation Options - United Nations ECE

(9) In what ways might a program to meet the Zero-Emission by 2040 Target require reexamination and possibly revision of different tiers of the Clean Energy Standard?

In its 20-year Outlook report, Power Trends, and its second quarter 2023 STAR, NYISO indicates a narrowing capacity margin for downstate. NYISO tells us that the NYC metro region will experience a dangerously inadequate capacity margin by mid-decade with a capacity shortfall of over 400MW as early as summer 2025. NYISO reports also indicate that transmission constraints across Long Island and in the southern tier will limit the renewable energy that can be moved even after the "Clean Path" transmission line is completed, even if any offshore wind gets built. The state plan triples energy imports and exports in its effort to make the grid appear reliable on paper. New York's plan depends on the availability of willing buyers for all the state's excess intermittent generation midsummer. Grid reliability and public safety require eager sellers for electricity all the rest of the year. A dangerous experiment is underway. We have seen in Texas and in California what happens when insufficient there

is insufficient grid capacity. In its Power Trends 2023, the NYISO cites the North American Electric Reliability Corporation's (NERC) recent long-term assessment which indicates that New York's neighbors are not likely to have any electricity to export.

Renewable buildout won't fix capacity issues anytime soon, if ever, and will only exacerbate reliability concerns. The Champlain-Hudson Power Express (CHPE) was originally intended to help during summer peak demand. As New York moves to winter peaking, we should be aware that CHPE can be curtailed on cold days when Quebec needs the energy. NYS's solar capacity factor rivals Alaska's. Last year (2022) New York's behind-the-meter solar had a 13% capacity factor (NYISO chart elsewhere in this filing), and solar generates almost nothing in the winter. Supply-chain bottlenecks and inflation have prompted onshore and off-shore solar and wind corporations to renegotiate contracts. As filed in this proceeding, offshore wind developers want more money. New York's Empire and Sunrise projects have already been pushed back by years. As reported by Politico, [13]

> **The developers of all four NYSERDA-contracted offshore wind projects in New York filed petitions with the Public Service Commission asking for an "inflation adjustment" on Wednesday. The requests cast doubt on the viability of the projects and threaten progress toward the state's 70 percent renewable by 2030 target. …consumer costs would increase if the PSC allows for the contract adjustments. Onshore renewable developers are also planning to make a similar request. Without relief, the Sunrise Wind project likely won't get a positive investment decision from the joint venture's board of directors... [Sunrise is] still targeting commercial operation in 2025, a year later than when it was originally awarded. Equinor and BP's projects are also delayed. Empire Wind 1, originally set for 2024 is now targeted for 2026.**

[13] POLITICO Pro | Article | Offshore wind developers ask for more money from ratepayers

Empire Wind 2, originally slated for 2027, is now targeted for 2028 and Beacon Wind 1 is also delayed by a year to 2029.

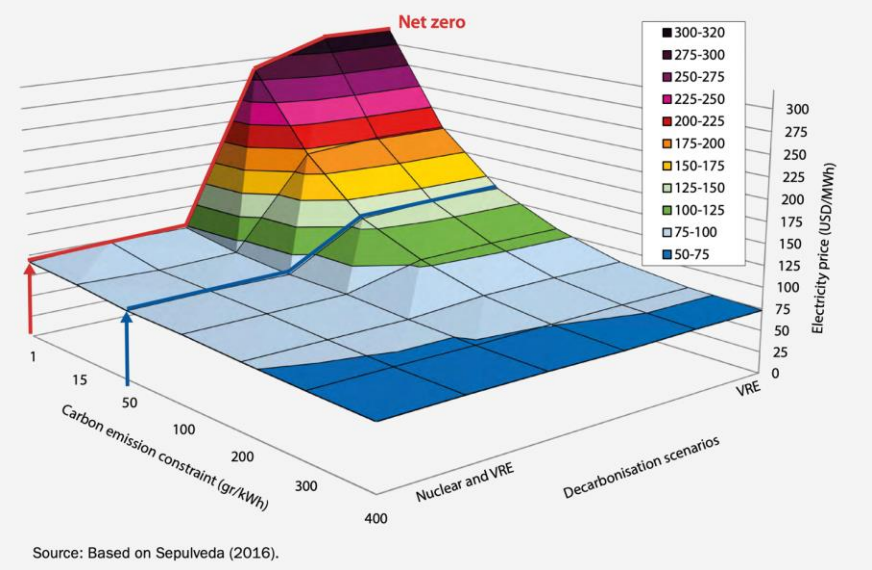
Certainly, the prospects for offshore are doubtful at best. With no jack ships and rising costs forcing contract renegotiations, it is possible that offshore wind construction never happens. In February, Reuters reported "Dominion 'on track' with $9.8 billion Virginia offshore wind farm." That offshore wind farm will have a capacity of just 2.6 GW. We should expect New York's proposed 20 GW to cost in excess of $75 billion, but perhaps significantly more.[14] We must also acknowledge L.I. transmission constraints reported by NYISO in its 20-year outlook: Litigation arising in densely populated, wealthy Long Island communities may halt transmission construction more effectively than poor upstate communities have been able to stop sprawling industrial solar and wind projects on their farms and forests.

Electricity is a just-in-time commodity. You need it when you need it. The problem with solar and wind is that they do not arrive when you need them. This makes integration into the grid expensive and complex. As intermittent resources are added, an equal capacity of fast-ramping dispatchable power must be available. Indeed, studies actually show more capacity in simple-cycle gas is required than the intermittent capacity it supports: "**a 1% percent increase in the share of fast-reacting fossil generation capacity is associated with a 0.88% percent increase in renewable in the long run**." [15] For New York, with just 6% solar/wind penetration and over 50% fossil-fuel powered, the integration costs are

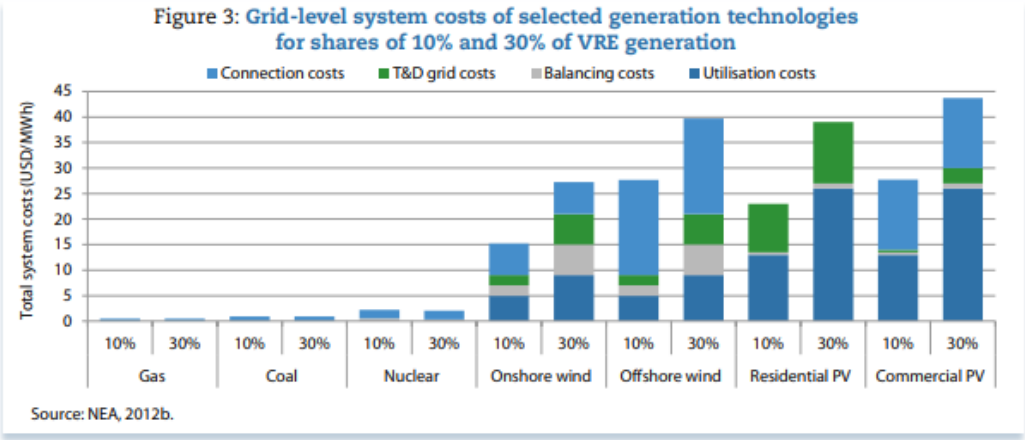
[14] https://www.reuters.com/business/energy/dominion-energy-on-track-with-26- gw-offshore-virginia-wind-farm-execs-2023-02-08/

[15] https://www.nber.org/system/files/working_papers/w22454/w22454.pdf

currently low. But costs for integration rise exponentially as penetration of renewables increases. [16]



We need new transmission to move the full capacity of the resource, even if it is never generated. We need battery storage and maintenance. Finally, we need landfill space and replacement materials when resources retire in 20 years. Note that system costs for intermittent resource connection, balancing, grid costs, and utilization are huge, even for 10%-30% penetration.[17]



[16] https://www.oecd-nea.org/upload/docs/application/pdf/2021-10/system_costs_of_electricity_-_cop26_flyer.pdf

[17] pg 10, https://www.oecd-nea.org/upload/docs/application/pdf/2019-12/7437-full-costs-sum-018.pdf

New York is really a tale of two grids. With the closure of Indian Point and its replacement by two big gas power plants, over 90% of downstate power comes from fossil fuels. New York does have some carbon-free resources: nuclear plants on Lake Ontario, and the Niagara and St. Lawrence hydro facilities. Our upstate grid is 91% clean. All these resources are fully utilized. Any new loads to the state grid, like downstate building electrification, or a Micron plant upstate, will be supported by fossil-fuel generation. They will need additional gas – approval of projects like the Iroquois compression expansion (ExC) – as well as postponement of fossil-fuel power plant retirements. We will likely need new gas plants brought online – like Danskammer.

The Energy Research Policy Institute's critical study of the IEA's 2050 Net Zero suggests that problems ignored in that net zero projection have already occurred in California and Germany. These include high prices, supply chain failures, the inability of mining to keep pace with development, and the failure of new technologies to be ready in time for use. [18]

> **The IEA asserts that the "Net Zero by 2050" scenario would enable a smooth energy transition that ensures constant fuel and electricity supplies, minimal stranded assets, and reduced volatility in energy markets. However, a comprehensive evaluation reveals that the net zero path is anything but smooth, imposing enormous costs and risks on the economies of the West. NZE would inflict a double whammy on the West. The first blow comes from NZE's recommendation to cease investment in new oil and gas fields beyond those already approved. There is no evidence that the world is experiencing falling demand for hydrocarbons, and policies to restrict supplies would lead to rapid and sustained increases in**

18 https://assets.realclear.com/files/2023/06/2205_a_critical_assessment_of_the_ieas_net_zero_scenario_esg_and_the_cessation_of_investment_in_new_oil_and_gas_fields.pdf

> **oil and gas prices. The second blow comes from the switch to a near all-renewable electrical grid, which would have electricity prices soaring more than threefold. These would be body blows to the economies of the West. Even if OECD countries remained fully committed to net zero despite these costs, it is highly unlikely that there would be a sustained two-speed transition. As the developing world fails to meet the energy requirements essential for economic development, most will remain heavily reliant on so-called legacy fuels (fossil fuels and nuclear fuels, when possible). These fuels can deliver sustained, cost-effective, and resilience energy to support economic growth. Renewable and low-carbon energy will play an important role, but it will not see massive introduction until major technological and cost concerns are overcome. Much of the developed world is likely to remain committed to pursuing a costly path toward a net zero future, but cost concerns and failure modes are likely to see a growing realization that the goal is not achievable without accepting substantial constraints to economic growth.**

(10) What is necessary to align a program to meet the Zero Emission by 2040 Target with the priority of just transition embedded within the CLCPA?

The most 'unjust' transition is the one that fails to happen – and this is the course New York is on.

As NYISO states in its 2023 Power Trends referenced earlier, solar panels and wind turbines create new grid reliability problems, even if required transmission existed. Most of the state's fossil-fuel capacity will be needed into 2030 and, doubtless, well beyond.

> **NYISO is obligated under its federally regulated tariffs to pursue solutions to resolve the reliability issue… Increasing levels of intermittent generation combined with increasing demand … are expected to result in at least 17,000 MW of existing fossil-fueled generating**

capacity which must be retained to continue to reliably serve forecasted "peak" demand days in 2030.

There seems to be a major disconnect state planners and environmental organizations have between the suddenly absent downstate nuclear baseload and lots more gas combustion. As an example, consider the astonishment expressed by Earth Justice, Sierra Atlantic, and a host of metro green organizations when they discovered that metro peakers are running much more than before Indian Point's closure. This was comment filed on a renewal permit for Harlem River Yards (HRY), 94 megawatts of peaker power in NYC:

> **HRY has significantly increased operations over the past five years, and, thereby, emissions of both greenhouse gases ("GHGs") and local air pollutants. …The Facility's Total Gross Load in 2018 was 44,612 megawatt-hours ("MWh"). In 2022, it was 125,135 MWh, a 180% increase over 5 years. Problematically, the New York Power Authority ("NYPA"), which owns the Facility, "projects that the facility will be operating in 2030 similarly to its current day operations.**

NYISO can't close peakers down. These will be needed to support intermittent generation. Again, in Power Trends 2023: "**The Peaker Rule includes a reliability consideration that allows for generation to remain in operation for up to four additional years if reliability needs arise from their deactivation… NYISO will likely need to designate affected peaker plants to remain in service beyond 2025**"

Sadly, in pursuing its flawed plan, the state will be creating many more "environmental justice" communities than it eliminates. Fossil fuels – in particular, inefficient simple-cycle plants – will be needed to support intermittent generation. NYISO and NYSERDA project the need for as much firm fast-ramping capacity as the state's current fossil fuel capacity (about 25 GW) but possibly, with beneficial electrification, as much as 45 GW. New York may find itself building new gas plants, as California has

done, rather than closing them. Additionally, the million-acre energy sprawl projected by NYSERDA will create EJ communities across rural New York. New assessment regulations in the current state budget ensure that communities do not get fair tax revenue from the buildout forced on them by accelerated siting, 94-C. Build Public Renewable Act (BPRA) language in that budget means that NYPA can seize land by eminent domain to construct the hundreds —perhaps thousands – of miles of transmission that the intermittent resources require in order to move energy to the NYS metro region. I doubt if people in rural upstate New York regard the state's "energy-sprawl" as a ***just transition***.

Despite lip service about jobs, there are few permanent jobs in solar or wind farms. The proposed 30,000-acre Alle Catt wind farm will support 13 permanent jobs and generate under 80MW average power once wind's capacity factor is figured.

> **Wages are a key factor for people when choosing a workplace but are excluded from the IEA's GEC model. Despite high subsidies and the rapid growth in solar and wind jobs, reflecting their fundamentally poor economics discussed above, hourly wages in wind and solar energy subsectors are significantly lower than those of nonrenewable-energy workers. In electric power generation in the U.S., the median hourly wage in natural gas generation was US$34.02 (nominal), 39% higher than the median wage of US$24.48 in solar generation. The only low-carbon subsectors with higher wages are in the nuclear industry, reflecting nuclear's high productivity.** [19]

(11) How might the benefits of a program to meet the Zero-Emission-by-2040 Target be measured for the purpose of ensuring that, consistent with PSL §66-p(7), it delivers "substantial benefits" to Disadvantaged Communities?

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19 https://assets.realclear.com/files/2023/06/2205_a_critical_assessment_of_the_ieas_net_zero_scenario_esg_and_the_cessation_of_investment_in_new_oil_and_gas_fields.pdf

If peakers and power plants in inner-city neighborhoods, and new power plants like Cricket Valley and CPV in the Hudson Valley can't be shut down, if rural upstate towns are forced to host industrial solar and wind resources that do not reliably, economically power the state, then we will have failed to deliver reduced-emission benefits to historic and new environmental-justice communities. As a Harvard study indicated, eight million people die annually from combustion emissions from fossil fuels. [20] In its recent Power Trends 2023, (also see above Q#10) NYISO indicates that at least 70% (17GW) of state fossil-fuel power-plant capacity will need to remain online to ensure reliability after 2030. It is likely that most of the state's 25GW capacity of fossil-fuel power plants will still be online. California has discovered that more intermittent generators require more fast-ramping simple cycle gas plants, and New York may be building more of these in a decade. EJ communities created as CLCPA was passed, in Dover and Wawayanda; as well as rural towns and villages currently battling industrial energy sprawl without the protection of home rule or robust environmental review, without the reward of fair tax assessment, are all targeted by New York's incoherent energy plan. From Power Trends: NYISO will need to keep inner-city and plenty of other peakers online.

> **If reliability margins decrease to a level in violation of any applicable reliability rules, the NYISO is obligated under its federally regulated tariffs to pursue solutions to resolve the reliability issue. The peaker plants located in New York City protect system reliability, but are located in environmental justice communities that have limited access to cleaner electric supply from other areas of the state due to transmission limitations. Sustaining reliability in these communities throughout the transition towards cleaner resources will be critical to achieving a just transition of the electric system as envisioned by the CLCPA. Achieving state**

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

policy mandates reliably while also protecting communities from the risk of power outages is a NYISO priority.

The state, guided by Big Green slogans and lacking understanding of how the grid works, has figuratively wedged EJ communities in the metro region between a rock and a hard place, and literally forced them to face the poor health impacts of fossil fuel emissions with the lights on, or with the lights off.

(13) What additional studies, if any, should the Commission undertake with respect to the development and deployment of resources capable of achieving a zero emissions grid?

The Commission should consider some of the numerous studies which indicate that intermittent generation will require substantial firm backup, new storage and transmission, and yet may nevertheless fail to economically, reliably, power the grid.

NYISO, the grid operator, whose job it is to keep the lights on, just released its 2023 Power Trends report. This document sheds serious doubt that the current plan will provide reliable energy capacity for New York. Albany, the Climate Action Council, and NYSERDA have ignored substantive criticism of the scoping plan. Perhaps they will listen to the NYISO which indicates that the state's proposed intermittent buildout will cause reliability issues, with the possibility of dangerous outages downstate, particularly if projects like the Champlain Hudson Power Express are delayed:

> **The recent [Reliability Needs Assessment] report emphasizes that already-thinning reliability margins could deteriorate further based on identified risk factors, including the potential for delays in planned infrastructure investments, more extreme weather, or unexpected generator outages or retirements… If CHPE is delayed, the absence of this resource could result in substantially increased risks to reliability by 2028.**[21]

[21] https://www.nyiso.com/documents/20142/2223020/2023-Power-Trends.pdf/

NYISO is obliged by the federal government to maintain a reliable grid, even if state law and the state energy plan try to undermine that effort. NYISO will keep big gas plants online if citizen safety requires it:

> **NYISO is obligated under its federally regulated tariffs to pursue solutions to resolve the reliability issue… Increasing levels of intermittent generation combined with increasing demand … are expected to result in at least 17,000 MW of existing fossil-fueled generating capacity which must be retained to continue to reliably serve forecasted "peak" demand days in 2030.**[22]

New York wants to shutter inefficient peaker plants. But solar panels and wind turbines need simple-cycle gas plants for backup. California has six times New York's installed relative capacity in intermittent generation but has had to build more fast-ramping gas plants to provide backup when there is no sun or wind. NYISO says that inner-city peakers will need to be kept online.

> **The Peaker Rule includes a reliability consideration that allows for generation to remain in operation for up to four additional years if reliability needs arise from their deactivation… NYISO will likely need to designate affected peaker plants to remain in service beyond 2025.**

New York's scoping plan triples required energy imports and exports in an effort to make a nonsensical plan look viable. NY hopes there will be buyers for its excess summer solar so that it does not have to dump it. California dumped 2.6TWh of electricity last year. That wasted energy could have kept the lights on in NYC for two weeks. There is a lesson for New York in this about the cost of energy: No one wanted California's excess solar electricity although it was generated by facilities which Californians had

[22] https://www.nyiso.com/documents/20142/2223020/2023-Power-Trends.pdf/

to buy, install, and maintain. New York will need its neighbor states to help power the grid all the rest of the time. NYISO suggests there may be no electricity to be imported:

> **NERC's 2023 Summer Reliability Assessment identifies reduced supply reserve margins in regions neighboring the NYISO [which] potentially limit the ability to import electricity from neighboring regions, putting greater importance on available supply and transmission within New York** [23]

We have frequently seen what happens in California when expected energy imports don't arrive. Indeed, California and Texas provide stark examples of how deadly it can be to pursue bad energy policy.

A publication by Jesse Jenkins[24] speaks to the fiscal inadvisability and engineering foolishness in pursuing a renewably-powered grid:

> **If wind and solar are pushed to do all the heavy lifting themselves, the system requires enormous excess generating capacity and storage (most of which is seldom used) to provide reliable electricity and completely drive out greenhouse emissions. This strategy ends up being much more expensive and much more demanding of land and infrastructure than other possible pathways.**

Brick and Thernstrom point out that[25]

> **…even with very high levels of wind and solar, considerable conventional capacity (here designated as NGCC-natural gas combined cycle) must be retained to ensure continuity of supply when it is calm or cloudy…Under 50% RPS [renewable] scenarios, more than 40% of the**

[23] https://www.nyiso.com/documents/20142/2223020/2023-Power-Trends.pdf/
[24] https://jacksonlab.stanford.edu/publications/academic/clean-firm-power-key-californias-carbon-free-energy-future
[25] https://innovationreform.org/wp-content/uploads/2016/11/EJ-Article-Brick-Thernstrom-1.pdf

installed capacity remains gas-powered; under 80% RPS scenarios, the NGCC component of the system remains almost as large, only supplemented with much larger renewables systems that produce smaller emissions reductions.

New York's 2030 70% plan (requiring almost 50% solar/wind) may not enable significant decommissioning of gas plants, even if it were possible to achieve this colossal increase in solar/wind resources in six years. At a certain point, with each RPS percent increase, smaller and smaller emissions reductions are achieved.

These are just two of many studies which suggest that substantial firm capacity will be needed even with 60%-80% intermittent capacity. Other studies consider the huge cost of integrating intermittent resources into the grid. Wind and solar installations will need dedicated transmission for full nameplate, although they will rarely if ever generate this power. They will require fast ramping backup – like inefficient gas peakers – available at full capacity. They will need landfills available for the panels in 20 years, and replacement for those panels. They require battery storage which will need to be replaced every 10-20 years.

NYSERDA's energy storage roadmap projects the need for 6.8 gigawatts (GW) of 8-hour storage. This represents over 50GWh of storage, and is 40 times the size of the world's largest lithium-ion facility in Moss Landing, CA. Besides costing tens – perhaps hundreds -- of billions of dollars, if energy demand doubles by 2050, as projected by NYISO, this storage would not power NYC for three hours.

Respected environmental scientists like Kerry Emanual have written in detail about challenges to decarbonization.[26]

[26] https://texmex.mit.edu/pub/emanuel/PAPERS/Nuclear_Salvation.pdf

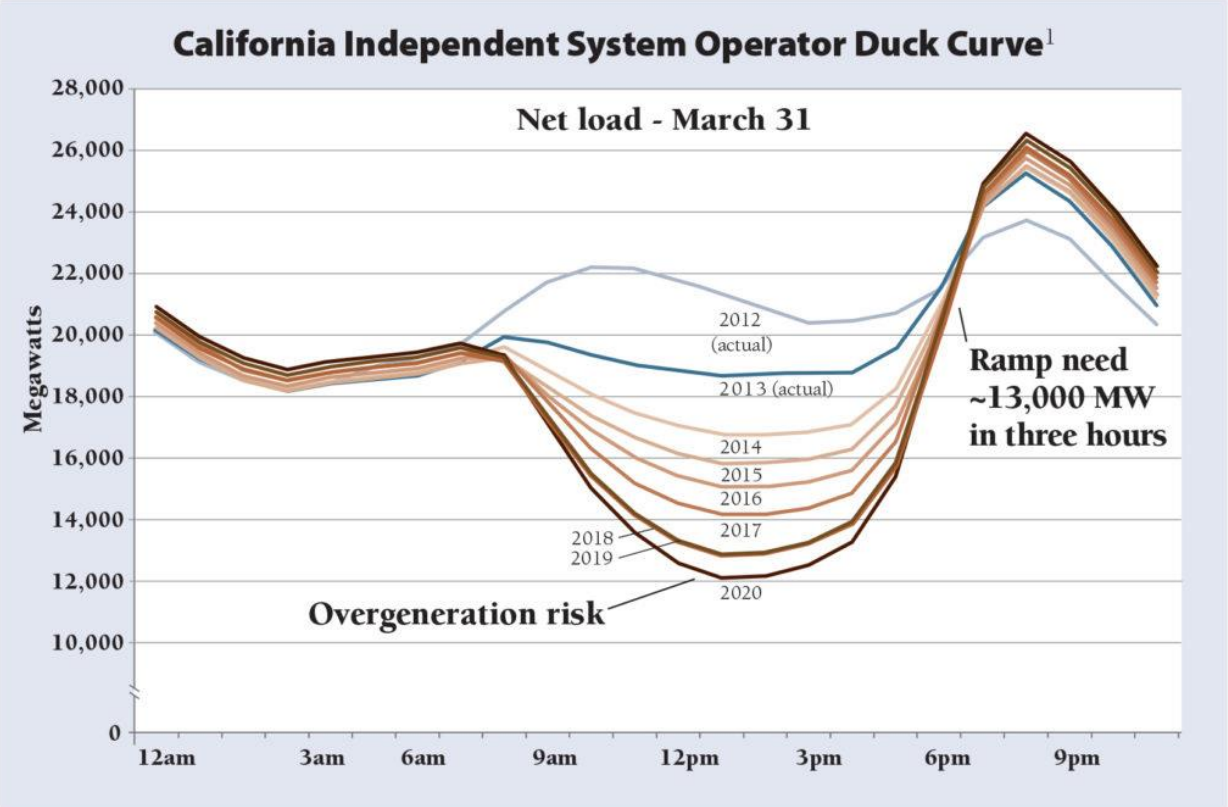
Demand for electricity is likely to nearly triple over the next 40 years. Globally, about 940 million people—almost three times the population of the United States—are without access to electricity; providing them with electric power is an essential step in lifting them out of poverty. Decarbonization of vehicles, today responsible for about a quarter of global greenhouse gas emissions, will also drive up demand for electricity.

The task is thus not only to decarbonize existing power grids but to extend them and to build new carbon-free grids in the developing world. In addition, major hard-to-electrify markets such as industrial processes, residential heating, and maritime transport rely overwhelmingly on combustion of fossil fuels, and in doing so account for about 35 percent of total carbon emissions: those sectors also urgently have to be decarbonized.

A few nations with small populations and plentiful non–fossil energy have decarbonized electricity; Norway with abundant hydro power and Iceland sitting atop an enormous geothermal source come to mind. Otherwise, nations that have successfully decarbonized electricity, such as Sweden, Switzerland, and France, did so largely with hydro and/or nuclear power, and they did so very quickly—within a dozen years or so. These are reality-based examples of how to decarbonize fast. By contrast, most nations that have pushed hard to ramp up solar and wind power alone have seen relatively slow growth in carbon-free energy and have not reduced their emissions appreciably. Germany, for example, managed to ramp up solar and wind power to almost 40 percent of net production, but because it is shutting down its nuclear power plants, it has reduced greenhouse gas emissions by only a small fraction. It also has one of the highest electricity costs in western Europe, has increased volatility in the European power market, and is compromising the stability of the European power grid.

Advocates of solar and wind rightly point to steep declines in costs of solar photovoltaics and wind turbines in painting a bright future for those sources. At low market penetration, the intermittency of these power sources is balanced by dispatchable sources such as natural gas. Once their market penetration becomes substantial, it becomes necessary to store energy during periods of low sunlight and/or wind, and the considerable costs of storing energy must be added to the production and operating costs of solar and wind arrays. Solar, wind, and hydro also have environmental costs (as do all energy sources), and most hydro sources are already being exploited, so there is not much further capacity for growth.

In this context, it is worth mentioning California's energy "duck curve."[27]



[27] CAISO, Stanford, and elsewhere. This from theEnergyCollective.com

California's solar capacity factor (22%-24%) is twice New York's (11-14%) but solar is generated midday when many people are at work. The duck curve is most extreme in spring, when weather is cool. This situation also seems to be getting worse with increases in installed solar capacity. [28]

> **The curve was developed to show the impact of increasing distributed solar PV capacity on the demand for grid electricity. As solar PV capacity grows, the demand for grid electricity falls during the day with the greatest decrease in the middle of the day when PV production is highest – the belly of the duck. In the afternoon as PV production declines towards sunset, the demand for grid electricity can grow quite quickly – the neck of the duck.**
>
> **The duck is growing faster than anticipated. Five years ago, the California ISO had expected California midday demand to drop over 40% on a sunny spring day by 2020 thanks to the growth of small solar PV systems. In fact, by 2018, the spring mid-day demand on the high voltage system had already decreased by two thirds. The consequent increase in supply required in the late afternoon as solar production recedes, was already close to 15 GW, significantly greater than the 2020 anticipated level of 13 GW.**

Emanuel notes

> **Modern nuclear reactors are very reliable and robust machines. Per kilowatt-hour generated, nuclear is among the very safest sources of energy, comparable to solar and wind and much safer than hydro and all fossil fuel sources. Transport and storage of spent fuel are technically manageable and in fact routinely practiced (Finland and Sweden are close to opening permanent repositories), but face substantial popular resistance.**

[28] https://www.iea.org/commentaries/more-of-a-good-thing-is-surplus-renewable-electricity-an-opportunity-for-early-decarbonisation

…in several eastern nations, nuclear energy is alive and expanding. South Korea has been building new 1 GW reactors for $2–3 billion both at home and in the Middle East. There is vigorous competition between China and Russia for the nuclear power export market, and, owing in part to the income generated from exports, these nations are also developing and building advanced reactors that are much more efficient and even safer than existing light water reactors.

Using the current South Korean capital costs, all of the projected global electrical power need of 5 terawatts in 2040 (IEA 2018) could be generated by building about 125 2 GW plants per year at a cost of $500 billion per year, about 0.6 percent of current gross world product (GWP) (CIA 2019). This does not include likely cost reductions from innovation and mass production. Moreover, shuttering fossil fuel plants results in large reductions in respiratory disease and deaths, at the economic equivalent of about $400 billion a year by 2040,1 so the $100 billion net annual cost of decarbonizing is roughly 0.1 percent of GWP.

Capital costs of building solar energy overnight storage with current technology would run in the hundreds of billions of dollars per year, but judicious combinations of nuclear and renewable energy would greatly reduce the need for storage, while nuclear heat could help decarbonize the large and growing industrial demand for high-temperature heat sources. Even conservative estimates of the costs of unmitigated climate change are far higher than the costs quoted here; for example, the Intelligence Unit of The Economist magazine estimates that the annual cost of climate change by 2050 will be 3 percent of the world's GDP (EIU 2019), or about $3 trillion.

Dr. James Hansen writes eloquently about NY's scoping plan. [29]

> **Recently, the state's Climate Action Council released a draft "scoping plan" on how the climate act might be implemented. It proposes hundreds of square miles of solar panels, thousands of onshore and offshore wind turbines, and massive battery investments. Acknowledging that existing renewable energy and storage technologies are insufficient to achieve a carbon-free grid, the plan hinges on future breakthroughs and extremely optimistic trajectories. However, it gives short shrift to our most reliable, proven means of decarbonization: nuclear power.**
>
> **The draft plan admits that nuclear power provides much of New York's carbon-free electricity today, even after decades of solar and wind deployment. Technical analysis in the plan also confirms that extending the operational life of reactors is a cost-effective way to limit greenhouse gas emissions. Yet the rest of the document portrays nuclear as more a problem than a solution, thus contributing to public misunderstanding and misplaced fear. Furthermore, the plan ignores the potential for advanced nuclear technology to help meet future electricity demand, and to produce high-temperature heat and carbon-neutral fuels for industry and transportation.**
>
> **Nuclear power has the smallest land footprint and lowest life-cycle carbon emissions of any energy source. It can generate electricity around the clock or as needed. It is also among the safest forms of energy on the planet. Indeed, Dr. Pushker Kharecha and I showed that as of ten years ago, nuclear power had saved 1.8 million lives by displacing polluting fossil fuels — a**

[29] https://www.timesunion.com/opinion/article/Commentary-Nuclear-power-must-be-part-of-New-17071213.php

number that could be multiplied several-fold by midcentury. Nuclear power provides good-paying union jobs and tax revenue. It enables vibrant, thriving communities.

Tackling the climate crisis requires policies based on facts, not prejudice. Wind and solar power help with early decarbonization, where they can replace fossil fuels without need for large storage and transmission upgrades. However, systems overly dependent on intermittent, low-energy-density renewables — as California and Germany have proven — lead to skyrocketing electric rates, grid instability, and continued dependence on fossil fuels. Cost-optimized energy modeling reveals that nuclear power must ramp up for emissions to approach zero. In fact, the U.N. Intergovernmental Panel on Climate Change finds that nuclear generation in 2050 grows by two to six times 2010 levels for all four illustrative pathways consistent with limiting global warming to 1.5°C. Today's policies need to reflect this awareness and initiate multi-decadal plans to achieve reliable, affordable, and sustainable energy systems.

Significantly, many governments are beginning to understand that nuclear power is part of the answer. France, which decarbonized its grid with nuclear years ago, has announced support for a new generation of reactors. So have the United Kingdom, the Netherlands, and Canada. In our country, several states have taken steps to preserve their existing plants, while others like Wyoming are developing passively safe advanced nuclear technology for the future. Members of Congress on both sides of the aisle are on board, too. Highlighting federal 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."

New York belongs at the forefront of innovation, not on the sidelines. A brighter tomorrow is possible, but it requires setting politics and ideology aside. If New York is to meet its climate goals while providing ample, reliable energy essential for prosperity, it must engage in an inclusive discussion of solutions and craft a realistic plan that recognizes the value of nuclear power today and in the future.

(14) Given that New York is not the only jurisdiction investigating options and opportunities for the research, development, and deployment of new technologies capable of achieving a zero emissions grid, how should the State seek to coordinate with and otherwise draw upon efforts that are underway elsewhere?

The Commission, and the Climate Action Council, should examine recent studies by PJM[30] and the California Independent System Operator (CAISO). PJM completed a study of costs to integrate intermittent generators into the grid. [31]

The study consisted of multiple scenarios that integrated between 30,000 MW and 80,000 MW of renewable generation and identified the need for as much as $3 billion in transmission upgrades to integrate PJM coastal states' offshore wind targets

Based on these numbers, New York should expect costs of $2B or more just for offshore transmission integration.

[30] PJM Interconnection is a regional transmission organization (RTO) that coordinates the movement of wholesale electricity in all or parts of Delaware, Illinois, Indiana, Kentucky

[31] https://pjm.com/-/media/library/reports-notices/special-reports/2022/20220510-grid-of-the-future-pjms-regional-planning-perspective.ashx

Other studies suggest major problems for offshore installations in hurricane conditions. Current (European) designed offshore wind turbines can only withstand 160MPH winds and have trouble with wind veer. But hurricane winds can exceed 200 MPH. Dominion has been silent about hurricanes, and ratepayers in Virginia will be on the hook for failures. This article references University of Boulder and the National Renewable Energy Laboratory research and indicates that redesign is needed to withstand winds over 160 MPH. [32]

> **George Bryan of the National Center for Atmospheric Research recommended ... a computer simulation driven by hurricane data from the last 15 years.[33] Bryan used this high-resolution model to recreate the worst of the worst — a category-5 hurricane eyewall, where winds can exceed 220 miles per hour — to see how wind turbines would hold up. The team also investigated how wind characteristics, such as changes in direction and turbulence, might affect turbines…Researchers found the extreme wind speeds they modeled would cause structural damage to wind turbines and possible failure of turbine parts. When wind speeds from typhoon Usagi in southern China exceeded turbine specifications in 2013, for instance, blades bent and towers toppled over.**
>
> **Large and fast changes in wind direction could be problematic too, based on Worsnop's model. Wind turbines work best when facing directly into the wind, so turbine rotors swivel about the tower to maintain a wind-in-the-face orientation. The researchers found most turbines would not twist fast enough to respond…Their model also predicted wind direction changes up to 55 degrees between the ground and the tip of a blade — a measurement called veer. As a result, these category-5 winds could bend a turbine blade in one direction — say, at**

[32] https://www.cfact.org/2022/06/24/hurricane-risk-is-real-for-offshore-wind/
[33] https://www.pbs.org/newshour/science/offshore-wind-turbines-cant-handle-toughest-hurricanes

the tip — as it simultaneously applies stress on another portion, causing the blade to malfunction or break.

The PJM study referenced earlier suggests key focus areas for the stakeholder community:[34]

- **Correctly calculating the capacity contribution of generators is essential: A system with increased variable resources will require new approaches to adequately assess the reliability value of each resource and the system overall.**
- **Flexibility becomes increasingly important with growing uncertainty: The study reaffirmed the need for operational flexibility to address the uncertainty of variable resources. Findings include 50% steeper net-load ramping periods, frequent dispatch of generators to their economic minimum, and lower capacity factors for thermal resources.**
- **Thermal generators provide essential reliability services today and an adequate supply will be needed until a substitute is deployed at scale: PJM and stakeholders must ensure that the market structure provides the right incentives to maintain these reliability services.**

With reference to these focus areas, note that fast-ramping generators like peakers needed to support intermittent resources have half the efficiency (about 30%-35%) of combined cycle plants (60% or more), so we could add significant solar/wind capacity to the grid but find, as California has discovered, that we haven't cut fossil-fuel demand significantly. Perhaps scoping plan authors and advocates in "Big Green" organizations had not taken the semester of physics or engineering to learn the difference between power (MW) and energy (MWh). In any case, New York has made a mistake in focusing on the capacity (MW) contribution of proposed intermittent resources. We need to look more carefully at their

[34] https://insidelines.pjm.com/pjm-releases-initial-results-of-renewable-energy-transition-study/

expected energy (MWh) contribution based on very conservative capacity factors. Consider what happened in Germany (winter, 2021) [35]

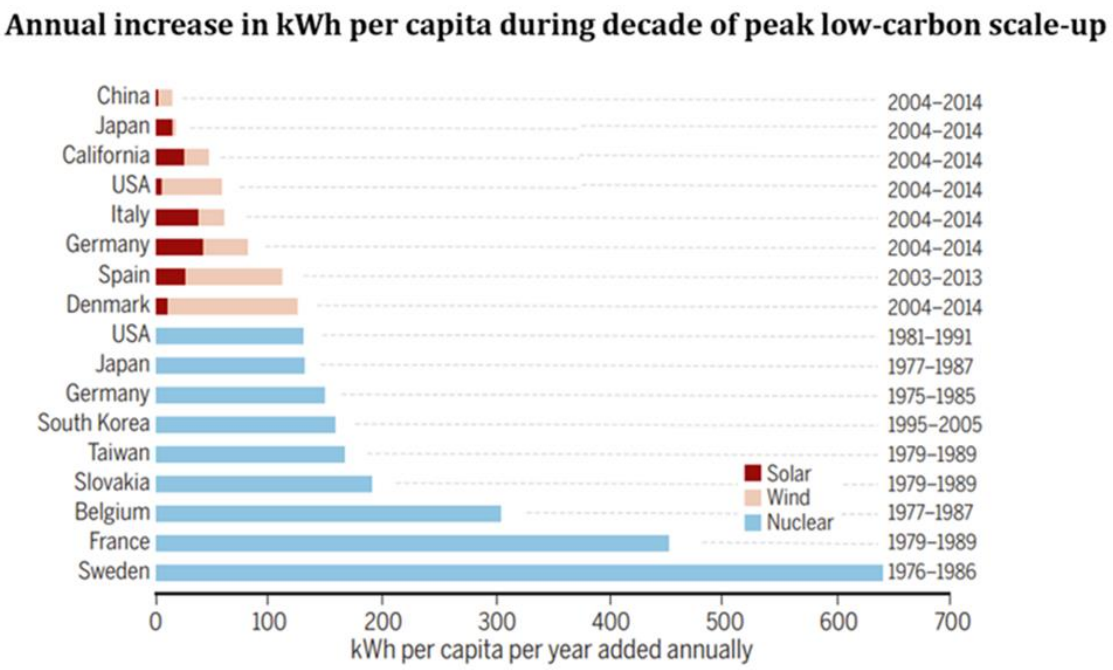
> **Germany's millions of solar panels are blanketed in snow and ice and its 30,000 wind turbines are doing nothing as the freezing weather has no wind resource to keep the turbines operating. Instead, the solar and wind units are drawing power from the grid powered mainly by coal to keep their internal workings from freezing up. Despite Germany being the poster child of Europe's renewable future, the country's Energiewende—transition to wind and solar power—is not working. The Germans have found that dependable, dispatchable coal can work in any weather and is the savior during these cold months. The plan is that Germany will have to rely more on natural gas from Russia, coal power from Poland and nuclear power from France, importing power along huge cables, instead of building a huge fleet of batteries to back up its intermittent renewable power.**
>
> **However, for this unreliability of wind and solar power during this year's snowy and icy winter, German consumers paid $38 billion ($30.9 billion euros) in subsidies for its renewable energy growth in 2020, despite the financial needs of other sectors of its economy afflicted by the coronavirus pandemic. The renewable energy subsidy is paid directly by consumers in their electricity bills, helping make German residential retail power costs the highest across the European continent and 3 times higher than those of the United States.**

[35] https://www.netzerowatch.com/coal-rescues-germany-from-its-renewable-energy-folly/

A picture of expected costs might be gleaned from CAISO's 20-year-outlook study.[36] In the $30.5B plan CAISO considered buildout very much like New York is planning:

> **a scenario that called for 37 GW of battery storage, 4 GW of long-duration storage, around 53 GW of utility-scale solar, 24 GW of wind generation**

Certainly, the Commission should consider those large economies which have effectively decarbonized. This should not be news, as we have known for half a century how to do it. The only large economies successfully to decarbonize, did it with baseload zero-emission resources: hydro, nuclear, or both.



In 10-15 years, using older technology, France and Sweden decarbonized their grids using nuclear power.

As noted earlier, New York must also take a closer look at those "jurisdictions" which have tried to decarbonize using primarily intermittent resources – California and Germany. Despite 30%-40%

[36] http://www.caiso.com/InitiativeDocuments/Draft20-YearTransmissionOutlook.pdf

solar/wind capacity on the grid, neither has significantly cut reliance on fossil fuels. Germany mines coal and suffers from dirty air and a dirty grid. California depends on imports for 30% of its energy, much of that coal-generated. When imports don't arrive, the lights go out in LA. Although California can boast the largest lithium-ion battery in the world-- the 1.2 GWh facility at Moss Landing-- there is no storage capable of solving the diurnal problem, let alone able to carry energy from summer to winter. PG&E customers pay 80% more than the average US cost for electricity.

Concluding Remarks

In order to accelerate an unpopular, unfair, and technically suspect buildout of solar and wind, Albany found it necessary to suspend environmental review and home rule, move industrial project tax assessments to the capitol, offer staggering subsidies for projects which mostly generate no energy at all, and permit NYPA to use eminent domain to build necessary transmission. The buildout sacrifices forest and farmland, indeed, whole communities, based on a flawed, slogan-driven, myopic plan. As noted by the NY Bar Association,

> ...**the burden of hosting renewables facilities, especially solar farms, will not be distributed evenly throughout the state. Rather, they will be concentrated in those areas where it is easiest and least expensive for energy companies to build. This means that developers will choose sites where population density and land prices are low, the ground is level, the soil contains no rocks or roots, and transmission lines are close – typically within two miles. These also happen to be the very places where New York's prime agricultural soils are located. In other words, the necessary solar and wind farms might well end up on New York's most valuable farmland… ORES, as well as the energy companies themselves, would be well advised to respect rural communities' legitimate land use concerns, regardless of the local law preemption provision of Section 94-c. Past failures to protect politically powerless**

communities from having to host a disproportionate share of New York's fossil fuel-driven power plants led belatedly to a recognition that those communities were victims of a grave environmental injustice. ORES should therefore muster the political will to respect local zoning codes that provide ample opportunity for the siting of utility-scale solar and wind facilities. It can do so by interpreting the "unreasonably burdensome" preemption provision as requiring a determination that the local law, in its entirety, unreasonably burdens the state in achieving its CLCPA goals before preempting that law.

Land use regulation belongs to those powers that New York municipalities have long considered to be theirs under "home rule." Eliminating it entirely to promote green energy could exacerbate New York's ever-present upstate-downstate, rural-urban divides. Indeed, some upstaters who may otherwise be well-disposed to green energy appear to be already turning against what they view as a renewables infrastructure that serves mainly downstate energy demands but burdens mainly upstate communities and their local foodsheds. As one town supervisor in Schoharie County stated, "This 'streamlining' of green energy siting has toxified the political middle." [37]

Ontario abandoned a 'green energy' plan similar to New York's because – as is happening in here– there was fierce backlash from the rural north which was required to host renewables in order to power the wealthier more populous south.[38]

Ontario Energy Minister Glenn Thibeault has issued a mea culpa on the way the Liberal government implemented its Green Energy plan. Thibeault says the implementation of the

[37] https://nysba.org/preempting-local-zoning-codes-fuels-opposition-to-renewable-energy-in-new-york/#_edn6
[38] https://globalnews.ca/news/3272095/ontario-energy-minister-admits-mistake-with-green-energy-program/

Green Energy Act has led to "sub-optimal outcomes" for consumers and to increased prices in electricity for families and businesses in Ontario.

Perhaps we will hear similar ***mea culpa*** coming out of the PSC, the CAC, and the governor's office in the next few years.