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

July 1, 2022

Draft Scoping Plan Comments
NYSERDA, 17 Columbia Circle
Albany, NY 12203-6399

*Submitted by electronic mail via scopingplan@nyserda.ny.gov*

**RE: Comments on Draft Scoping Plan**

Please accept the following comments on behalf of New York Energy & Climate Advocates (NYECA). We are a non-profit, volunteer-based organization of scientists, engineers, environmentalists, business professionals, and advocates for social justice who understand the reality of climate change and the moral imperative for timely action employing effective solutions that work in the real world.

We acknowledge the substantial effort which has gone into adoption of the Climate Leadership and Community Protection Act (CLCPA), analysis that has been performed by NYSERDA, and numerous meetings that have been convened by the Climate Action Council and various working groups. We are also grateful for the public hearing process which has allowed interested parties to provide comment. However, our organization is deeply concerned that the scoping plan drafted by the Council will not meet the CLCPA's aggressive goals. As we will demonstrate, the unrealistic and technically flawed plan which has been proposed sets New York up for failure with respect to its decarbonization objectives, ultimately perpetuating the state's reliance on fossil fuels. In doing so, it also threatens to prolong the exposure of environmental justice communities to pollution, unduly burden ratepayers, and hurt the state economically.

Respectfully, our concern stems from the fact that NYSERDA and the Climate Action Council have cast aside important "tools in the toolbox", thereby turning a difficult task into one that, from a practical standpoint, becomes impossible. No form of energy is without impact and the technical potential of some carbon-free sources are limited. However, addressing the climate crisis requires an unbiased, science-based review of all viable technologies without prejudice. The draft plan fails to do this.

As we discuss, by downplaying the value of New York's reliable fleet of nuclear plants and ignoring the potential of expanding nuclear power in state (and to a lesser degree hydro), the draft is left contemplating implausible scenarios—constructs which rely on unrealistic amounts of intermittent generation, massive battery storage, and an unbelievable network of hydrogen-based firm backup capacity, comparable to the total capacity of fossil fuel plants in the state today. Further, by relying on substantial amounts of imported electricity, a dubious exchange of energy with other regions to meet real-time demand, and copious amounts of materials produced elsewhere in the world, the draft plan undermines claims that its proposed approach serves as a model of sustainability for the nation or world. Perhaps most concerning is that the draft scoping plan turns a blind eye to clear warnings of how the strategy it has put forth—as seen in both California and Germany—falls apart in practice, and the danger which that failure poses to New York's environment, its economy, and energy security.

To be clear, we support the state's goal of carbon-free electricity by 2040. We also believe that it is achievable—but not with the plan which has been proposed.

Our comments are organized into five parts:

(1) An unrealistic approach to a very real problem
(2) System-level realities of grid decarbonization
(3) Errors and oversights
(4) Consequences of failure
(5) Designing a decarbonization plan that works
(6) Recommendations

Additionally, our comments incorporate by reference various materials and testimony previously submitted by NYECA and other parties to the Climate Action Council, its working groups, and the Public Service Commission.

Our comments focus on the electric sector because the burning of fossil fuels for electricity is a major contributor to greenhouse gas emissions, and because—as the Council and NYSERDA admit—successful decarbonization will require the beneficial electrification of other sectors, which in turn requires generating even more electricity. If New York does not successful decarbonize its electric grid, the CLCPA will fail regardless of other measures.

Sincerely,

Keith Schue
Technical Advisor, MS Electrical Engineering
New York Energy & Climate Advocates
keithschue@gmail.com
407-470-9433

Leonard Rodberg, PhD
Professor Emeritus of Urban Studies Queens College/CUNY
and Co-Director Community Studies of New York, Inc.
New York Energy & Climate Advocates
lensqc@infoshare.org
917-601-0186

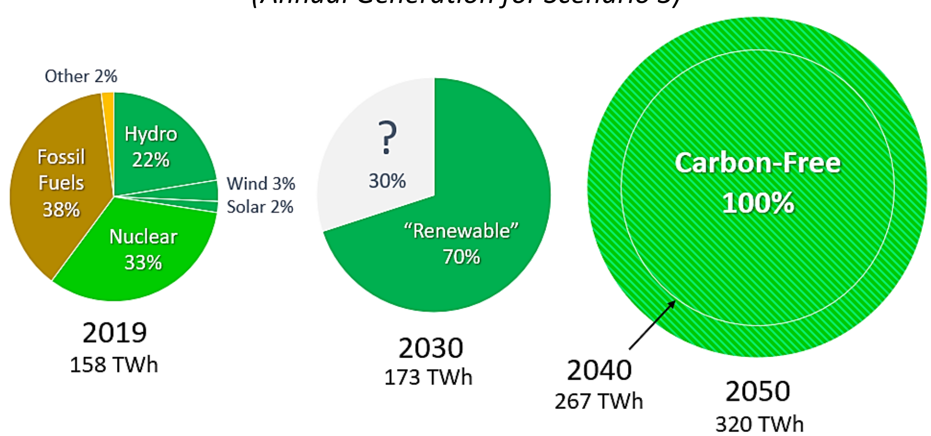
## I. An Unreal Answer to a Real Problem

To appreciate the challenge New York faces, it is useful to compare the composition of electricity that the state consumed in 2019, the year in which the CLCPA was adopted, to targets set forth by the CLCPA and NYSERDA. For this, we reference Scenario 3 in NYSERDA's Integration Analysis, which has received the most attention; however, our comments are largely applicable to all four scenarios.

As seen below, total demand for electricity in New York was about 158,000 GWh in 2019.[1] Approximately 27% of this was met from renewables (predominantly hydropower), 33% from nuclear, and 38% from fossil fuels. Notably, electricity generation from fossil fuels has actually increased in New York following the closure of Indian Point.[2] NYSERDA predicts that demand will grow to more than 173,000 GWh by 2030 when the CLCPA requires that 70% electricity demand be met with renewables. Achieving this interim goal will be a herculean task. But even if successful, nearly all of the resulting gains in greenhouse gas reduction will be wiped out if nuclear power is lost in the 2030 timeframe and the remaining 30% of New York's electricity demand is met with fossil fuels.

By 2040, the CLCPA requires that the state's grid be carbon-free—and the legislation does not place any conditions on the composition of that generation. However, in that year NYSERDA also predicts that demand will exceed 267,000 GWh annually with the beneficial electrification of other sectors. By 2050, NYSERDA expects demand to swell to almost 320,000 GWh. This growth is depicted by the increasing size of each pie below.

***Electricity Generation in 2019 and CLCPA Electricity Goals***
*(Annual Generation for Scenario 3)*




While the above figure illustrates the formidable task of producing enough electricity as demand grows, designing a grid that is capable of reliably meeting demand at all times, regardless of load and supply conditions, is far more complex. It is a task that requires attention to not only the nameplate capacities of various sources and the amount of electricity they produce over the course of a year, but the availability of those sources to provide electricity when needed in real time. Moreover, it requires

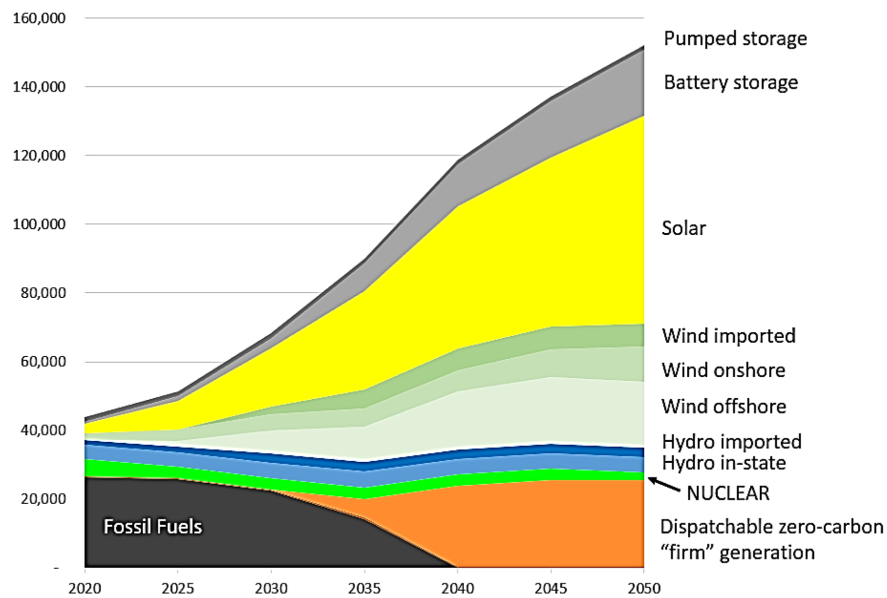
[1] NYISO 2020 Load & Capacity Data Gold Book, https://www.nyiso.com/documents/20142/2226333/2020-Gold-Book-Final-Public.pdf; includes 2043 GWh of behind-the-meter solar estimated in 2019 (using 12.3% DC solar capacity factor derived from NYISO 2020 annual solar generation and BTM installed DC solar capacity projections).

[2] https://www.nuclearny.org/indian-point/

attention to what resources comprise the system (generators, storage, and transmission), the optimal balance of those resources taking into account their different performance characteristics, and ultimately how many new resources must be deployed.

The following figure depicts NYSERDA's proposed deployment of generation and storage capacity in Scenario 3 of its Integration Analysis through 2050.

**NYSERDA Scenario 3 Electricity Generation Capacity (MW)**




As seen above, NYSERDA's plan relies upon a very rapid and dramatic expansion of generation capacity and storage. Whereas NYSERDA predicts a *doubling* of demand between 2020 and 2050, the amount of carbon-free capacity to meet that demand—which translates into physical equipment that must be built and deployed—would need to increase nearly *nine-fold*. The fundamental reason for this is because the Climate Action Council's draft plan relies overwhelmingly on underperforming resources with low capacity factors. The DC capacity factor of photovoltaic solar panels within upstate New York is only about 14%-16%.[3] Likewise, onshore wind in the state has an average capacity of only 26% based on NYISO data.

NYSERDA's assumptions about capacity factor and other flaws in the plan are discussed in the next section of these comments. However, even if one ignores those issues, at face value the agency's own figures reveal that the scale and pace of deployment for solar, wind, and other necessary support infrastructure being contemplated defies reality, exceeding rates anywhere on the globe. Neither NYSERDA nor DEC attempt to quantify the physical impacts of such an endeavor, including the amount of land conversion involved, material requirements, transmission, or the logistics of supply chains and construction. Nevertheless, as discussed below, NYSERDA's estimates of required capacity are sufficient to gauge whether the proposed plan passes the straight-face test. It does not.

[3] Solar capacity factor varies by latitude and configuration, with tracking panels performing better than fixed. See https://pvwatts.nrel.gov/pvwatts.php. In its analysis, NYSERDA assumes a DC to AC capacity ratio of 1.2.

*Solar*

In Scenario 3, NYSERDA predicts the need for about 60,000 MW of solar in 2050, of which about 45,000 MW would be large-scale utility-grade installations that NYSERDA assumes will be single-axis tracking, ground-mounted projects. NYSERDA assumes that the remaining 15,000 MW of solar are “distributed generation” projects, which could include both rooftop solar and ground-mounted community solar arrays. The National Renewable Energy Laboratory (NREL) estimates a total land area of about 8 acres per $MW_{AC}$ of capacity for large-scale, single-axis tracking projects and for small-scale fixed-panel installations.[4] This includes spacing between rows of panels for access and to prevent shading, as well as related onsite equipment and infrastructure (land within a project’s security fence). Therefore, if at least a third of “distributed generation” solar projects are ground-mounted community solar, this totals roughly 50,000 MW of industrial-scale projects requiring 400,000 acres of land.

Such a buildout would require converting over 600 square miles of rural New York--mostly undeveloped natural lands, forest, or farms—to glass, copper, and steel. Indeed, this would require sacrificing about 23 square miles—an area larger than Albany—to industrial energy sprawl each and every year for the next 27 years. (Even if one assumes very optimistic gains in solar efficiency in the years ahead, such an approach would still likely require consuming a land mass somewhere between the size of the city of Binghamton and Albany each year.) The draft scoping plan provides no analysis of the logistical feasibility of such an endeavor or its environmental impacts.

The following photo assists in visualizing the impact. The Long Island Solar Farm at Brookhaven National Labs is a 31.5$MW_{AC}$ plant occupying approximate 200 acres.[5] New York would have to build approximately 60 solar farms of this size each and every year for the next 27 years in Scenario 3.

***Long Island Solar Farm at Brookhaven National Labs***


[4] https://www.nrel.gov/docs/fy13osti/56290.pdf; see also https://greencoast.org/solar-farm-land-requirements/
Average total area for large-scale single-axis solar PV: 8.3 acres/$MW_{AC}$
Average total area for small-scale (less than 20MW) fixed panel PV: 7.6 acres/$MW_{AC}$
[5] Long Island Solar Farm utilizes fixed panels, rather than tracking. Fixed panel systems require slightly less land per watt of nameplate capacity but have lower capacity factor.

Like many of the large-scale installations currently being proposed, construction of the Long Island Solar Farm impacted forest and wildlife habitat. However, at least in the case of Brookhaven National Labs, substantial natural land was put into permanent conservation as mitigation for those impacts. No such requirement exists for projects approved through New York's Office of Renewable Siting (ORES).

Given New York's climate and latitude, particularly upstate where most solar projects would be located, it makes little sense that the draft plan chooses an approach which relies so heavily on technology that has the lowest performance and poorest capacity factor of all renewable sources. Simply due to location, for every two solar panels installed in southern California, New York would require three to produce the same amount of electricity—and even doing so, the effective availability of that electricity would be substantially less. California also possesses large swaths of brown desert that the public might otherwise consider disposable. However blanketing upstate New York with industrial solar plants would consume green rolling hills, forests, and farmland—likely causing many to see red in more ways than one. As we discuss later, a strategy that copies California should be even less attractive in light of the poor results and adverse consequences observed there.

*Wind*

In addition, NYSERDA predicts the need for over 8,000 MW of additional land-based wind development within the state pursuant to Scenario 3. Assuming onshore wind turbines with individual capacities of 3-5 MW each, this corresponds to about 2000 additional land-based wind turbines, or more than one installed every week somewhere upstate for the next 27 years. At a density of roughly 80 acres per MW of installed capacity, this would require wind farms covering 640,000 acres of the state, or approximately 1000 square miles.[6] From a technical standpoint, the optimal siting of wind turbines is much more difficult than solar since performance is highly dependent or location and topography. Optimizing performance often requires siting on forested hilltops, which are also highly visible. However, again, the draft scoping plan provides no analysis of the logistical feasibility of such an endeavor or its environmental impacts. Nor has NYSERDA evaluated the technical feasibility of finding thousands of available sites capable of achieving the very optimistic capacity factors assumed. As with solar, the Climate Action Council seems to take for granted the tolerance of upstate communities to this level of impact.

With respect to offshore wind, NYSERDA estimates the need to develop over 19,000 MW of capacity in Scenario 3, more than twice the amount of offshore wind capacity mandated by the CLCPA. Assuming the use of large 10 MW turbines, this would require completing the installation of one offshore turbine every week for the next 27 years. The draft scoping plan provides no analysis of the logistical feasibility of this. In addition to onshore and offshore wind, NYSERDA assumes in Scenario 3 that it will be able to import about 6600 MW of wind from other regions to provide about as much energy as generated by all of the onshore wind turbines it proposes in-state. Based on notations in Appendix G of its Integration Analysis, NYSERDA appears to assume the source of this imported electricity will be Ontario ISO (Canada), Hydro Quebec (Canada), and the PJM grid. However, NYSERDA provides no other information on where those facilities (offshore or onshore) might reside or analysis on the feasibility of these other regions installing additional wind capacity to service New York's needs or to build the transmission facilities to deliver that electricity to New York. As discussed in the next section, achieving

[6] https://www.nrel.gov/docs/fy09osti/45834.pdf ; Average total area: 34.5 hectares/MW = 85.3 acres/MW

the very high capacity factors assumed for imported wind power would require facilities that are almost entirely offshore.

*Storage*

Because wind and solar are intermittent rather than dispatchable sources, it is not possible to simply add their respective capacities to ensure that adequate electricity is available to meet demand. Ensuring reliability requires a complex statistical analysis of intermittent generation on a moment-by-moment basis throughout the year to determine how much capacity is necessary. In addition, ample storage is needed so that at least some of the energy produced by wind and solar can be saved for when it is actually needed. NYSERDA estimates the need for over 19,000 MW of storage capacity in 2050. Importantly, investments in the storage plants require the deployment of chargeable banks of energy, and the scoping plan assumes that batteries are configured for 4-hour and 8-hour duration. Estimating an equal amount of both, this corresponds to about 115 GWh of total storage. Notably, the largest battery plant in the world today is the 1.2GWh Moss Landing facility in California. The draft scoping plan would require a hundred of these in Scenario 3.

*"Firm" Generation as "Backup"*

Perhaps the most extreme example of how the draft scoping plan sidesteps reality is in its provision of zero-carbon "firm" generation. NYSERDA acknowledges that even with a hundred times more battery storage than Moss Landing, batteries will be insufficient to turn intermittent generators into reliable sources of energy. In Scenario 3, New York would additionally need to build and maintain generators of "firm" carbon-free electricity capable of being dispatched when intermittent generation is inadequate and storage has been depleted. However, the way NYSERDA proposes to accomplish this is by building and maintaining 25 GW of hydrogen fuel-cell capacity by 2050. To support this, NYSERDA also proposes 400 miles of hydrogen-grade pipeline, an unspecified amount of electrolyzer equipment to produce hydrogen from water, an unspecified volume of hydrogen storage utilizing salt caverns, and additional wind and solar capacity to power the electrolyzers. "Round-trip" efficiency of this kind of power-hydrogen-power conversion is only 50%, meaning that only half of the energy needed to produce hydrogen could be recovered through subsequent generation. NYSERDA also proposes to import half of the hydrogen required from outside the state.

The following is a picture of the largest hydrogen fuel cell plant in the world, a 50MW facility in Hanwha, South Korea which cost over $200 Million.[7] In Scenario 3, New York would need to build over 500 facilities like this after 2030. Between 2030 and 2035, New York would need to build one such plant every five days. This is in addition to electrolyzers, 400-miles of new pipeline, and underground cavern storage.

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[7] https://www.hanwha.com/en/news_and_media/press_release/hanwha-energy-celebrates-its-completion-of-the-worlds-first-and-largest-byproduct-hydrogen-fuel-cell-power-plant.html
It should be noted that hydrogen fueling the Hanwha plant is derived from a petrochemical process, not renewables.


Remarkably, 25GW is almost equal to the total combined capacity of all fossil fuel power plants in New York today. Yet, the zero-carbon "firm" generators proposed by NYSERDA in Scenario 3 are intended to serve just 2% of total demand in 2050 and operate at an operational capacity factor of less than 3%.[8] Since NYSERDA also assumes that all of the energy required for in-state electrolysis comes from renewables, increasing this utilization rate is impossible without even more renewable capacity. From a system-level standpoint, it is inconceivable that New York would construct such an immense network of facilities and infrastructure to serve merely 2% of demand.

To be clear, NYECA does see a role for hydrogen in New York's energy future, especially to assist in the decarbonization of other sectors. However, that applicability will be profoundly limited if the source of energy for hydrogen production is intermittent renewables like wind and solar. As discussed in the next section, zero-carbon firm generation capacity is essential for a reliable zero-carbon grid, but from a system-level standpoint it makes far more sense to invest in zero-carbon generation that is capable of operating at much higher capacity factor.

*Baseload Hydro and Nuclear*

Today, nearly all of New York's carbon-free electricity is provided by baseload hydropower and nuclear. In fact, prior to the unnecessary closure of reactors at Indian Point in 2020 and 2021, hydropower and nuclear reliably supplied over half of all the state's electricity. Not dependent on weather, the capacity factor for nuclear power is 95%.

Importantly, NYSERDA's Integration Analysis actually assumes the relicensing of all three of the state's upstate nuclear plants (Ginna, Fitzpatrick, and 9 Mile Point) for another 20 years, and it estimates an economic saving of about $9 Billion in doing so. If not for the extension of those licenses, the extreme buildout of solar, wind, storage, and hydrogen-based backup generation which has been proposed would be even more unimaginable. However, the text of the draft plan gives short shrift to the value of nuclear power, acknowledging its carbon-free attributes, but then referring to unspecific concerns over safety and environmental impacts without actually identifying any.

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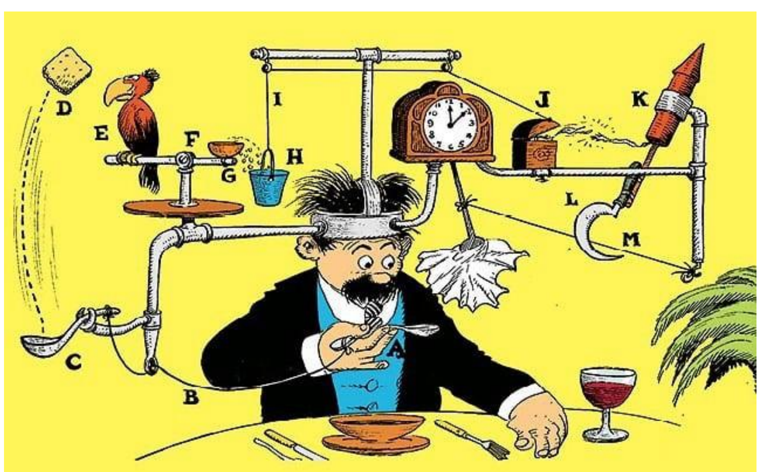
[8] Scenario 3 identifies 25,359 MW of zero-carbon firm capacity in 2050 to produce 6,399 GWh of electricity annually, which corresponds to an operational capacity factor of 2.9%. In Scenario3, NYSERDA predicts total load in 2050 to be 319,942 GWh.

This unscientific bias against nuclear is evident throughout the plan in its failure to discuss the value of high-capacity factor, high-energy density generation which nuclear power offers, its focus on "renewables" rather than carbon-free generation, and its advocacy for programs and initiatives like CCAs that focus exclusively on renewables. Most disturbing is that NYSERDA's integration analysis summarily excludes new nuclear technology in its list of "candidate resources" and fails to include any substantive discussion of the potential for deploying advanced nuclear technology anytime within the plan's 30-year horizon. As we discuss later, this flies in the face of numerous studies on the most effective strategies for decarbonization, the recommendation of climate experts (including the United Nations), leadership occurring in other states and countries in the development of next-generation nuclear power, and even federal policy of the Biden administration which encourages the development of new nuclear resources.

To a lesser degree, the draft plan also ignores the potential for additional hydropower in New York. Although there is little opportunity to expand large-scale facilities, the plan overlooks the possibility for small-scale hydropower, such as run-of-river projects which could contribute to the state's carbon-free portfolio and enhance reliability. It is ironic is that while the plan dismisses the continued importance of baseload generation, one of the first sources of carbon-free energy the state has pursued in an effort to show some sign of progress toward CLCPA goals is the importation of additional hydropower from Canada.

It has been said that electricity is the easiest aspect of decarbonization, and that eliminating greenhouse gas emissions from other sectors (transportation, heating and industry) is the hard part. Indeed, this ought to be the case. However, the draft scoping plan proposed by the Climate Action Council and NYSERDA takes a Rube Goldberg approach to electricity that would make decarbonizing the state's grid as complicated and as difficult as possible. By relying overwhelmingly on low-capacity-factor intermittent sources, which in turn require massive amounts of storage, backup generation, and transmission, the proposed plan not only invites failure, but also puts New York's economy and ratepayers at risk while maximizing harm to the environment.

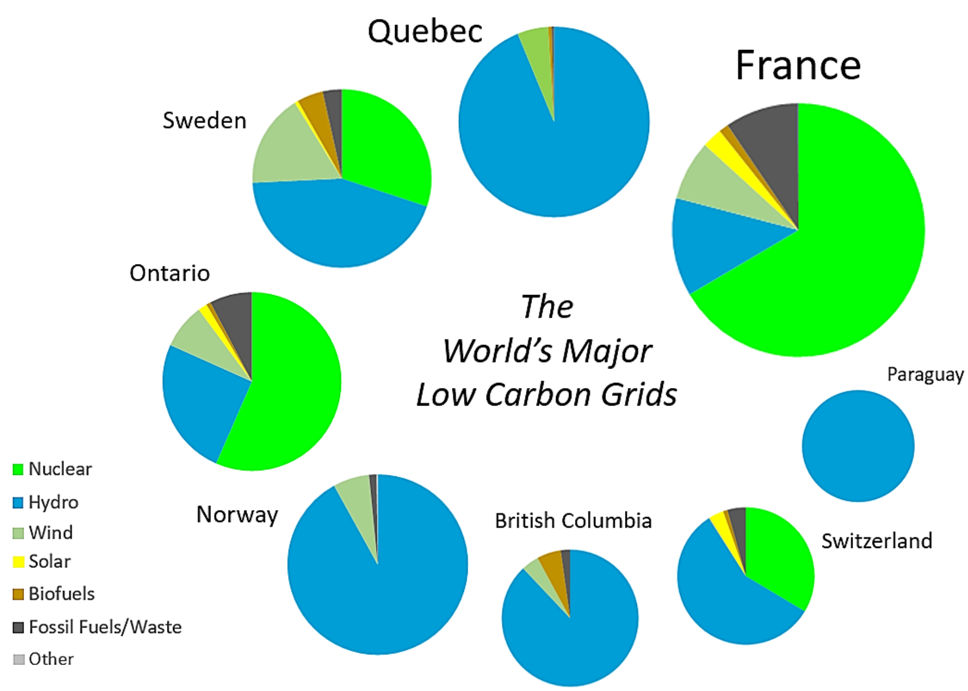


## II. System-Level Realities of Grid Decarbonization

The mantra of "100% renewables" is a popular rallying cry for several environmental interest groups. However, slogans are not a plan—nor should they become the basis for developing one. The CLCPA does not have a "100% renewable" mandate. It calls for New York to receive at least 70% of its electricity from renewable sources in 2030, and it requires that the state's grid be carbon-free by 2040, placing no conditions after 2030 on the portfolio needed to achieve this. Nonetheless, the draft plan proposed by the Climate Action Council and NYSERDA is one that relies overwhelmingly on sources defined as "renewable"—particularly low-capacity factor, intermittent generators. This puts it at odds with every successful large-scale example of grid decarbonization around the globe, as well as credible analysis by experts in grid dynamics.

### Importance of Firm Generation

"Firm" generation, meaning baseload or dispatchable generation capable of delivering electricity whenever needed, is a primary component of every electric grid on Earth, whether it has a high-carbon, low-carbon, or zero-carbon content. Throughout much of the world, producing electricity is a dirty business because it relies on firm generation from fossil fuels. But even nations with a low-carbon grid depend on firm generation, usually hydropower or nuclear[9].




Costa Rica and Iceland are sometimes cited as examples of "100% renewable" energy, but these small countries depend on firm generation, too. Iceland gets its firm energy from deep geothermal, which is only an option in areas with unique volcanic or seismic activity.

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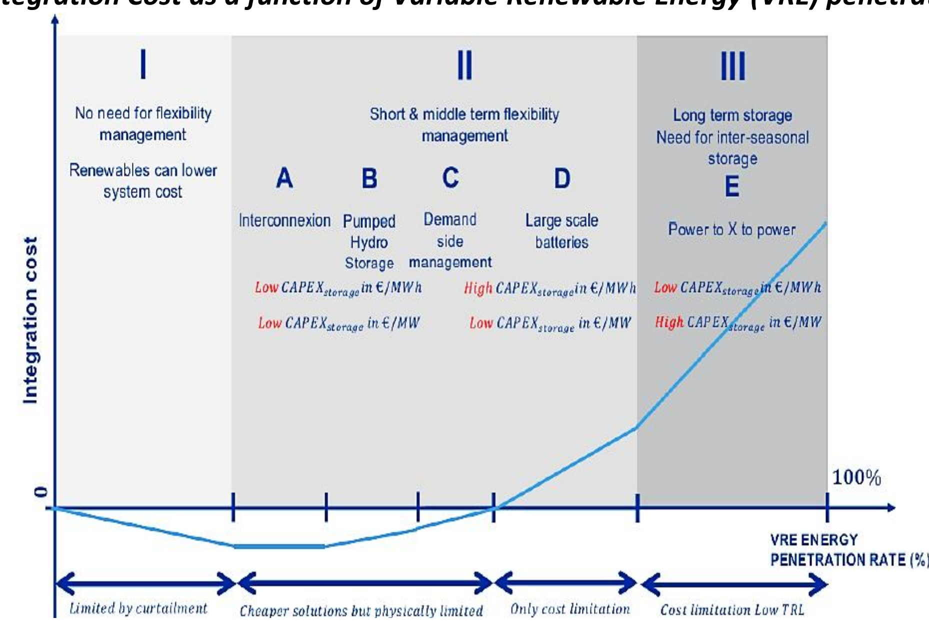
[9] Charts depict grids that are at least 85% zero-emission and generate more than 40 TWh annually.
Canadian provinces: https://www.statcan.gc.ca/en/start
Other countries: https://www.iea.org/data-and-statistics/data-product/electricity-information

The fact is that very few parts of the world possess sources of “firm” renewable energy large enough to meet all or most of their electricity needs. Everywhere else, places that have successfully decarbonized did so with nuclear power. Most notably among these is France, an industrialized nation with more than 67 million people. Receiving over two thirds of its electricity from nuclear, France substantially decarbonized its grid years ago and now has some of the cleanest in Europe.

By contrast, carbon-free grids that run predominantly on intermittent sources exist only on paper. Nowhere in the world have solar and wind approached levels of penetration anywhere near that which has been proposed in New York’s draft scoping plan. Further, as we will discuss, even where modest levels of intermittent generation have been achieved, like California, problems of grid instability occur.[10] Solar and wind can be useful, particularly during the early stages of decarbonization when integrating intermittent sources into the electric grid does not require major upgrades in storage and transmission. However, as those sources make up a larger percentage of total generation, the challenges of attempting to maintain reliability when production is governed by the weather instead of real-time demand becomes a formidable barrier—one which makes that integration much more difficult and costly.

This phenomenon is illustrated in the diagram below from a recent report titled *Integration Cost of Variable Renewable Resources to Power Systems—A Techno-Economic Assessment in European Countries*.[11] The term Variable Renewable Energy (VRE) means intermittent generation such as solar and wind.

***Integration Cost as a function of Variable Renewable Energy (VRE) penetration***




[10] One country that has been relatively success with intermittent generation is Denmark, which receives 53% of its electricity from wind. This can be attributed to a very large offshore resource with relatively high capacity factor, greater dependence on “firm” imported electricity which may not be carbon-free to balance intermittency, and a relatively small population (less than 1/3 of New York State). Denmark has also become increasingly dependent on biomass combustion, which is a “firm”, but extremely polluting source of energy.

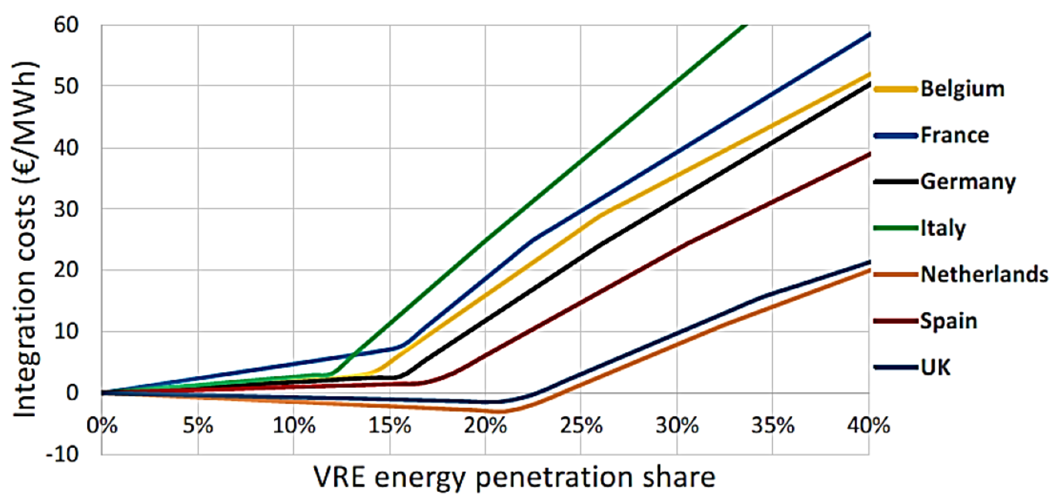
[11] Monterrat, Hilliard, Carrejo, Devaux; *Integration Cost of Variable Renewable Resources to Power Systems—A Techno-Economic Assessment in European Countries*; 10th IEEE International Conference on Renewable Energy Research and Applications (ICRERA 2021); https://ieeexplore.ieee.org/document/9598566

At low penetration, solar and wind only displace fossil fuel generation when the sun shines or the wind blows—and so they do not require storage or other system-level support. At these levels, they can even offer a net saving to customers by competing with other sources on a dollar per kWh basis. Their relatively low Levelized Cost of Electricity (LCOE) reflects this.

However, this changes as intermittent sources are called on to serve a larger percentage of demand. At moderate penetration, large-scale storage becomes essential, along with transmission improvements to avoid bottlenecks which may otherwise cause curtailment. Demand-response management can help reduce load during times of low output from renewables, but system-level impacts nevertheless become more pronounced, ultimately translating to additional expense which must be borne by ratepayers or taxpayers. At higher penetration, batteries are inadequate and long-term inter-seasonal storage becomes necessary. (NYSERDA proposes hydrogen.) However, with this comes the need for an entire additional layer of facilities and infrastructure to make, store, and transport energy.

Importantly, these impacts are not limited to effects seen when trying to accommodate the last few percentage points of generation. As shown below for Europe, impacts on cost start to appear at only 15% to 20% penetration.[12]

***Integration Cost in European Countries through 40% Penetration***




As we later discuss, these findings are also consistent with challenges encountered in California where solar and wind have been aggressively pursued, but are still responsible for less than 30% of in-state generation. It also underscores the danger of making decisions based on LCOE, a metric that does not take into account system-level factors.

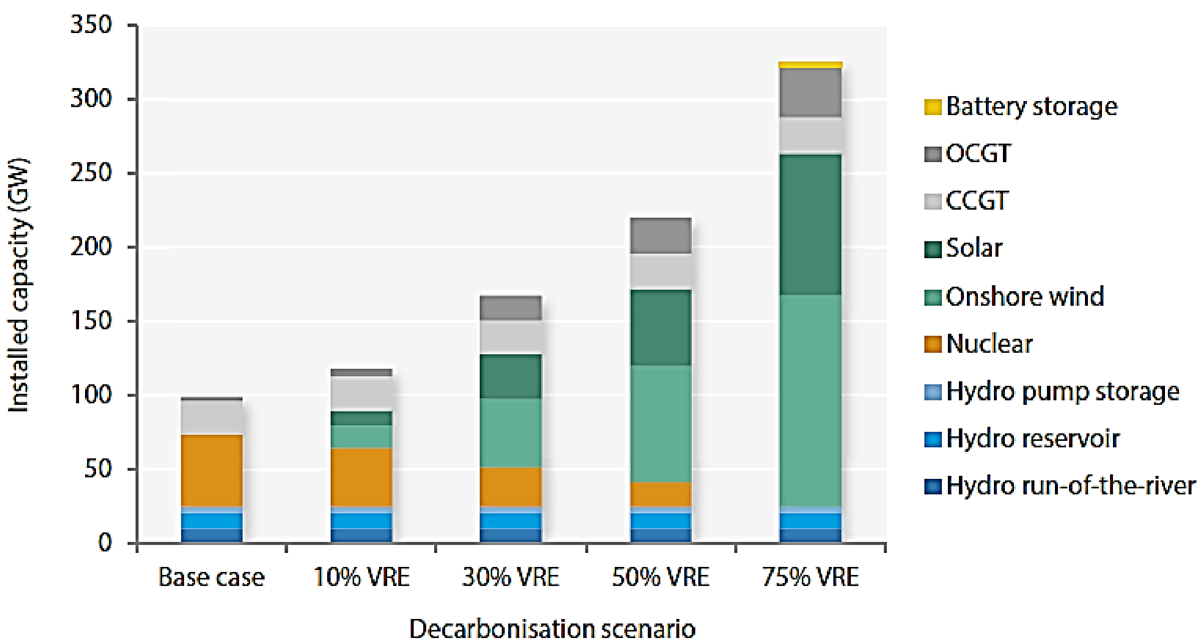
[12] Ibid; https://ieeexplore.ieee.org/document/9598566

Research Confirming Benefits of Systems with Ample Zero-Emission Firm Generation vs. Without

The Organization for Economic Cooperation and Development (OECD) is an international body consisting of 36 democracies including the United States that work together to address the economic, social, and environmental challenges of globalization. In 2019, OECD published a report titled *The Costs of Decarbonisation: Systems Costs with High Shares of Nuclear and Renewables*.[13] Working with power system modelers at the Massachusetts Institute of Technology, its authors evaluated different paths for reducing the carbon intensity of electricity produced in OECD countries to 50 grams of carbon dioxide per kWh by 2050, and considering the penetration of intermittent renewables in the range of 10% to 75%.

Like NYSERDA, the OECD study found that relying predominantly on intermittent generation requires tremendous amounts of installed capacity. However, authors of the OECD report actually explored how this varies for decarbonization scenarios involving different levels of intermittent and firm generation. As seen below, far less installed capacity is needed for systems where firm nuclear plays a substantial role.[14] (For modeling purposes, hydropower was held constant due to its limited potential for expansion.)

***Capacity Mix with Different Shares of VRE***

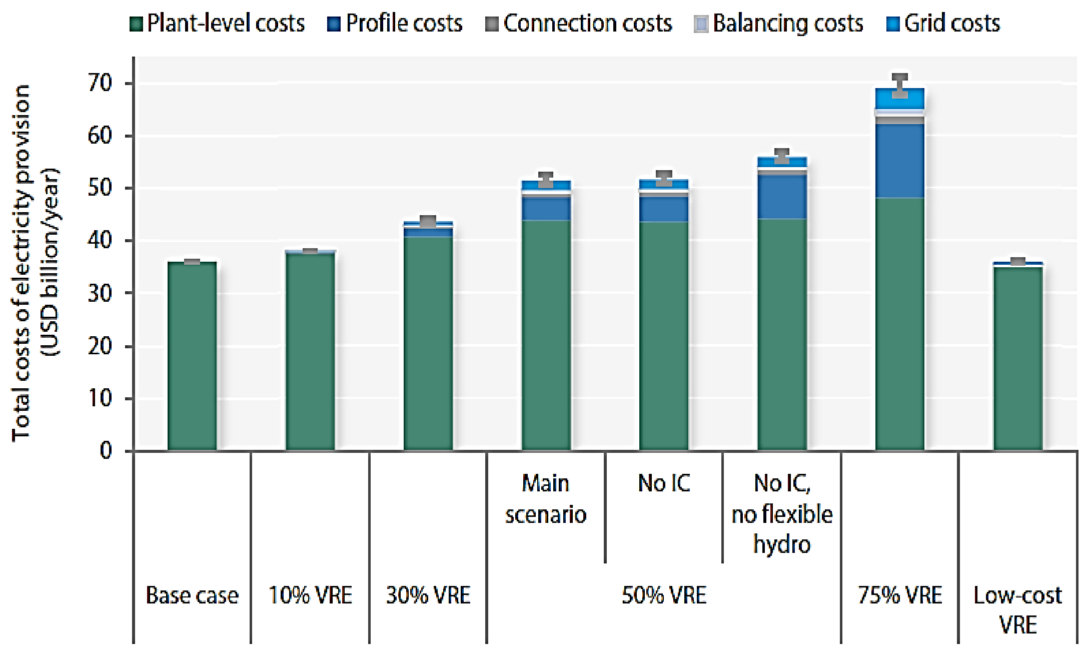



[13] *The Costs of Decarbonisation: Systems Costs with High Shares of Nuclear and Renewables*; OECD Publishing, NEA No. 7299, 2019. https://www.oecd.org/publications/the-costs-of-decarbonisation-9789264312180-en.htm

[14] Concepts like hydrogen-based backup generation do not show up in the OECD model because a small amount dispatchable gas-fired generation is retained within its 50 grams per kWh emission target.

The OECD study also found that low-carbon systems with high levels of intermittent generation were consistently more expensive than those employing firm generation. Notably, the plan proposed by the Climate Action Council and NYSERDA for New York would entail an even higher penetration of VRE resources than the highest scenario contemplated by OECD.[15]

***Total Cost of Electricity Provision including plant and System Level Costs***



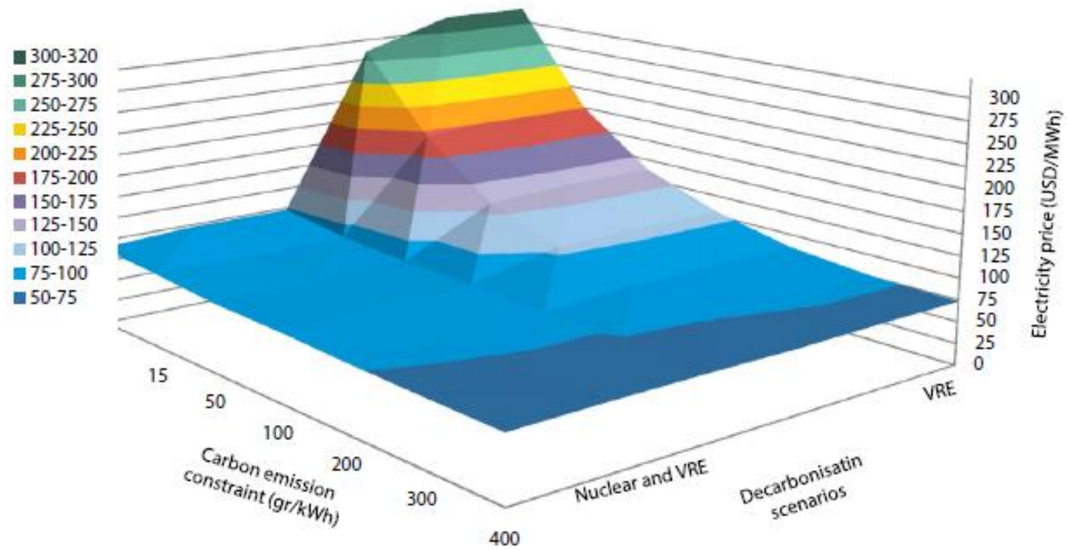

As seen above, the only case in which the OECD report found total cost to be comparable to a base case served predominantly by nuclear and hydropower is in a "low-cost VRE" scenario where plant and system-level costs of intermittent generation are less than today. However, even in this scenario, the OECD report found that firm generation should play a significant role with 40-60% participation from nuclear. According to authors, this would "support a vision of a future electricity mix that is realistic for a broad range of OECD countries".

Supporting this, the report also references a MIT study which models the cost of electricity in three dimensions for a range of emission reduction targets and different mixes of renewable and nuclear sources in New England. As seen in the following graph, electricity prices rise sharply as the target carbon density per kWh drops for systems that rely predominantly on intermittent sources, but only modestly for those that include nuclear power.[16]

[15] In Scenario 3, NYSERDA proposes 28,947 GWh of onshore wind, 25,546 GWh of imported wind, 80,046 GWh of offshore wind, and 116,044 GWh of solar in 2050 with a total load of 319,942 GWh. This corresponds to 78% VRE penetration.

[16] Sepulveda, *Analyzing Different technological Pathways*, Massachusetts Institute of Technology, September 2016, https://dspace.mit.edu/handle/1721.1/107278.

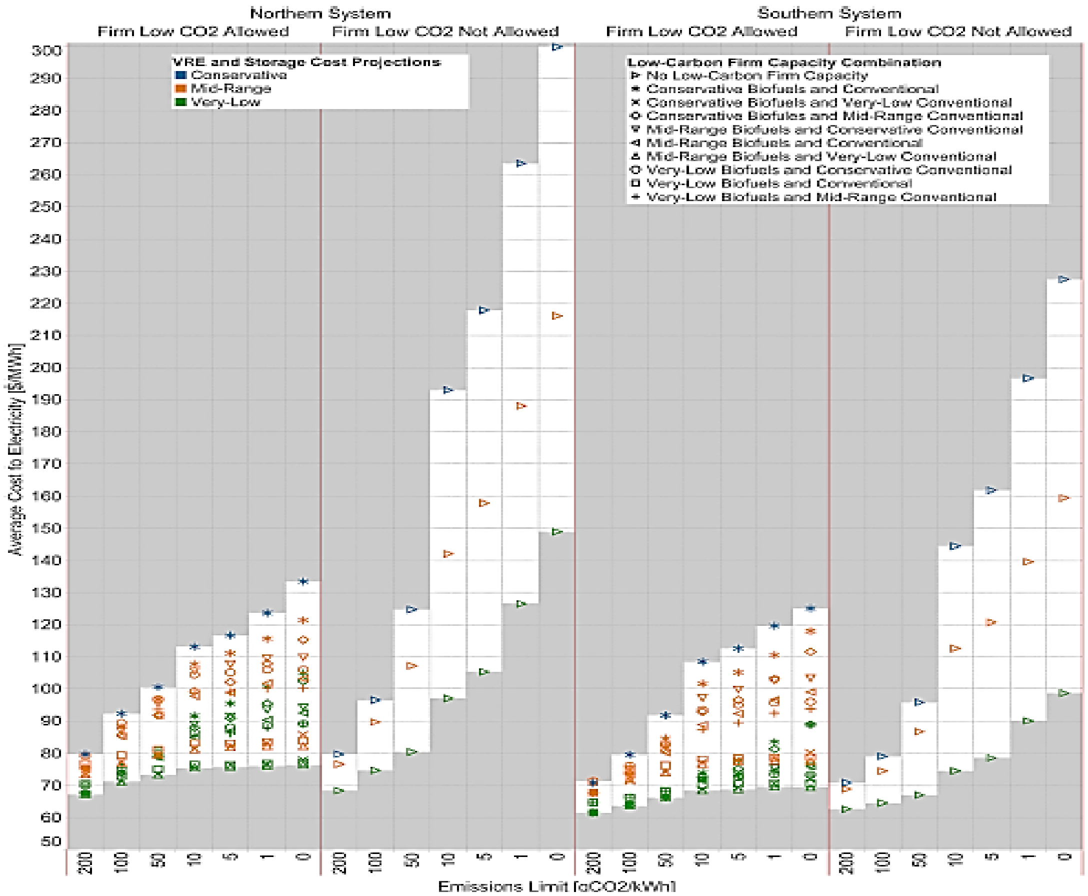
*Average Price of Electricity as Function of Pathways and Emissions Intensity Targets (ISO-NE)*




Although the draft scoping plan for New York draws abstract conclusions about societal benefits, it fails to address how the strategy it proposes will actually impact ratepayers.

Other research further confirms the importance of firm baseload or dispatchable generation to achieve a reliable carbon-free grid. In *The Role of Firm Low-Carbon Electricity Resources in Deep Decarbonization of Power Generation*, Sepulveda, Jenkins, and others evaluate over 900 distinct scenarios for northern and southern portions of the United States in combination with different levels of intermittent generation, storage, demand flexibility, and transmission for a range of carbon limits. Researchers found that the availability of firm low-carbon technologies including nuclear reduces cost significantly in fully decarbonized cases and for emission limits below 50 grams CO2/KWh in the vast majority of cases. They also found that the optimal capacity of different sources change depending on the target emission limit. This underscores the need to evaluate near-term investment decisions based on their contribution to long-term decarbonization goals. For example, a substantial investment in intermittent solar and wind may make sense for a less stringent interim decarbonization target, but not if the ultimate goal is a carbon-free grid. For this reason, authors emphasize the importance of a broad research portfolio and policies which support expanding, rather than constraining, options.

***Average Cost of Electricity under Different Technology Assumptions and CO2 Emission Limits for Northern and Southern Systems***



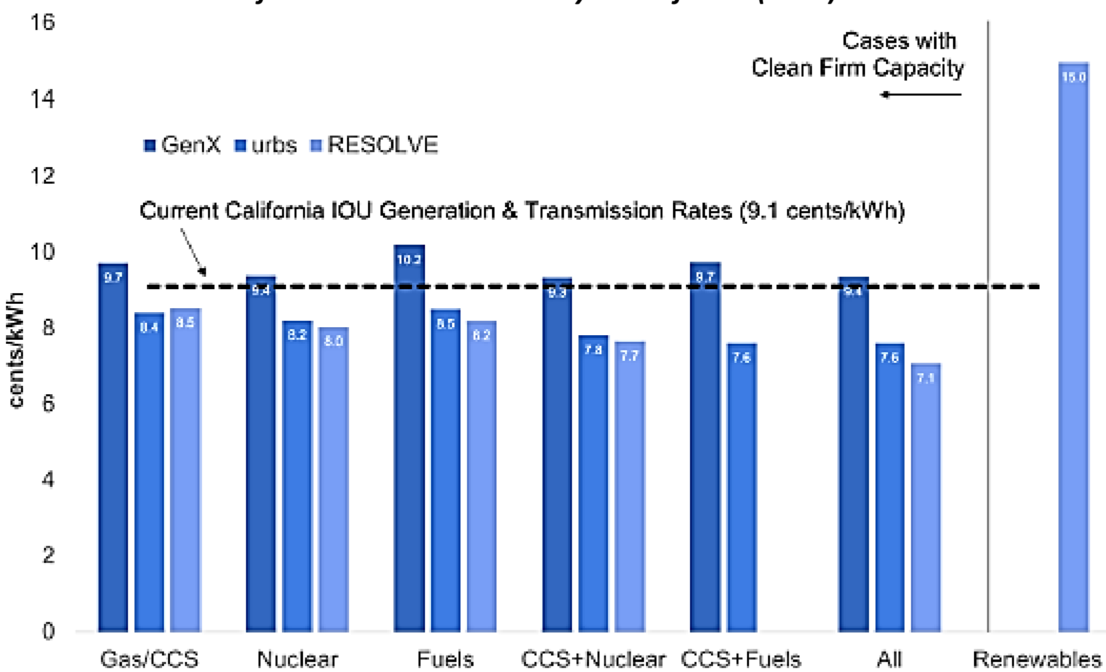

Similarly, in *Renewables and Decarbonization: Studies of California, Wisconsin and Germany*, Brick and Thernstrom compare the feasibility and costs of achieving an 80% renewable portfolio standard (RPS) to a balanced portfolio of carbon-free sources.[17] In each case, they found that balanced portfolios with a larger role for firm carbon-free generation achieve greater greenhouse gas reduction with far less investment in new generation capacity and infrastructure than the 80% RPS scenario. They also found that achieving comparable 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.)

[17] 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)]

Regionally-focused research supports the need for firm carbon-free generation as well. Particularly compelling is a study titled *California Needs Clean Firm Power, and so Does the Rest of the World*.[18] Coordinated by the Clean Air Task Force and Environmental Defense Fund, the 2021 report brought 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 net-zero emissions by 2045. Although each ran separate models, their findings were remarkably similar: that a 100% or nearly 100% renewable solution focused on the widespread deployment of wind, solar, and storage will not do the job.

The joint report found that relying on wind and solar, California would require capacity equal to half the total generating capacity of the United States and six times the current capacity of all sources (fossil fuel, nuclear, hydro, etc.) serving California today. Although New York uses less electricity than California, it can expect similar hurdles, heightened by the fact that the CLCPA promises carbon-free electricity by 2040. As seen below, aside from the shear physical challenges involved, the California report reveals that a carbon-free energy portfolio focused entirely on "renewables" is simply not cost effective.

***Wholesale Generation and Transmission Costs***
***for Carbon-Free Electricity in California (2045)***




[18] 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; wee 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/

Specifically, authors of the California report write:

> *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…. On a dollar per kilowatt hour basis, wind and solar power are now cheaper than carbon-intensive sources of electricity …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.*
>
> *…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. 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.*

The report also found that portfolios with clean firm power require far less land and transmission infrastructure. California currently has 15 million megawatt-miles of transmission. Portfolios with clean firm power would add 2-3 million megawatt-miles, but portfolios without would require tripling the amount of addition transmission to 9 million.

> *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.*

The California report specifically defines "clean firm power" *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."*** With respect to nuclear power, authors write:

> *[N]uclear 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… 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.*

The following summarizes findings of the California report:

| Issue | | With Clean Firm Power | Without Clean Firm Power |
|---|---|---|---|
| **Costs for generation and transmission**<br>*California transmission and distribution costs are currently about 9 cents/kWh* | | ~9 cents/kWh | ~15 cents /kWh |
| **Solar and Wind Capacity**<br>*Entire U.S. electric generating capacity is ~1100 GW* | | 25 – 200 GW | 470 GW |
| **New Storage***<br>*Largest battery facility now being built is 0.3 GW /1.2 GWh.*<br>*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**<br>*CA land area is ~164,000 sq miles* | | 625- 2500 sq miles | 6250 sq miles |
| **Transmission**<br>*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*

Notably, most of the above studies include an evaluation of the impact that various technology scenarios have on the cost of electricity to customers. Several also involve E3 and its proprietary RESOLVE model. Yet, the draft scoping plan for New York, which relies on E3's model, includes no analysis whatsoever of the cost impact to ratepayers. Nor does it provide any comparative analysis of alternative scenarios involving additional nuclear power. Interestingly, however, E3 actually has considered the potential for expanding nuclear capacity elsewhere in the country.

In its 2020 *Pacific Northwest Zero-Emitting Resources Study*, E3 analyzed scenarios in which the northwest part of the United States (Washington, Oregon, and parts of Idaho and Montana) could decarbonize its electric grid with renewables and "firm" zero-emitting resources, including nuclear power—both existing and advanced.[19] In all scenarios, E3 predicted that relicensing the region's one nuclear power plant, Columbia Generating Station (CGS), can reduce costs by up to $1.35 Billion each year. Moreover, E3 found that by deploying additional firm zero-emission capacity such as Small Modular Reactor (SMR) technology, savings in excess of $8 Billion can be achieve annually in a zero-emission scenario. According to E3, the potential for nuclear becomes even more attractive using SMR cost estimates provided by NuScale or with the federal production tax credits (PTC) offered for advanced nuclear projects.

Significantly, E3 found nuclear power valuable in achieving a zero-carbon grid for the Pacific northwest even though the region already receives much of its electricity from hydropower. Without additional firm zero-emitting capacity, E3 states that eliminating carbon emissions from the electricity sector would likely be prohibitively expensive.

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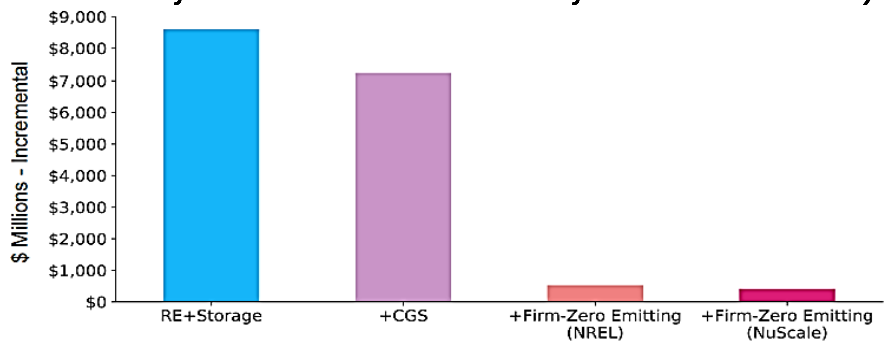
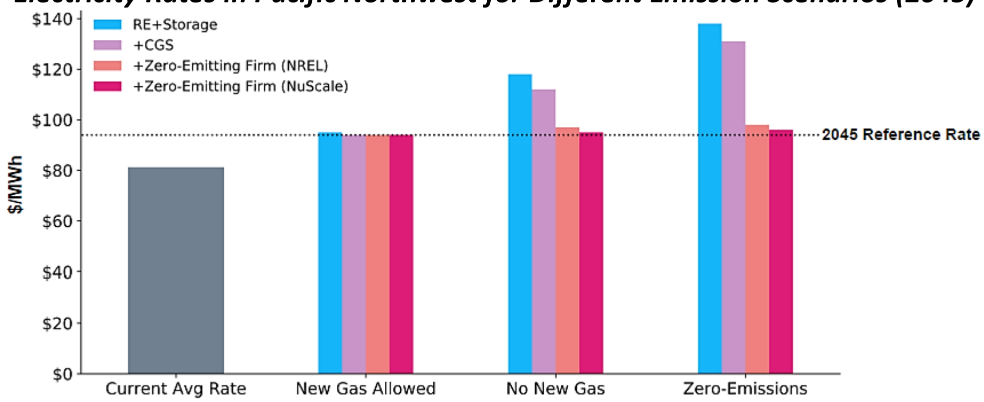
[19] *Pacific Northwest Zero-Emitting Resources Study*, Energy & Environmental Economics, January 13, 2020. https://www.ethree.com/wp-content/uploads/2020/02/E3-Pacific-Northwest-Zero-Emitting-Resources-Study-Jan-2020.pdf ; see also *E3 Examines Role of Nuclear Power in a Deeply Decarbonized Pacific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

***Annual Incremental Cost of Zero Emission Scenario in Pacific Northwest Electricity System (2045)***

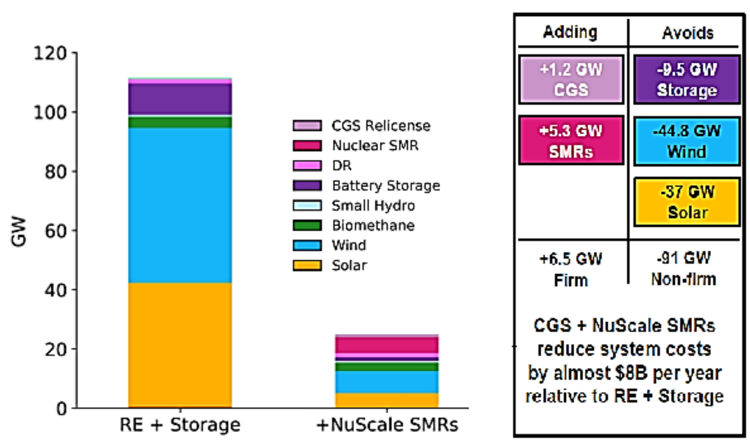



***Electricity Rates in Pacific Northwest for Different Emission Scenarios (2045)***




In addition to saving $8 Billion annually, E3 found that by adding 6.5 GW of "firm" zero-emitting capacity through the relicensing of Columbia Generating System and deployment of SMR technology, the Pacific Northwest region could avoid 91 GW of non-firm capacity (44.8 MW of wind, 37 GW of solar, and 9.5 GW batteries). According to E3 estimates, in a "renewable only" scenario, the direct land-use impact of wind and solar projects built to serve the Northwest region would be up to 2.5 times the combined area of the Portland and Seattle metropolitan areas, and indirect land-use impacts could be as high as 10 to 50 times larger than Portland and Seattle combined.

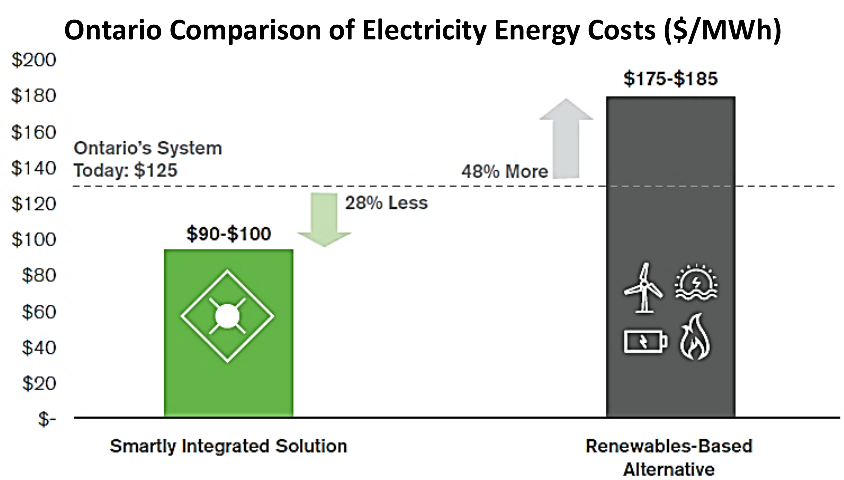
***Effect of Including Firm Nuclear Capacity in Pacific Northwest Zero Emission Scenario (2045)***



Research is also taking place in Canada on most effective decarbonization strategies. For example, in 2020, environmental and economic leaders in Ontario convened a Green Ribbon Panel which produced a report titled *Clean Air, Climate Change and Practical, Innovative Solutions to Grow the Economy and Reduce GHG Emissions*.[20] Nuclear power has already contributed significantly to reducing emissions from the electricity sector in Ontario. However, the Canadian report found that much of this gain will be lost if its Pickering Nuclear Generating Station is decommissioned. The report determined that maintaining and refurbishing nuclear capacity will be essential to achieving greenhouse gas reduction goals, managing cost, and serving demand in the future. The report also recognized the potential for new nuclear power in the future, including small modular reactors, which Canada has committed to developing. By intelligently integrating firm nuclear power with renewables, the panel found that emission targets could be achieved for half the cost of plans which focus on renewables only:

> *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 and New York have similar climates, similar energy portfolios, and similar per-capita energy use, so it would be appropriate for New York policy to be informed by research of its northern neighbor.

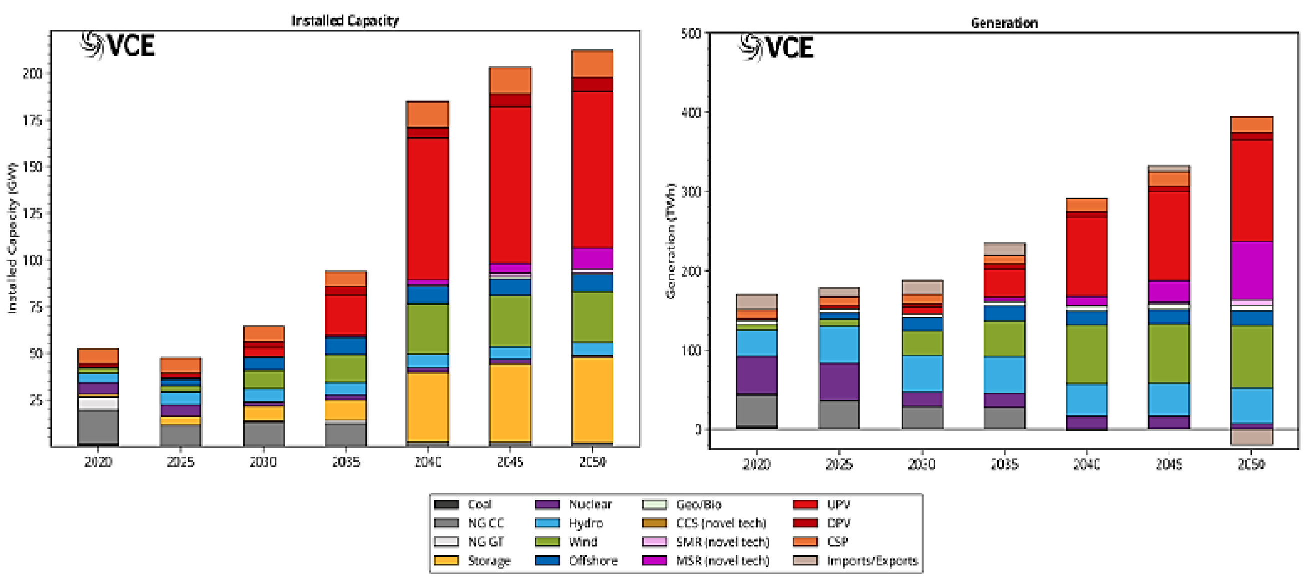



[20]Green Ribbon Panel, *Clean Air, Climate Change and Practical, Innovative Solutions to Grow the Economy and Reduce Greenhouse Gas Emissions in Ontario,* September 2020. http://s34294.pcdn.co/wp-content/uploads/2020/09/200062_GreenReport_ClimateChange-FINAL-SEPT-10.pdf

Perhaps most interesting, a study has been conducted for the state of New York which, unlike the draft scoping plan, actually considers the potential expansion of nuclear power. In 2021, Vibrant Clean Energy (VCE) was commissioned by Vote Solar, Local Solar for All, and the Coalition for Community Solar Access (CCSAP) to analyze the role of distributed generation in decarbonizing New York's electricity sector. Titled *Decarbonizing New York Through Optimizing Distributed Resources*, the objective was to meet CLCPA goals, including 70% renewables for electricity in 2030, 100% carbon-free electricity by 2040, and widespread electrification of other sectors by 2050. However, to ensure reliability and a cost-effective portfolio of generation and storage, advanced nuclear power was included in the VCE model.[21]

Using both Molten Salt Reactor (MSR) and Small Modular Reactor (SMR) technology, the VCE report recommended expanding nuclear power in New York to annual generation levels greater than before the closure of Indian Point. NYECA believes that an optimal plan for New York would emphasize the preservation of existing nuclear plants in addition to building new ones. Nevertheless, the VCE's conclusion that New York should plan for more nuclear power in the future, not less, is significant.

***Vibrant Clean Energy WIS:Dom-P Model Results for New York State***




Most recently, in June 2022, VCE conducted another study for the United States on behalf of the *Nuclear Energy Institute*, which modeled a 95% reduction in greenhouse gas emissions from the electricity sector and 60% reduction economy-wide by 2050. The study found that cumulative customer costs could be reduced by $450 Billion nationally with advanced nuclear power. Within New York, the VCE's study identified 9,600 MW of new nuclear capacity in its nominal scenario.[22]

[21] Clack, Choukulkar, Cote, McKee; *Decarbonizing New York through Optimizing Distributed Resources*; Vibrant Clean Energy; October 1, 2021. https://www.vibrantcleanenergy.com/wp-content/uploads/2021/10/VCE-VS-NY_Final.pdf
[22]Clack, Choukulkar, Cote; McKee; *Role of Electricity Produced by Advanced Nuclear Technologies in Decarbonizing the U.S. Energy System*; Vibrant Clean Energy; June 17, 2022. https://www.vibrantcleanenergy.com/media/reports/ ; https://www.vibrantcleanenergy.com/wp-content/uploads/2022/06/VCE-NEI-17June2022.pdf;

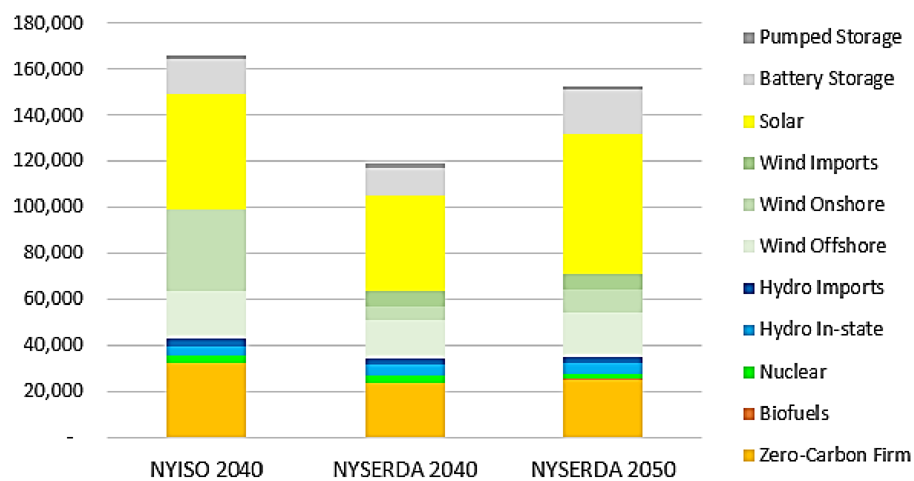
NYISO Phase II Report

The signature purpose of New York's Independent System Operator (NYISO) is to keep the lights on—to ensure that the many components of the state's grid work together effectively to maintain reliable service at all times. In late 2020, NYISO released a *Phase II Climate Change Impact and Resilience Study* which critically examined what would be required to achieve the CLCPA goal of carbon-free electricity by 2040 while maintaining reliability if New York were to pursue a plan focused predominantly on intermittent renewables.[23] NYISO's findings provide a sober warning of the challenges and risk that such a strategy presents. They also show how predictions can vary dramatically depending on how conditions are modeled.

Significantly, NYISO found that to maintain reliability, New York would need substantially more installed renewable capacity and zero-carbon firm generation *in 2040* than NYSERDA's Integration Analysis predicts will be needed *in 2050.* Notably NYISO came to this conclusion even though it did not factor in additional renewables required for hydrogen production, which NYSERDA claims to include.[24]

**Comparison of New York Electric Capacity Portfolios**

NYISO Phase II Analysis (CLCPA-2 case) and NYSERDA Scenario 3




It is concerning that NYSERDA's analysis differs so much from that of NYISO, the entity charged with maintaining the state's electric grid. We believe NYSERDA must reconcile its work with NYISO's Phase II report and provide a substantive explanation of differences to the Climate Action Council and public. Although NYECA does not claim to have expert knowledge of RESOLVE, several aspects of NYSERDA's model concern us which likely relate to why results from NYSERDA and NYISO are so far apart—and why NYSERDA's analysis is likely to be overly optimist. These are discussed in the next section. We also find that NYISO makes a number of extremely relevant observations in its report.

[23] *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

[24] In its Phase II report, NYISO simply identifies a level of zero-emission firm capacity as back up for intermittent generation. NYSERDA asses that this is provided using electrolysis from renewables.

Regarding reliability, NYISO leaves no doubt about the difficulties created by relying so heavily upon 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. [Phase II report, page 10]*

With respect to the practical limitations of storage, NYISO writes:

> ***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[25]. …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. [Phase II report, page 11]*

Finally, as it relates to maintaining a functional grid without fuel-based solutions, NYISO writes:

> ***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. [Phase II report, page 13]*

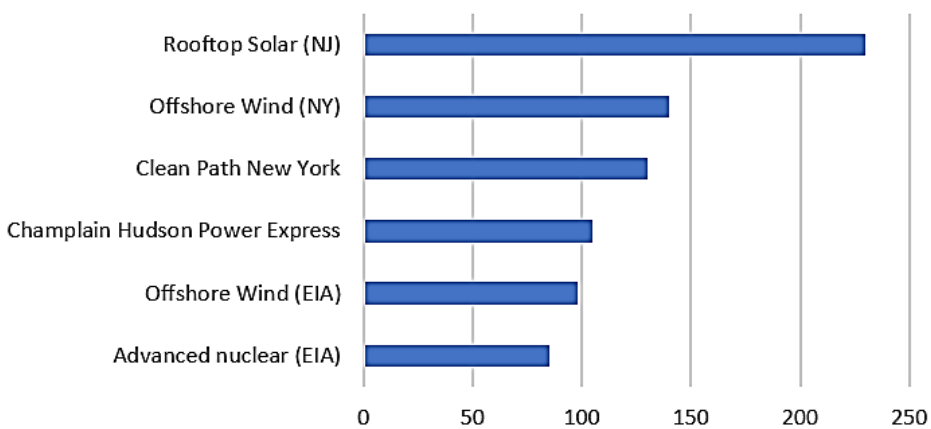
[25] NYSERDA includes a similar amount of storage in its Integration Analysis. Scenario 3 provides for 19,212 MW of storage with 4-8 hour duration. This corresponds to between 77 and 154 GWh of energy storage.

An important value of the previously described studies is that they take a careful look at system-level impacts and costs which vary significantly, depending on the penetration of intermittent renewables. They conclusively demonstrate that for deep decarbonization, systems that make use of nuclear power, like France, are more feasible and cost-effective than those which do not.

They also reveal that comparing the levelized cost of electricity (LCOE) for different generators does not tell the whole story. It is noteworthy, however, that even when considering just LCOE, one finds that the cost of nuclear power is competitive with certain types of renewable energy that New York has already accepted as worthy investments. As seen below, a recent study by the U.S. Energy Information Agency (EIA) estimates that the unweighted LCOE of advanced nuclear power entering service in 2040 will be less expensive that offshore wind.[26] It will also be less expensive that the contract prices for electricity from the Champlain Hudson Power Express (CHPE) and Clean Path New York (CPNY) projects, the average LCOE estimated by NYSERDA for New York's own wind projects (which were expected to come online in 2024 but have since been delayed), and the average price of New Jersey's SREC solar subsidy.[27]

***LCOE for Advanced Nuclear Compared to Other Resources***

*(dollars/MWh)*




Source: U.S. EIA Annual Energy Outlook 2022, Hydro Quebec/CHPE and CPNY contract prices, NYSERDA Offshore Wind Policy Options Paper (2018), NJ Solar SREC Auction

Vague accusations of nuclear power being too costly hold little water if one carefully examines what New York and its neighbors are willing to spend in order to bring intermittent renewables online. If investments in offshore wind, rooftop solar, and long-distance renewable power transmission projects are deemed prudent, then so should be investments in comparably-priced and reliable nuclear power that does not burden the grid with additional system-level costs.

[26] *Levelized Costs of New Generation Resources in the Annual Energy Outlook 2022*, U.S. Energy Information Administration, March 2022. https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf

[27] https://www.nyserda.ny.gov/-/media/Files/Publications/Research/Biomass-Solar-Wind/Master-Plan/Offshore-Wind-Policy-Options-Paper.pdf
https://njcleanenergy.com/renewable-energy/programs/utility-financing-programs/utility-financing-programs/pseg

Although the draft scoping plan produced by the Climate Action Council and NYSERDA acknowledges the need for “firm” generation, it misses a key take-away from the previous studies by seeking to satisfy that need with a technology—green hydrogen—that also depends on renewables. Since hydrogen produced from solar and wind is really just another form of storage, this does not avoid the monumental challenges of scale and cost that large-scale energy storage presents. As we will discuss, since firm capacity is an essential component of any reliable system, a more effective strategy would be to utilize sources of “firm” carbon-free generation with high capacity factor capable of serving a much larger proportion of statewide electricity demand.

## III. Errors and Oversights

In addition to relying on an unrealistic buildout of intermittent generation and broadly neglecting the value of reliable baseload or dispatchable power, we believe that NYSERDA's Integration Analysis contains a number of specific errors, oversights, and omissions which prevent it from serving as dependable framework for the draft plan.

<u>Dubious use of imports/exports</u>

NYISO's Phase II assessment is very conservative with respect to importing and exporting electricity. Except for existing hydropower from Canada and expected additional imports of Canadian hydropower downstate through the CHPE project, NYISO models the New York grid as an independent sustainable network. On the other hand, NYSERDA takes an extremely liberal approach to interconnection in its Integration Analysis. In addition to Canadian hydropower, NYSERDA relies on a large amount of electricity from out-of-state wind generation, as well as substantial exchanges of electricity from unspecified sources between New York and other regions. NYSERDA also assumes that half of all hydrogen required to provide zero-carbon "firm" generation will come from out of state.

To begin with, such an approach appears to undermine a stated objective of the Governor, Climate Action Council, and supporters of the CLCPA that climate action taken by New York should serve as a model for others to follow. Clearly not every state can expect to receive clean energy from somewhere else to make up for what it is unable to generate itself. The fact that New York possesses significant offshore wind potential (which most states lack), but would *still* need to rely on hydropower from Canada, wind turbines located in other states or another country, and hydrogen produced from electricity somewhere else shows that the proposed plan cannot be construed as a repeatable model for others to follow.

However, this approach also appears to contravene statutory objectives of the CLCPA. In all scenarios, NYSERDA assumes that in 2050 approximately 5% of real-time demand (about 15,000 GWh), would be served by electricity imports, balanced out on an annual basis by exports of the same magnitude. This would apparently allow electricity produced by renewables in New York when not needed to be traded for dispatchable electricity from out-of-state (likely fossil fuels) at other times to meet actual demand—what could be described as a "battery on paper." We note that this amount of annually imported/exported electricity represents roughly three times the volume of energy that NYSERDA predicts will be drawn from actual batteries and pumped storage. However, the CLCPA does not call for a "net" zero-carbon grid. The CLCPA requires that 70% of electricity meeting actual demand come from renewable sources in 2030 and that all of it come carbon-free sources by 2040. Regardless, it is not possible for New York to claim that climate goals are being met if that "success" depends on the continued existence of dispatchable fossil fuel power plants in neighboring states.

Ample research and modeling (as well as conditions seen in places like California) confirm that the challenges of reliability and the need for storage and "firm" backup generation become increasingly pronounced as more intermittent sources are added to a grid. In fact, in its Phase II report, NYISO concludes that between 4% and 10% of New York's electricity would need to come from zero-carbon "firm" sources in 2040.[28] However, NYSERDA estimates in its Scenario 3 analysis that zero-carbon firm sources would serve merely 2% of demand in both 2040 and 2050.[29] It would seem that NYSERDA's Integration Analysis may be using a "paper battery" to create the appearance of results not attainable in the real world.

However, even if New York commits to receiving imported electricity only from renewables (regardless of how much it exports itself), the state could be inviting a reliability problem. This is because a dearth of electricity from weather-dependent wind and solar sources in New York is likely to coincide with similar conditions in neighboring states (as NYISO warns of in its Phase II report). A related concern in either case is whether neighboring states or Canada would need or want surplus electricity produced from renewables in New York during periods of excess in-state supply. A surplus in energy from wind or solar in New York is also likely to coincide with a surplus in neighboring states that are trying to decarbonize. Even if out-of-state recipients of surplus electricity are found, New York could find itself in a situation like California which must give away or even pay its neighbors to take electricity. The OECD study mentioned earlier also discusses this "auto-correlation" effect:

> *Because they all respond to the same meteorological conditions, wind turbines and solar PV plants tend to auto-correlate, i.e. produce disproportionally more electricity when other plants of the same type are generating and to produce less when other wind and solar PV plants are also running at lower utilization rates. In combination with the zero short-run marginal costs of VRE resources, this causes a decrease in the average price received by the electricity generated by VRE as their penetration level increases, a phenomenon often referred to as self-cannibalisation.*

The draft scoping plan does not discuss these issues or how they would be addressed.

*Unrealistic Capacity Factors*

Several of the renewable capacity factors that NYSERDA identified within its Integration Analysis appear to be overly optimist. For example, NYSERDA states that in 2020, land-based wind projects totaling 10,154 MW of capacity existed in New York and that those turbines produced 4796 GWh of electricity. This corresponds to a capacity factor of 28.6%. However, NYISO estimates an average capacity factor of 26% for land-based wind and reports that the actual performance of installed wind have fallen in New York from 25.6% in 2019 to 23.9% in 2020 and 22.7% in 2021.[30] By contrast, based on NYSERDA projections of capacity and annual generation in Scenario 3, we calculate that NYSERDA assumes the average capacity factor of land-based wind in New York will grow to 30.5 % in 2030, 31.3% in 2040, and 32.5% in 2050.[31] The draft scoping plan provides no explanation for why it has rejected actual empirical data regarding wind performance in the state or how it can explain

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[28] NYISO find that 10% of electricity would come from unspecified dispatchable emission-free (DE) sources in the winter and 4% in the summer in its CCP2-CLCPA scenario. See figures 46 and 48 of NYISO Phase II report.
[29] In Scenario 3, NYSERDA predicts that zero-carbon "firm" resources will produce 4,440 GWh in 2040 while total statewide demand is 267,143 GWh. In 2050, NYSERDA predicts that zero carbon "firm" resources will produce 6399 GWh while total statewide demand is 319,942 GWh.
[30] NYISO 2022 Gold Book
[31] For Scenario 3, NYSERDA projects 4,600 MW, 6,126 MW, and 10,154 MW of land-based wind generating 12,296 GWh, 16,799 GWh, and 28,847 GWh in 2030, 2040, and 2050 respectively.

substantial growth in capacity factor in the future. Even if technological improvements occur, it is important to recognize that average capacity factor in 2050 will reflect the contribution of both old and new turbines. This makes NYSERDA's very high estimates hard to believe.

It is well known that the maximum theoretical limit of wind turbine efficiency is limited by Betz's Law, which means that there is little room to improve upon the efficiency of modern turbine technology.[32] From a practical standpoint, the only way to significantly enhance performance is with larger turbines capable of accessing sustained winds at higher elevation. However, this also makes siting more difficult. Since performance is highly dependent upon location and because so many turbines would be required in the draft plan, it is unlikely that NYSERDA's very high estimates of capacity factor could be maintained. Early wind projects may be able to select optimal sites, but those built later would likely have to settle for less ideal locations. With respect to offshore wind, NYSERDA assumes a 47% capacity factor. This 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%.[33]

The draft plan also appears to assume astonishingly high capacity factors for imported wind power. Based on capacity and annual generation in NYSERDA's Integration Analysis, we calculate a capacity factor of between 44% and 45% for the two decades between 2030 and 2050. Unless NYSERDA believes that nearly all of the wind power that New York imports will be from turbines offshore, this is not possible. It also raises questions about where such projects could even be located.

NYSERDA neglects to provide separate estimates of annual generation for utility grade and distributed solar projects. However, based on the breakdown of capacity by zone, we find that NYSERDA anticipates the proportion of both changing over time, with very large-scale utility-grade projects accelerating in later years. NYSERDA stated that its model assumes single-axis tracking for all utility grade projects. This is unlikely since the vast majority of large-scale projects existing and proposed, both in New York and throughout the country, are fixed-panel installations. NYSERDA claims in its Integration Analysis that utility-grade projects totaling 308 MW existed in 2020, but we are not aware of any that use tracking panels.

Within Schoharie and Montgomery counties where a large number of utility-scale solar projects are proposed, the DC capacity factors of fixed-panel and single-axis solar installations are about 14% and 16% respectively.[34] Applying a 1.2 DC/AC capacity ratio, this translates to AC capacity factors of 16.8% and 19.2%, This roughly correspond to AC solar capacity factors identified in NYSERDA's integration analysis for 2020 and 2025. However, NYSERDA also assumes that capacity factor will increase over time, approaching 22% by 2050. While the efficiency of solar panels may improve, thereby leading to higher nameplate capacity per panel, capacity *factor* is primarily a function of external conditions such as latitude, weather patterns, and the extent to which the system tracks movement of the sun. Furthermore, just like wind, solar farms operating in 2050 would include many that were built earlier. This makes NYSERDA's prediction that the average capacity factor of solar throughout New York (utility-grade and distributed) will reach 22% very difficult to believe.

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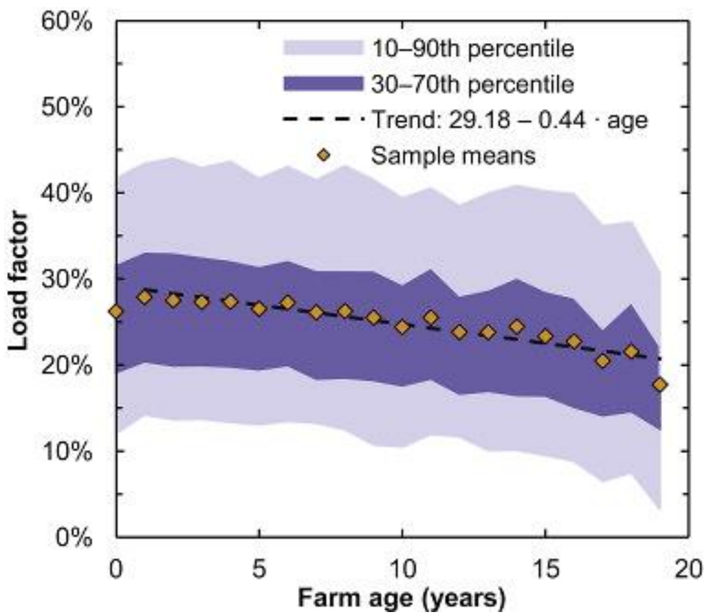
[32] https://en.wikipedia.org/wiki/Betz%27s_law
[33] https://energynumbers.info/capacity-factors-at-danish-offshore-wind-farms#.
[34] https://pvwatts.nrel.gov/pvwatts.php

In addition to the above concerns, the draft scoping plan appears to ignore how equipment degradation impacts capacity factor over time. For the purposes of its analysis, NYSERDA assumes that the lifetime of wind and solar projects are "indefinite" (at least through the 2050).[35] However, in reality, thirty years is a very long time for wind turbines and solar panels to operate, and if not replaced, performance will decline. According to a 2014 study of 282 land-based wind farms in the United Kingdom, wind turbines output was found to drop 1.6% per year, with average capacity factors declining from 28.5% when first installed to 21% after 19 years.[36]

**Measured Decline in Wind Farm Capacity Factor in the United Kingdom**




If this rate of degradation is experienced in New York, then it could mean that by 2040, half of new onshore wind capacity added every year will not be producing additional energy for decarbonization, but instead simply compensating for the perpetual degradation of wind turbines already installed.[37] By 2050, it could mean that effective onshore wind capacity could drop by about a third of its aggregate nameplate capacity and effective offshore wind capacity could drop by almost a quarter. Similarly, NREL estimates that the capacity factor of solar PV panels declines by about 0.5% annually. For rooftop panels with restricted air circulation, the rate of decline may be even greater.[38] So by 2050, the effective capacity of solar PV projects could drop by more than 20% of its aggregate nameplate capacity. In other words, the 60,600 MW of installed solar capacity that the draft plan anticipates will be in place by 2050 in Scenario 3 may only be capable of providing 48,000 MW of power, and proportionally less energy.  If NYSERDA is not factoring these declines in performance into its model, the consequences could be immense.

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[35] See Annex 1, input assumptions.

[36] Staffell, Greene, *How does wind farm performance decline with age?* Renewable Energy, Volume 66, June 2014, pages 775-786. https://www.sciencedirect.com/science/article/pii/S0960148113005727?via%3Dihub

[37] For Scenario 3, in the period of time between 2035 and 2040, additional onshore wind capacity would be added at a rate of 6125 MW - 5220 MW = 905 MW over five years, or 181 MW per year. However, in 2040 the effective capacity of 6125 MW would drop 1.6%, which is approximate 98 MW. This is more than half of 181 MW.

[38] https://www.nrel.gov/state-local-tribal/blog/posts/stat-faqs-part2-lifetime-of-pv-panels.html

Necessary replacement of renewable infrastructure

As stated above, NYSERDA's integration analysis assumes an indefinite lifetime for solar, wind, and storage projects. This means that it ignores the impacts and cost of replacing aging equipment. In reality, solar panels and wind turbines typically last a couple of decades and lithium-ion batteries less. By 2050, and likely sooner, renewable resources installed today will need to be removed, disposed of, and replaced. Ignoring such factors distorts NYSERDA's modelling.

However, wind turbines, solar panels, and batteries not only degrade with time, they are also vulnerable. Relying on sprawling wind and solar farms for most of the state's electricity will expose New York's grid to weather events or other external forces that require more frequent replacement of equipment due to both age and damage. Moreover, extreme weather events could cause extensive loss of not only transmission, but also generation capacity that could take a very long time to replace. This is a particular concern as climate change causes storms to become more frequent and intense. Wind turbines today are not designed to withstand storms greater than Category 3, and solar farms are far more fragile.[39]

The following shows what happened to wind turbines and solar panels in Puerto Rico when Hurricane Maria, a Category 5 storm, struck.[40] With weather patterns changing so dramatically, it would be unwise to assume that New York is immune to such events.

**Wind Turbines and Solar Farm Damage in Puerto Rico**
**Damaged by Hurricane Maria in 2017**

By comparison, nuclear power plants are "hardened" facilities that can operate 80 years or more—outlasting solar, wind, and batteries by a factor of four. Clearly New York's future extends more than 30 years. However, by tallying up capital expenses but truncating benefits in 2050, NYSERDA's analysis discriminates against long-term investments.

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[39] Wind turbine presentation sponsored by Our Energy Policy, Dec, 2019.
https://www.ourenergypolicy.org/offshore-wind/

[40] 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

Transmission

Other than stating frequently that transmission improvements are needed, the draft scoping plan provides no substantive discussion of how much or what kind of new transmission infrastructure must be built. The Resource Cost tabs of Technical Supplement Annex 1 seems to provide general input assumptions about the cost of transmission upgrades within individual zones. However, this does not address major transmission upgrades and new corridor projects that will be necessary between zones, including long-range transmission to bring electricity downstate from upstate wind and solar projects, or into the state from outside New York.

Significant public attention has been given to two particular projects for bringing electricity downstate, Champlain Hudson Power Express (CHPE) and Clean Path New York (CPNY). However, together these add up to merely 2550 MW of total transmission capacity. Presently, the downstate region includes over 22,428 MW of dispatchable capacity from oil- and gas-fired power plants. (It also experiences a summertime peak demand in excess of 30,000 MW.) Therefore, unless firm carbon-free capacity is built downstate to replace that dispatchable fossil fuel generation and serve demand, much more additional long-distance transmission capacity will be needed to bring clean electricity downstate from elsewhere. Notably, this is true even with the eventual addition of offshore wind, since that will also not be dispatchable. When the wind does not blow and batteries are depleted, New York City will still need electricity. Relating to this, the contract with CHPE approved in April 2022 provides no guarantee of service. In the future, if Quebec needs more electricity on a frigid day in winter and Manhattan needs more electricity for the same reason, then Manhattan—and those residents who have converted to heat pumps—could be left in the cold. Perhaps such matters should have been considered before eliminating downstate New York's largest source of firm, locally-produced, carbon-free power.

Scenario 3 of the draft plan also proposes 6600 MW of addition capacity to import electricity from wind turbines located outside of the state (the PGM service region, Ontario, and Quebec). In addition, it proposes importing and exporting over 15,000 GWh electricity from unspecified sources, more than a three-fold increase over current levels. Nowhere in the plan, or its Integration Analysis, is there any discussion of the giant transmission projects that would have to be built to support these heightened levels on interconnection.

Curtailment

The very high capacity factors apparent in NYSERDA's Integration Analysis suggest zero curtailment of wind and solar. This makes the draft plan an outlier to nearly all other studies that have been conducted regarding the operation of grids that rely on large amounts of intermittent generation.

Solar curtailment already occurs in places like California where the amount of renewable penetration is still far less than what New York's draft plan anticipates.[41] Curtailment of wind has even occurred already in New York.[42] Furthermore, NYISO predicts that significant curtailment of renewable will occur as the state attempts to meet its 70% by 2030 goal unless substantial transmission improvements are made. In its 2019 Congestion Assessment and Resource Integration Study (CARIS), NYISO predicts that that without improvement, congestion between "renewable generation pockets" would likely result in 11% curtailment of total renewable energy production across the state, and that in some areas, curtailment could reach as high as 63%.[43] It would be overly pessimistic to assume these levels of impairment in the future. However, assuming zero curtailment is also unrealistic.

Unlike NYISO, which quantitatively discusses the issue of curtailment in its Phase II report, the draft plan essentially ignores the problem and broadly assumes that all "excess" electricity from renewables can be directed to the operation of electrolyzers for hydrogen production. However, making full use of excess electricity during periods of high wind and solar output might require installing more electrolyzers than needed. Without a robust analysis of grid dynamics and hydrogen use, it is impossible for NYSERDA to know whether electrolyzers are a sufficient load. Excess electricity could also potentially be exported. But again, NYSERDA has not performed the robust analysis of projected inter-regional and interstate transmission to conclude that interconnection capacity (and external demand) will be adequate avoid curtailment completely.

Inefficient backup generation

An issue often overlooked by energy models is the extent to which the inefficient "partnering" of intermittent sources with dispatchable generation affects emissions in a dynamic system. One cannot simply subtract new renewable generation on a watt-hour basis from prior fossil-fuel generation and assume that carbon-emissions decline proportionally. For example, in a predominantly fossil fuel grid, baseload generation may be served by gas-fired combined-cycle plants that run throughout the day at efficiencies of 60%. However, when wind and solar are introduced, the firm "backup" generation called upon to provide electricity when those intermittent sources are suddenly absent may be simple-cycle generators with efficiencies closer to 33% which can fire-up quickly but burn more gas per watt-hour. These essentially operate like "peakers", except that instead of running during periods of peak *demand*, they run at time of low renewable *supply*. If larger combined-cycle generators are dispatched, their ramp-up time is slower and fuel efficiency suffers (along with pollutant controls). Another technique is to run gas plants in "hot standby", which means that fossil fuels are burned even when not producing electricity. So depending on the amount intermittency in a system and how switching

[41] http://www.caiso.com/informed/Pages/ManagingOversupply.aspx
[42] NYISO Power Trends 2021, https://www.nyiso.com/documents/20142/2223020/2021-Power-Trends-Report.pdf/
[43] NYISO Power Trends 2021

between sources is handled, carbon emissions may not actually improve much (and in some cases may even become worse) with intermittent sources in the mix.

Unfortunately, these are the convoluted practices already occurring in California which has deployed a lot of solar and wind. Operating a grid this way might help meet arbitrary renewable targets, but does little for greenhouse gas reduction and climate change. It also has a deleterious impact on system cost. As discussed in the OECD study previously cited:

> *…increasing penetration of variable wind and solar PV forces a shift from relatively efficient combined cycle gas turbines (CCGT) to open cycle gas turbines (OCGT), which are less efficient but more flexible and have lower capital costs. This is due to the fact that increasing flexibility requirements and reduced load factors favour the deployment of the less capital-intensive dispatchable power plants to satisfy residual load. This change from more efficient plants working a high number of hours to less efficient plants working less hours but having lower capital cost typically raises the profile costs and the total system costs of the high VRE scenarios.*

Unless and until the electricity grid is carbon-free, these real-world factors will impact fuel consumption, carbon emissions, and system cost. However, they are ignored in the draft plan and NYSERDA's analysis.

## IV. Consequences of Failure

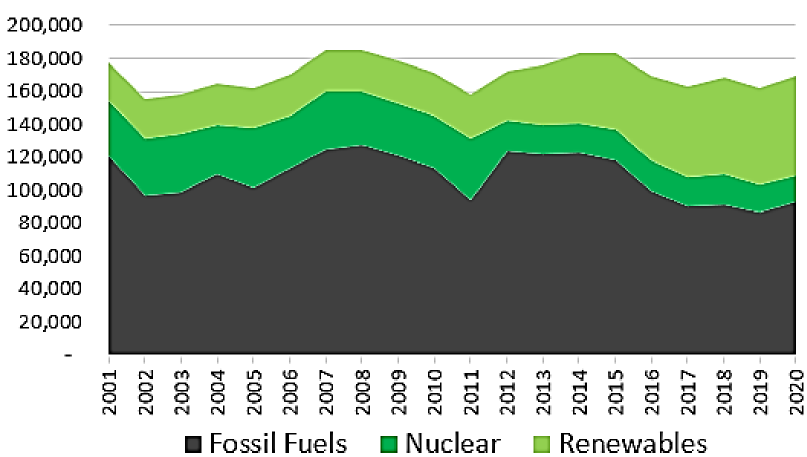
Credible studies, including those previously discussed, demonstrate that decarbonization plans which are over reliant on intermittent generation are least reliable, least affordable, and most likely to fail. However, the most compelling arguments against such a strategy are in the real world. California, Germany, and even New York itself offer cogent examples of how this expensive experiment plays out.

California

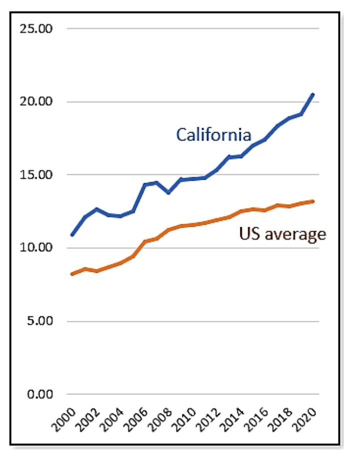
After spending billions of dollars on wind and solar, California has managed to increase non-hydro renewables to about a third of electricity generation in state. While this might seem like progress, it has solidified dependence on gas-fired power plants needed when renewable supply cannot meet demand. At the same time, the state is prematurely shutting down its largest source of reliable carbon-free energy, nuclear power. The San Onofre nuclear plant was shuttered in 2013, and the two reactors at Diablo Canyon are scheduled to close in 2024 and 2025. Consequently, California today relies on fossil gas for 40% of its electricity, a proportion that has changed little over the past two decades.[44] The state has also become increasingly dependent on imports, with transmission projects being built to receive electricity from fossil fuel neighbors.[45] Despite twenty years of investment in renewables and self-promotion as a climate leader, California has accomplished little besides treading water.

Meanwhile, residents and ratepayers have paid a hefty price to replace reliable energy with intermittent. Blackouts have made national news, forcing many families to purchase diesel generators and causing the state to beg residents not to charge their electric vehicles. In an effort to restore reliability, California recently sought air pollution wavers from the federal government so that it can build four new gas-fired power plants. At the same time, electric bills that were already above the national average have skyrocketed.[46]

***California Electricity Generation***




***Residential Electricity (cents/KWh)***




44 https://www.energy.ca.gov/data-reports/energy-almanac/electric-generation-capacity-and-energy
45 https://capitolweekly.net/closing-diablo-canyon-spurs-fears-over-replacement-power/
46 https://www.eia.gov/electricity/sales_revenue_price/

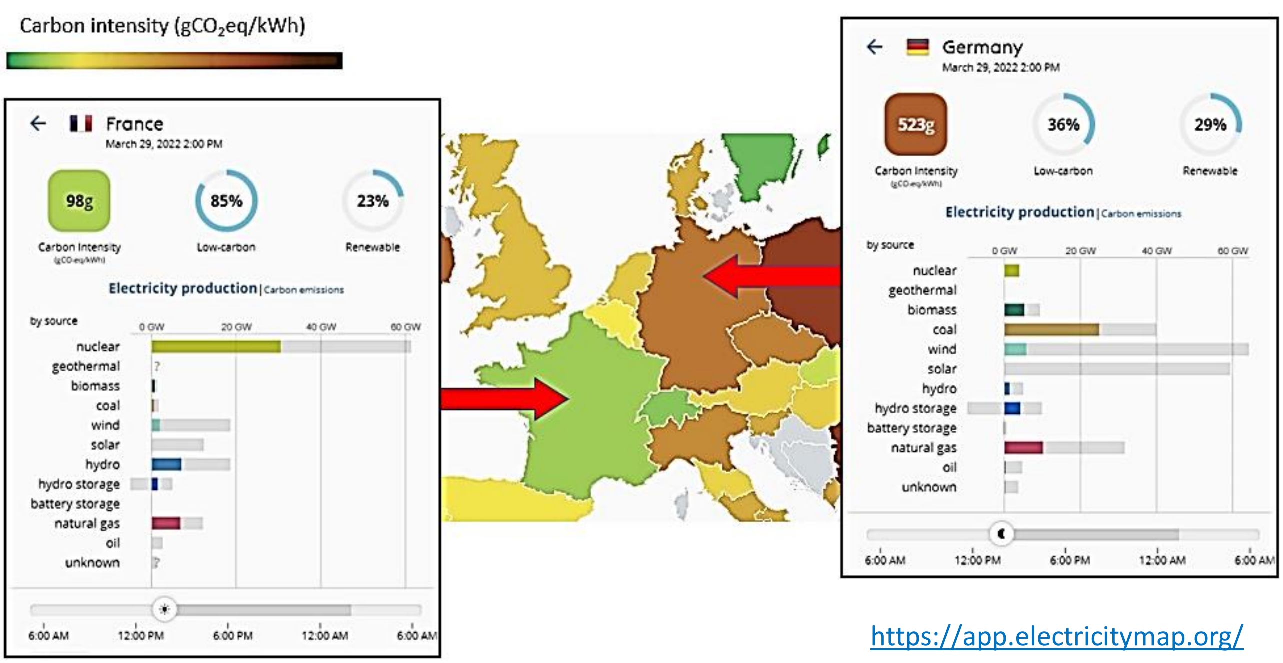
## Germany

In 2010, Germany embarked upon *"Energiewende,"* once described as the most ambitious energy revolution by any industrialized nation. But as half a trillion Euros were committed to renewable investments, the country simultaneously sought to eliminate nuclear power within its borders—thus wiping out a source of carbon-free energy that once provided over a quarter of all its electricity. As a result, much of Germany's electricity still comes from the most polluting form of energy on the planet: lignite coal extracted from open-pit mines in the country which are expanding. Over the past decade, Germany also became increasingly dependent on Russian gas, thereby emboldening the Kremlin to believe that it could invade eastern Europe with impunity.

Unfortunately, the tragedy continues today. Rather than contemplating how its bias against nuclear power has undermined action on climate change and fostered political instability in Europe, Germany is doubling-down on its failed plan by supporting the construction of terminals to receive liquified natural gas (LNG) from the United States and lobbying the European Commission to include fossil gas as part of a taxonomy of sustainable energy solutions. Under the pretense of "renewable" energy, Germany also burns wood imported from forests that had previously sequestered carbon and crops from farmland that could have fed people. Ironically, despite remaining obstinately opposed to nuclear power, Germany continues to import electricity on a daily basis from nuclear power plants in France to maintain reliability.

The following figure, which depicts real-time data from ElectricityMap (https://app.electricitymap.org) for a typical day in spring, illustrates this tale of two nations. (Green indicates lowest carbon intensity and brown indicates high.) As seen below, a lot of installed renewable capacity does not necessarily translate into a lot of energy.

***Intensity of Carbon Emission from the Electricity Sector: Germany and France***

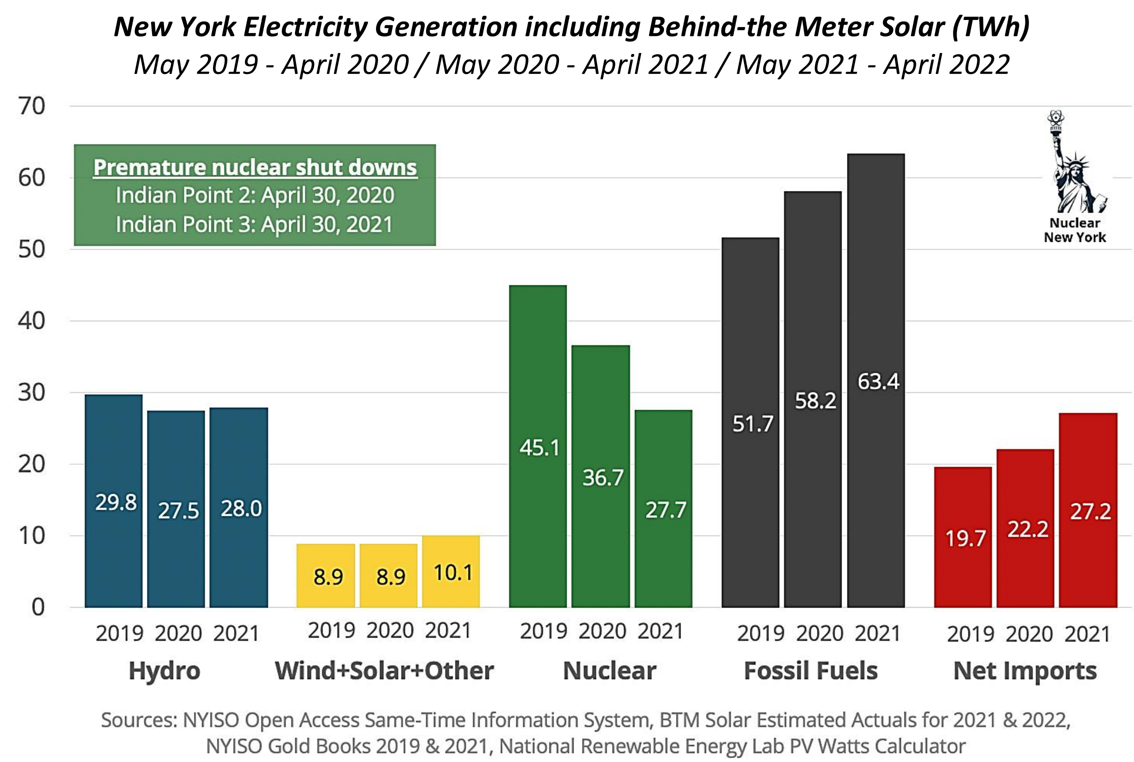



https://app.electricitymap.org/

New York

California and Germany are clear examples of how ideologically-driven energy planning leads to failure, but there is another much closer to home.

In 2019, the year that the CLCPA was enacted, 60% of New York's in-state electricity generation (including behind-the-meter solar) was carbon free, mostly due to nuclear power (33%) and hydro (22%). However, that was also the last year that Indian Point ran at full capacity. In April 2020, following a lengthy political campaign by former Governor Cuomo, anti-nuclear activists, and the fossil fuel industry, Unit 2 at Indian Point was permanently taken out of service. Indian Point's remaining reactor, Unit 3, was shuttered in April 2021. As seen below, real-time data collected by NYISO confirm that the loss of generation from Units 2 and 3 has resulted in an unmistakable corresponding increase in generation from fossil fuels.[47] That electricity generation has come from gas-fired power plants built to replace Indian Point, CPV Energy Center (678 MW) and Cricket Valley Energy Center (1,100 MW), as well as from existing fossil fuel plants in the downstate metropolitan area which run more than before.[48] New York's reliance on dispatchable out-of-state fossil fuel generators within the surrounding region also grew, as seen in a marked increase in "net imports." Significantly, this ramp-up of fossil generation occurred even during the COVID pandemic when electricity demand actually fell.




[47] NYISO Open Access Same-Time Information System (OASIS): http://mis.nyiso.com/public/P-63list.htm.
Load data from NYISO. http://mis.nyiso.com/public/P-58Clist.htm

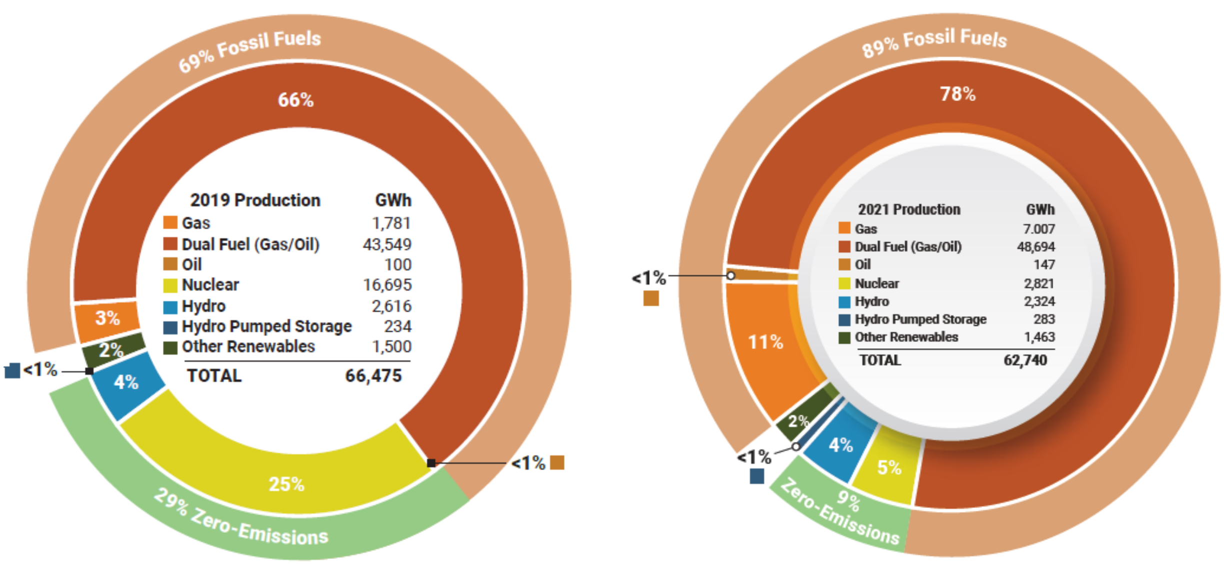
[48] Both CPV and Cricket Valley Energy (CVE) participated in Indian Point contingency plan proceedings before the PSC. CVE broke ground shortly after the announced closure agreement of Indian Point in 2017, and became operational just days before the closure Unit 2 in 2020.

Contrary to the claims of several anti-nuclear groups, renewable energy and "efficiency" did not replace Indian Point. Gas did.[49] In fact, shutting down just one of Indian Point's two reactors removed more carbon-free electricity from the grid than generated annually by every wind turbine and solar panel in the state.

For years, Indian Point provided the downstate grid with 2,100 MW of reliable carbon-free power to customers at a remarkable capacity factor of 93%. However, by sacrificing that 16,700 GWh of annual baseload energy, New York decided to let 7 million metric tons of avoidable carbon dioxide emissions be pumped into the atmosphere every year—a reality that will persist until the grid is fully decarbonized, assuming that occurs. Further, those greenhouse gas impacts double when lifecycle emissions of methane are taken into account.[50] Moreover, shuttering Indian Point set the state backwards on environmental justice because dirty fossil-fuel power plants within EJ communities—including those disproportionately impacted in New York City—must now remain in operation longer than if fossil fuel plants had been shut down instead.

These facts are verified in consecutive editions of NYISO's annual Power Trends report. As seen below, downstate grid-delivered electricity went from 69% fossil fuel generation in 2019 to 89% in 2021.[51] Meanwhile New York's upstate grid has remained approximately 90% carbon-free thanks to hydropower and nuclear.

***NYCA Downstate Energy Production 2019 and 2021***



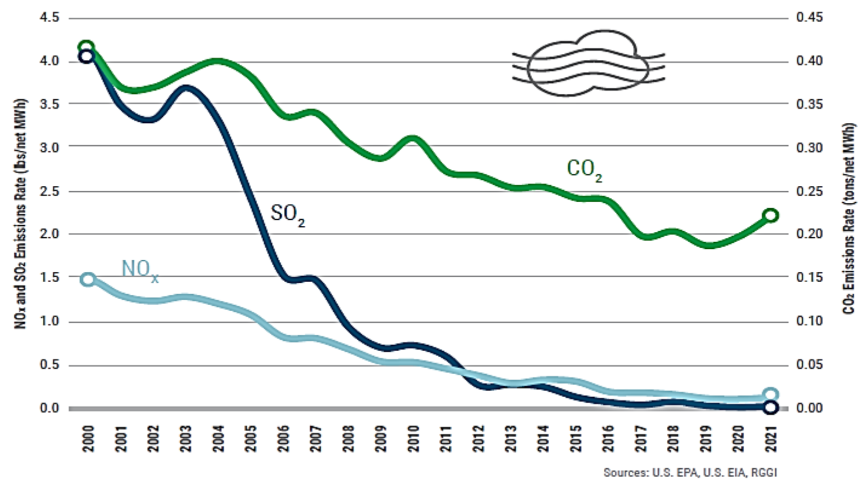

[49] https://climatecoalition.org/setting-the-record-straight-on-indian-point

[50] based on a global warming potential of methane which is 86 times that of $CO_2$ over 20-years

[51] NYISO Power Trends 2020, https://www.nyiso.com/documents/20142/2223020/2020-Power-Trends-Report.pdf; NYISO Power Trends 2022, https://www.nyiso.com/documents/20142/2223020/2022-Power-Trends-Report.pdf; Note that downstate energy in 2021 includes partial contribution from nuclear power since Indian Point Unit 3 operated from January through April before being shut down.

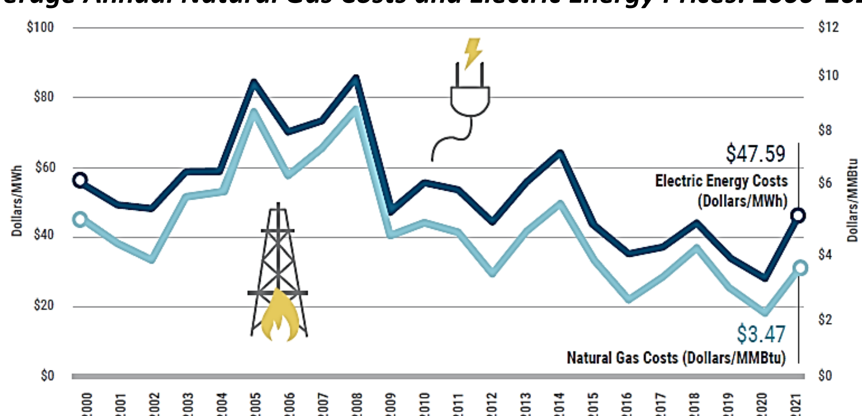
Addressing the impact of greenhouse gas emissions for the electricity sector, NYISO states in the current 2022 Power Trends reports: *"Recent increases in the $CO_2$ emission rate coincide with the phased closure of Indian Point nuclear units 2 and 3 in 2020 and 2021, respectively."* As seen in the figure below from NYISO, $CO_2$ emission which had been falling in prior years, rose after 2019.[52]

***Emission Rates from Electric Generation in New York: 2000-2021***




To make matters worse, the closure of Indian Point has hurt ratepayers, including those downstate who now bear the brunt of higher emissions. According to 2022 Power Trends, "As noted by the NYISO's independent market monitor, wholesale electric prices in New York have generally increased as a result of the retirement of Indian Point 2 in April 2020 and Indian Point 3 in April 2021." [53]

***Average Annual Natural Gas Costs and Electric Energy Prices: 2000-2021***



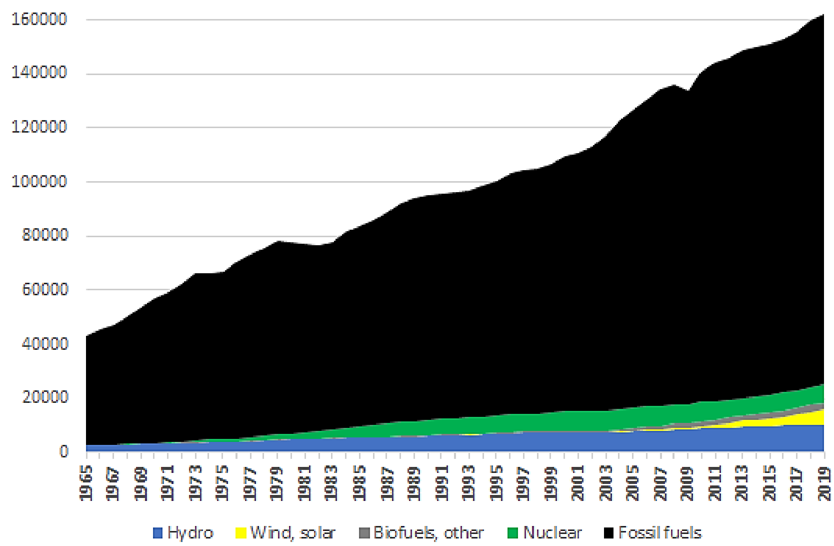

The inconvenient truth is that in the three years since adoption of the CLCPA, New York took an enormous step backwards on fighting climate change and environmental justice. We can expect the same to occur if the licenses of New York's upstate nuclear plants are not renewed. New York should learn from past mistakes, not repeat them.

[52] NYISO Power Trends 2022
[53] NYISO Power Trends 2022

The World

The examples above are not isolated cases. As seen throughout the country and the world—Vermont, Massachusetts, California, and Europe—wherever nuclear power has been lost, it has been replaced by fossil fuels. Although significant, growth in low-energy-density low-capacity-factor solar and wind has been dwarfed by the ongoing worldwide expansion of energy-dense coal and gas.[54] Those professing leadership must also recognize that solutions developed to address climate change in affluent nations must work elsewhere. This includes Asia and India where energy demand is skyrocketing. Around the globe, efforts to stem climate change and end fossil fuel consumption without nuclear power have failed, and the planetary harm of that failure will grow for as long as we continue down the same path.

**World Energy Consumption (TWh)**
Source: Our World in Data (Energy Mix)




[54] Our World in Data; traditional biomass not shown
https://ourworldindata.org/global-energy-200-years

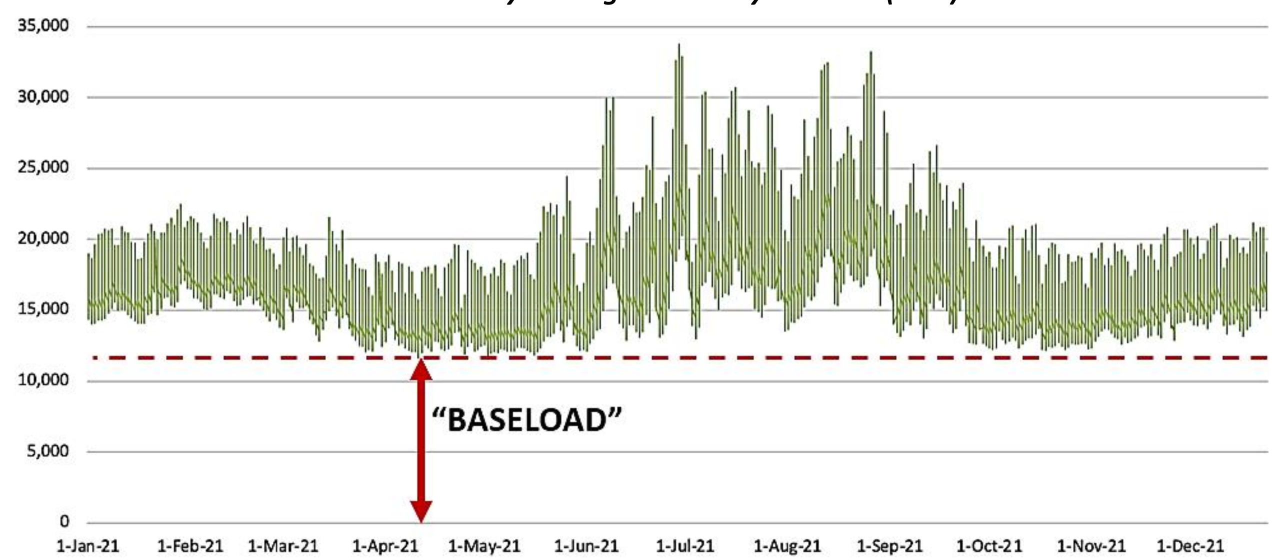
## V. Designing a Decarbonization Plan that Works

It is clear from objective research and real-world circumstances that the draft scoping plan which has been proposed by the state Climate Action Council and NYSERDA cannot realistically succeed. In this section, we discuss elements of a plan that can.

Solar and wind pose two fundamental problems: (1) low energy density, which affects the sheer volume of materials, land, and infrastructure required to produce electricity; and (2) intermittency, which interferes with the delivery of energy when it is actually needed, making the integration of such sources into the grid increasingly difficult as more are deployed. The greatest mistake that New York can make is to underestimate the difficulty that these two factors present. An effective solution will be one that avoids them.

As seen below, over half of total electricity demand in New York is baseload—meaning demand which is present nearly all of the time. Today this amounts to about 12 GW of power and 100,000 GWh of annual energy. However, in a future when demand is twice as high due to the electrification of other sectors, it is conceivable that this could be upwards of 24 GW and 200,000 GWh.[55] So rather than assembling a multitude of intermittent low-capacity-factor generators plus massive battery storage in an effort to provide most of this aggregate continuous energy, a far more efficient use of generating capacity would be to incorporate a much smaller set of firm generators with high-capacity-factor that are capable of running continuously, or nearly so.

***New York Daily Average Electricity Demand (MW)***

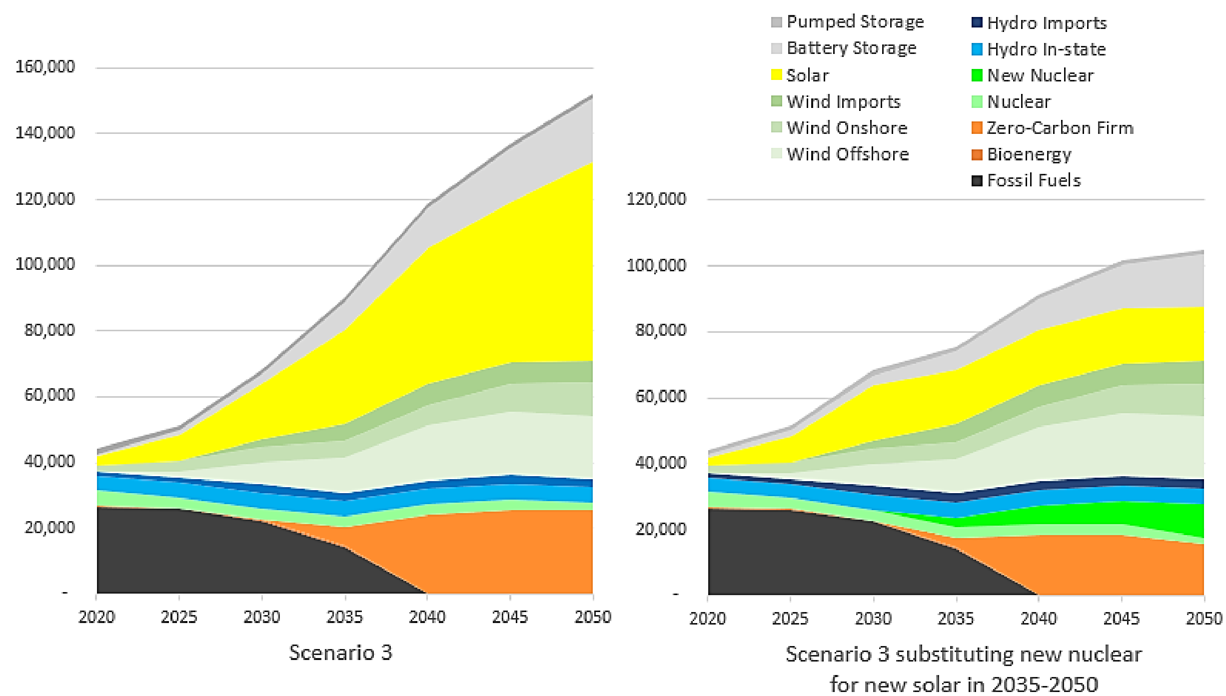



Nuclear power and hydropower are ideal for this purpose. This would include existing nuclear plants as well as new advanced reactors—firm carbon-free resources which, in this case, could be dispatched all or most of the time. Existing large-scale hydropower and perhaps some smaller hydro projects would also contribute to baseload generation.

[55] Note that actual demand profile is likely to shift from summer peaking to winter peaking due to increased use of electric heat pumps.

Wind, solar, and batteries continue to be part of the total portfolio. However, the advantage of such an approach is that it avoids an excessive, unrealistic, and unwelcomed buildout of solar and wind, massive battery plants and imposing new transmission infrastructure—thereby saving farmland and nature. Furthermore, it avoids a tremendous amount of *additional* dispatchable zero-emission capacity for “backup” generation. As previously discussed, Scenario 3 would require building 25 GW of firm zero-emission capacity in the form of giant hydrogen fuel cell facilities, electrolyzers, underground caverns for hydrogen storage, and 400 miles of new hydrogen-grade pipeline for when solar and wind cannot deliver and batteries are depleted. Since nuclear power is a firm zero-emission source, all or most of this additional dispatchable firm capacity would be unnecessary. The approach we are suggesting constitutes a much more efficient use of installed capacity and infrastructure.

The following is an example of how this could apply. As previously discussed, NYECA believes there are significant oversights and omissions in NYSERDA analysis which render it overly optimistic in its predictions of capacity, infrastructure and cost. However, even ignoring those issues, we can comparatively observe how including addition nuclear improves the picture. In this case, we substitute new nuclear power for new solar in 2035-2050, when advanced nuclear technology is expected to be widely available.[56]

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[56]In this example, no new solar capacity is added after 2030. New nuclear capacity in 2035, 2040, 2045, and 2050 is determined by multiplying the amount of new solar avoided each year by the ratio of solar and nuclear capacity factors. Zero-carbon firm resources are also reduced by the amount of new nuclear added each year. As an estimate, battery storage is reduced proportionally to the reduction in total solar and wind capacity, although this probably retains more battery storage than necessary since solar is likely to require more storage than wind. Since NYSERDA includes some additional solar for electrolysis to support dispatchable zero-carbon firm generation, the amount of new nuclear power required should also be slightly less than shown. Assuming a high operational capacity factor for nuclear (95%) is valid because in this case total nuclear and hydro does not exceed baseload with increased demand. The 70% renewable goal is unaffected since new nuclear is not added until after 2030.

As seen above, bringing a modest amount of new nuclear capacity online after 2030, approximate 10 GW, would have the dramatic impact of reducing the amount of solar capacity needed by 44 GW. At a power density of 8 acres/MW for single-axis tracking, this would save more than 350,000 acres—548 square miles—of farmland or wildlife habitat from conversion to industrial solar projects. By comparison, 10 GW of nuclear power corresponds to fewer than five plants the size of Indian Point, which only occupied 250 acres.[57] In addition, at least 10 GW of underperforming, inefficient, and costly dispatchable zero-carbon firm generation could be avoided. As a proportion of infrastructure identified in NYSERDA's proposal, this corresponds to two hundred 50 MW hydrogen fuel cell plants comparable to the previously mentioned facility in Korea (the largest in the world) and 160 miles of new hydrogen-grade pipeline. Although more difficult to estimate without modeling, a substantial reduction in battery storage would be realized as well, along with a significant reduction in required transmission infrastructure.

Again, the above example does not attempt to correct for any mistakes in the scoping plan's Integration Analysis. Addressing overgenerous assumptions by NYSERDA relating to renewable capacity factors, dubious reliance on imported electricity, and other issues, the reduction in installed generation and storage capacity illustrated above would be even more pronounced. Although our example only looks at solar, the real-world benefits of substituting nuclear for wind, particular onshore, would also be significant (especially if NYSERDA's unrealistic capacity factors for imported wind is taken into account).

As demonstrated above, instead of considering zero-carbon "firm" generation capacity as merely ***back-up*** for intermittent sources, a more efficient and cost-effective system-wide allocation of generation capacity and infrastructure can be achieved by integrating new zero-carbon "firm" generation into the **backbone** of New York's energy system so that it can serve a meaningful portion of demand. Working in tandem with renewables, this would also help to facilitate a more successful deployment solar and wind that is realistic, ecologically responsible, and welcomed by the communities hosting them.

*Poor Choices*

Although a number zero-carbon "firm" sources have been suggested to help New York meet its climate goals, they vary greatly in their availability and usefulness.

NYSERDA describes "green hydrogen" produced by electrolysis using electricity from wind and solar as a source of firm generation. This is somewhat of a misnomer because hydrogen produced by electrolysis requires significantly more energy to make than it yields when re-oxidized. (In fact, typical "round-trip" efficiency for power-$H_2$-power is only about 50%.) As such, rather than generation, hydrogen is really a *carrier* of energy, or a form of energy *storage.* While "green hydrogen" can be used to store and later dispatch a small amount of energy for later use, the fact that it relies on wind and solar means that it cannot supply large amounts of energy for long periods of time. As discussed, building extensive facilities involving electrolyzers, fuel cells, underground storage, and pipelines to create a small amount of electricity is not economical or efficient. A more useful application for hydrogen is in decarbonizing other difficult sectors of the economy such as industrial processes requiring high temperature combustion or aviation. (In fact, nuclear power can help with this.)

[57] See also discussion of total lifecycle land use impacts in subsequent section of these comments.

Biogas, sometimes described as Renewable Natural Gas (RNG) might also be considered a source of firm generation. However, it is also fuel-constrained. The volume of methane recoverable from landfills, sewage, and agricultural processes is inadequate for anything more than small-scale or occasional use. Similarly, 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. However, the negative climate consequences of biomass must also be considered. Burning wood 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. Moreover, with respect to air pollution and public health, biomass combustion is just about as harmful as coal.

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 carbon produced. 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.[58] CCS projects to date are only experimental and nowhere have they been deployed at scale.

Nuclear Power —Firm Generation for Today and Tomorrow

By far, the firm zero-carbon source of electricity with greatest potential to meet energy needs of New York and the world is nuclear power. Having provided reliable baseload electricity for decades, nuclear power plants in the United States are responsible for over half of the nation's carbon-free electricity. Except when occasionally removed from service for maintenance or refueling (which occurs only about once every year or two) a nuclear plant can run nearly continuously at a capacity factor of 95%.[59] The efficiency and economics of any generator improve the more it runs, so it makes sense that this is how many nuclear power plants operate. However nuclear plants, like other thermal facilities, are also capable of gradual load-following, which makes them dispatchable. In fact, this is commonplace in France where nuclear is responsible for 70% of electricity generation.

Nuclear power is a versatile source of energy that can meet demand as needed, whether that is all the time or less. In this way, it provides reliability while creating an environment that allows all carbon-free sources, including renewables, to function most effectively in the roles to which they are best suited. Since nuclear is not fuel-limited, this also makes it a valuable safeguard against New York failing to meet climate goals if solar, wind, and storage do not materialize at the scales contemplated. However, nuclear energy has beneficial applications beyond power generation, including applications that can further contribute to greenhouse gas reduction. Using surplus electricity and/or heat from nuclear

[58] This is a derived directly from the molecular weights of methane, $CH_4$ (16) and carbon dioxide, $CO_2$ (44).
[59] Ironically, immediately prior to its closure, Indian Point achieved a world record of 753 days in continuous operation for a light-water reactor. https://mobile.twitter.com/indian_point/status/1384153530844409860 (posted April 19)

power, hydrogen can be produced in a manner that is truly scalable.[60] 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.[61]

Clearly, the most practical application of nuclear power today is in the continued operation of facilities which have already been built. In fact, according to the International Energy Agency (IEA), refurbishing existing nuclear plants so that they can continue operating is among the most cost-effective means of ensuring carbon-free electricity in the future.[62] This finding is also supported by NYSERDA's own Integration Analysis which determined that New York would save $8.7 Billion by extending the licenses of the reactors at Nine Mile Point, Fitzpatrick, and Ginna. Together, New York's upstate nuclear facilities provide 3,355 MW of zero-carbon firm capacity and supply the state with over 26,400 GWh of annual electricity. This corresponds to 20% of total in-state generation and enough carbon-free electricity to power 44 million households. [63]

***New York's Nuclear Assets***


If New York is serious about curbing greenhouse gas emissions from the electricity sector, then relicensing its three upstate nuclear facilities should be a high priority. However, if New York hopes to wean itself of fossil fuels entirely, achieve a carbon-free grid by 2040 and maintain reliability even as statewide demand doubles, then it needs to invest in new nuclear power as well. Opportunities for this exist today and more will open up in the decade ahead.

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[60] 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/

[61] 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.

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

[63] Based on average annual consumption of electricity per household in New York of 602 kWh https://www.electricchoice.com/blog/electricity-on-average-do-homes/

Presently available Generation III+ reactors are based on the Pressurized Water Reactor (PWR) or Boiling Water Reactor (BWR) technologies used today throughout the United States and Europe, but with modern enhancements that include inherently safe or passively safe features like natural convection-based circulation and gravity-fed reservoirs for emergency cooling. For example, six Westinghouse AP1000 reactors are currently in operation or under construction, four in China and two in the United States. Most recently, Westinghouse also signed an agreement with Ukraine for nine AP1000 reactors to improve European energy independence.[64]

However, the most promising candidates for nuclear power in New York are likely to be one or more Generation IV or Small Modular Reactor (SMR) designs presently under development. [65] Some typical characteristics of these are:

- Small size. SMRs are generally defined as 300MW or less. Individual reactors are built in a factory according to a standardized design and then transported to the site, thereby reducing construction time and cost.
- Flexible operation with improved load-following capability to support peaking and carbon-free partnering with intermittent solar and wind
- Inherently or passively safe features throughout
- Improved fuel efficiency and consumption of long-lived actinides, depending on technology

Many different advanced reactor designs are currently being developed around world using a variety of fuels types, heat transfer media (water, sodium, gas) and fission mechanics (fast or thermal neutron). However, three American companies which have received funding for demonstration projects from the Department of Energy are NuScale, X-Energy, and Terrapower's Natrium reactor. Each are scheduled to have working projects complete this decade and reactors available for widespread deployment in the 2030-2040 timeframe.

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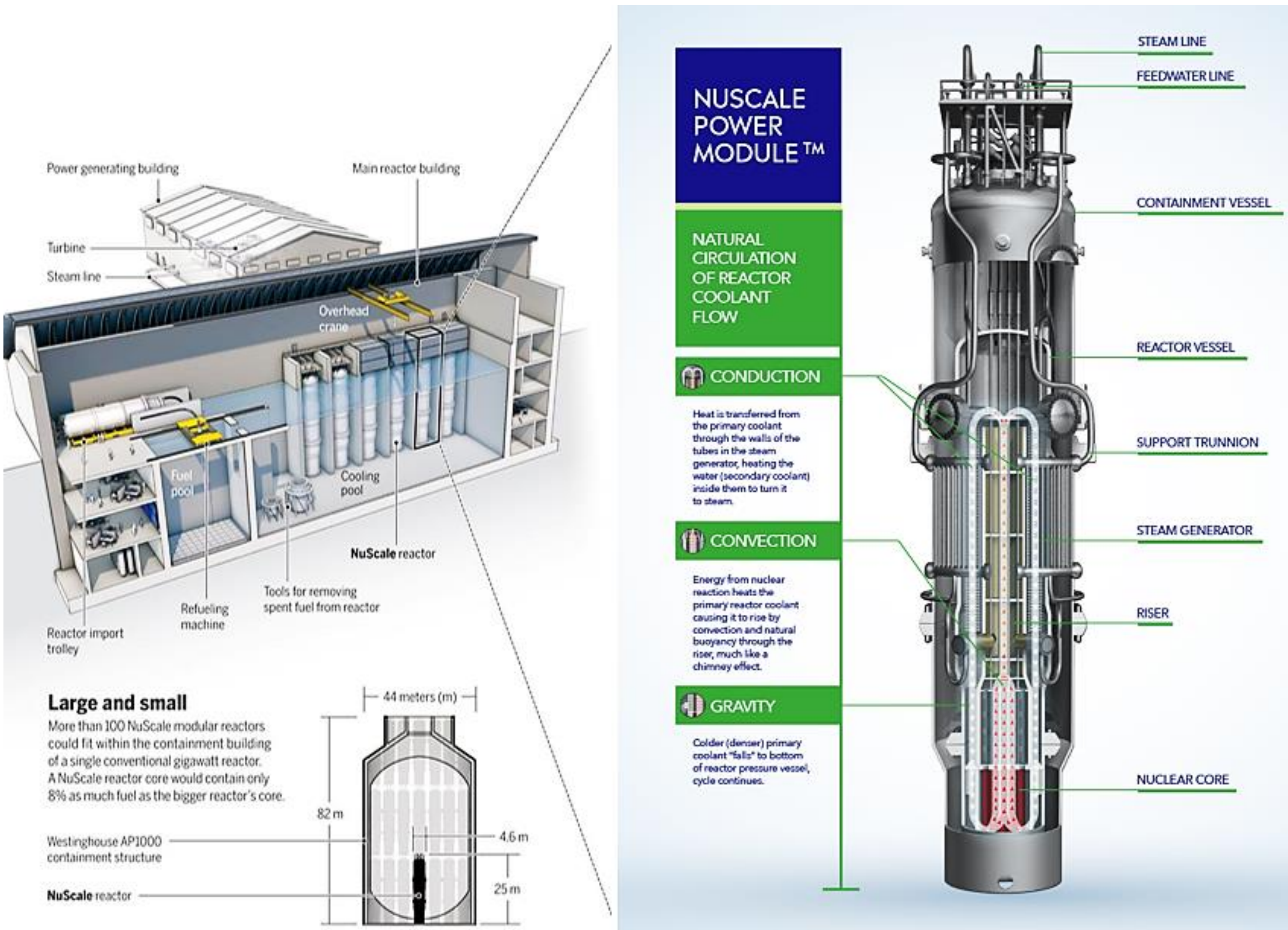
[64] https://www.world-nuclear-news.org/Articles/Westinghouse-and-Energoatom-expand-plans-to-nine-A; China is also pursuing development of its own versions (CAP1000 and CAP1400); https://www.ans.org/news/article-3933/china-greenlights-four-additional-ap1000-reactors/

[65] Generation IV technology: https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/generation-iv-nuclear-reactors.aspx;
Small Modular Reactors https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-power-reactors/small-nuclear-power-reactors.aspx

The NuScale design involves a 77MW small modular reactor.[66] Each is a self-contained light water reactor employing walk-away-safe technology with up to twelve reactors co-located in a pool below grade. NuScale will build its first set of reactors at Idaho National Labs and connect to the grid in 2029 as part of a regional Carbon Free Power Project (CFPP).[67] The company is also working with Poland and Romania to deploy its technology in Europe.[68]

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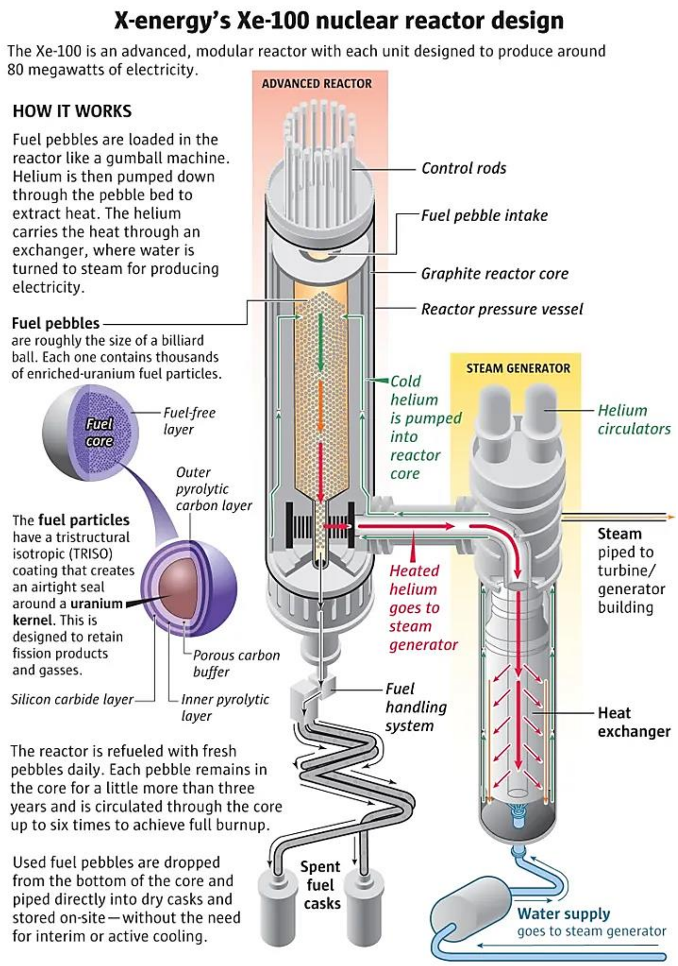
[66] https://www.nuscalepower.com/

[67] https://www.cfpllc.com/

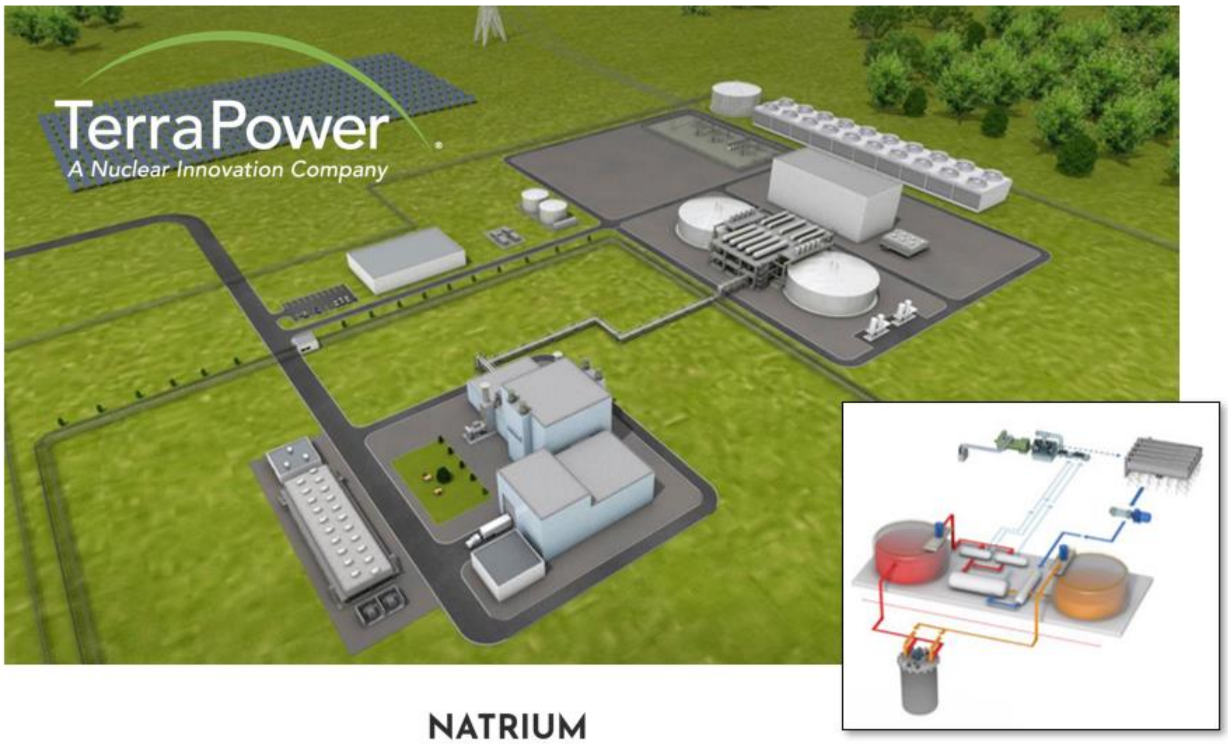
[68] https://www.world-nuclear-news.org/Articles/NuScale,-KGHM-agree-to-deploy-SMRs-in-Poland;

X-Energy is developing a pebble bed, helium cooled reactor that utilizes tri-structural isotropic (TRISO) fuel.[69] This fuel consists of spherical "pebbles" containing fissionable particles encased in layers of carbon on a microscopic scale which are slowly cycled through the reactor over several years. The pebbles are unable to melt and essentially constitute their own containment vessel, making the design ultra-safe. Heat energy to make electricity is then extracted by helium gas that circulates through the pebble bed. The XE-100 SMR is designed to generate approximately 76 MW of electricity with four reactors in group. X-Energy will build its first reactor at an existing nuclear plant in Washington State. The company also intends to manufacture its own TRISO fuel and is actively pursuing its pebble reactor design in Canada.[70]




[69] https://x-energy.com/; see also https://x-energy.com/video/technology-explainer; https://www.energy.gov/ne/articles/x-energy-developing-pebble-bed-reactor-they-say-cant-melt-down;
[70] https://x-energy.com/canada

The Natrium reactor is a joint project of TerraPower, founded by Bill Gates, and GE Hitachi.[71] It consists of a 345 MW sodium-cooled fast reactor, along with liquid sodium thermal storage which allows the plant to deliver up to 500 MW of electricity during peak periods of more than five hours.[72] The first Natrium demonstration plant is scheduled to be completed in 2028 at the site of a coal plant being shut down in Wyoming, thereby protecting jobs while replacing a dirty power plant with clean, carbon-free electricity.




## NATRIUM

The Natrium technology features a 345MWe reactor combined with a gigawatt-scale thermal energy storage system that can be optimized for specific markets. The molten salt-based storage technology is adopted from and has been widely demonstrated around the world in the concentrated solar power industry. The Natrium technology's reactor creates heat that can be used to generate electricity immediately or be contained in thermal storage reserves. That heat can be turned into electricity upon demand from the grid when need peaks or renewables are unavailable. For example, the state-of-the-art energy storage can boost the system's output to 500MWe of power for more than five and a half hours when needed.

The innovative combination of an advanced sodium fast reactor with energy storage allows the reactor to operate at a high capacity factor while simultaneously capturing more daily electricity revenue and supporting the increased use of renewables. The Natrium technology can also provide the heat needed for industrial processes that currently rely on fossil fuels – such as desalinating water, providing district heating or producing hydrogen, petrochemicals or steel – without generating carbon emissions.

Another promising nuclear design by GE Hitachi with plans to produce electricity this decade is the BWRX-300, an advanced boiling water reactor capable of generating 300MW of power.[73] GE Hitachi plans to build its first BWRX-300 reactor in Ontario as part of the Darlington New Nuclear Project. The company also has agreements in place within the United States and Europe.

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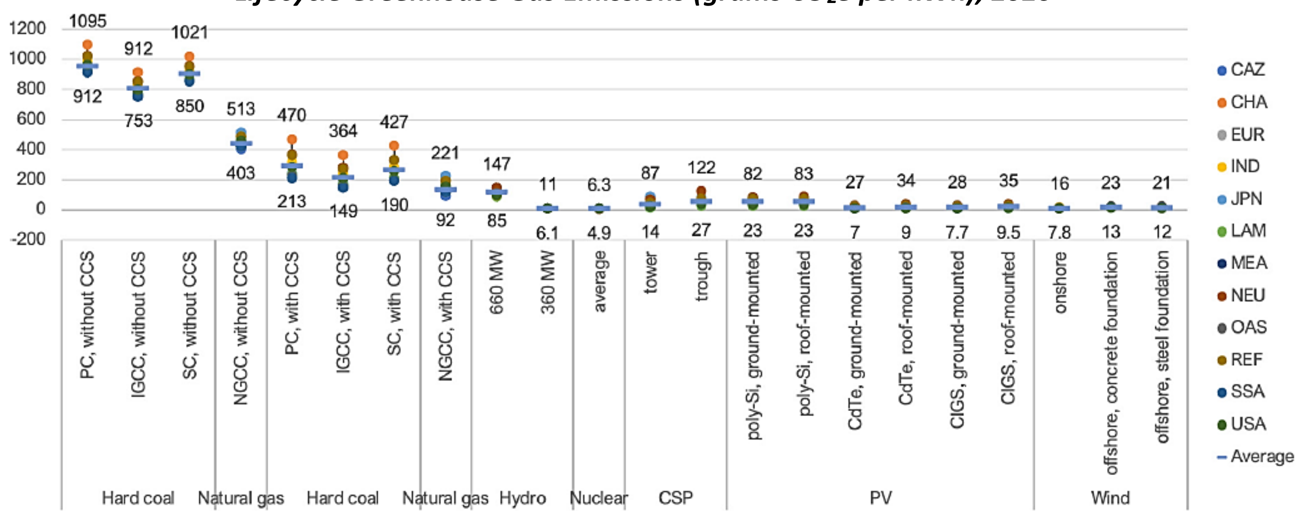
[71] https://www.terrapower.com/; https://natriumpower.com/
[72] https://www.terrapower.com/wp-content/uploads/2022/03/TP_2022_Natrium_Technology.pdf
[73] https://nuclear.gepower.com/build-a-plant/products/nuclear-power-plants-overview/bwrx-300; see also https://www.youtube.com/watch?v=y5Vt8vJrvm4

Nuclear Power—A Green Alternative for a Livable Planet

For years nuclear power has been a victim of sensationalistic reporting, movies, and misinformation campaigns which have hindered its expansion and benefited the fossil fuel industry. It is not the purpose of these comments to debate or assess the motivation behind those activities. Nevertheless, it is important for any objective analysis of energy options to consider the relative impact of technologies based on facts, rather than vague supposition.

A nuclear power plant produces zero on-site carbon emissions because it does not require combustion. However, according to a recent study by the United Nations Economic Commission for Europe (UNECE), nuclear also has the lowest carbon footprint of any energy source when total lifecycle greenhouse gas emissions are considered. [74]

***Lifecycle Greenhouse Gas Emissions (grams $CO_2$e per kWh), 2020***




With respect to land consumption, the direct footprint of a nuclear power plant is orders of magnitude less than solar or wind for the same amount of energy. This is particularly relevant in New York. A hypothetical solar farm capable of producing as much electricity as Indian Point would consume nearly 80,000 acres of land, whereas Indian Point occupied merely 250 acres.[75] However, when looking at total lifecycle issues of mining for materials, fuels, decommissioning, and handling of waste, nuclear power also has by far the lowest land use impact of any form of energy, renewable or fossil.[76]

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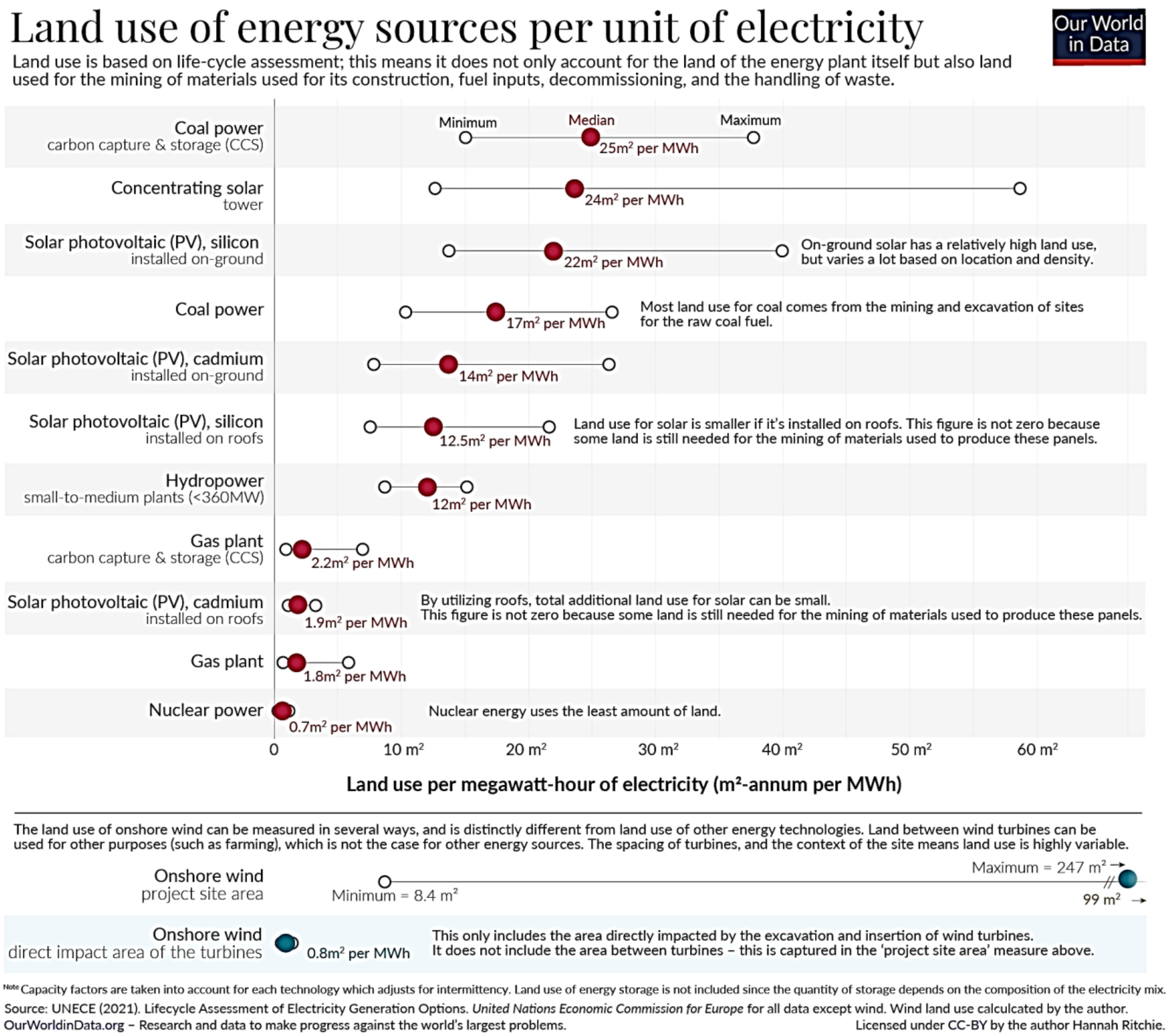
[74] *Carbon Neutrality in the UNECE Region: Integrated Lifecycle Assessment of Electricity Sources*, UN Economic Commission of Europe, March 2022 (UNECE report). https://unece.org/sites/default/files/2022-04/LCA_3_FINAL%20March%202022.pdf; see also *Global Climate Objectives Fall Short Without Nuclear 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 ;
A 2021 report by the Joint Research Center for the European Commission to evaluate energy taxonomies found similar results, citing a compiled review of 21 competent sources, and showing an average emission intensity of 28 Tonnes $CO2_e$/GWh compared to 26 Tonnes $CO2_e$/GWh for wind, and significantly less than 85 Tonnes $CO2_e$/GWh for solar. https://publications.jrc.ec.europa.eu/repository/handle/JRC125953

[75] 8 acres/MW for single axis tracking solar (NREL), 20% capacity factor for solar (AC), 93% capacity factor for nuclear.

[76] https://ourworldindata.org/land-use-per-energy-source



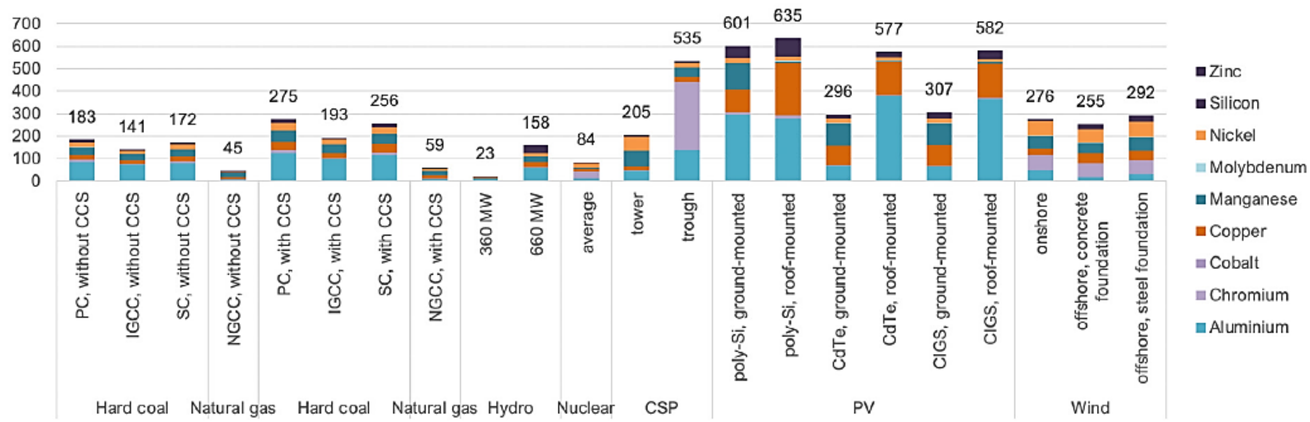

The above findings may seem counterintuitive, considering that nuclear power requires fuel, which is sometimes mined, whereas "renewables" like wind and solar ostensibly do not.[77] However, nuclear fuel is extremely energy dense, meaning that only a very small amount is needed to produce a tremendous amount of energy. In fact, one pound of uranium has the energy content of about 3 million pounds of coal. Furthermore, although "renewables" do not require fuel *per se*, they require a substantial amount of material—including mined material—for their construction, producing a relatively small amount of electricity in return. This includes bulk materials for construction and transmission like copper, concrete, and steel, as well as rare earth or special materials such as lithium and cobalt used in batteries. Compounding issues of waste, solar panels and wind turbines have short lifespans, typically twenty years. On the other hand, a nuclear power plant with proper maintenance can last more than 80 years.

[77] Solution mining, rather than open-pit mining is being increased used for uranium extraction. Uranium fuel can also be "recycled" from previously spent fuel. It can also be "un"-enriched from weapons-grade material, thereby putting former stockpiles to productive use and improving international security.

For example, nuclear power is sometime criticized for using a lot of concrete. In fact, a typical 1000 MW reactor might use 300,000 tons. However, wind turbines also use concrete for their structural foundation. A single 3 MW wind turbine may require 1200 tons. However, at 3 MW each, 1192 wind turbines are needed to produce as much energy as a 1000 MW nuclear plant. This corresponds to 1,431,000 tons of concrete—almost five times more than a nuclear plant producing the same amount of energy. Similarly, a 1000 MW nuclear plant might use 47,000 tons of steel, whereas a 3 MW wind turbine may use 335 tons.  1192 wind turbines would therefore require about 400,000 tons of steel, or over eight times more than a nuclear power plant.[78] Accounting for the lifespans of nuclear and wind, the differences could be even more pronounced.

The following compares the amount of other material needed for different types of energy (copper, aluminum, etc.).[79] As seen, nuclear requires comparatively little material, but solar and wind require even more than fossil fuels. Like fossil fuels, "renewables" are a very extractive industry.

***Material requirements for different energy sources (g per MWh)***




However, the large material footprint of wind and solar affects not only extraction. It also affects fabrication, transport, construction, and disposal (or abandonment) of materials. Notably extraction and fabrication for renewables technology in the Unites States occurs largely overseas, which may involve methods that are environmentally damaging, unsustainable, and socially or ethically objectionable.[80] All of these factors challenge blanket assumptions of sustainability which are often attributed to "renewable" energy.

In light of this information, it should come as no surprise that nuclear power also has a much smaller ecological impact on wildlife, habitat, and natural ecosystems than other forms of energy. The detrimental effect of fossil fuel combustion on climate change and human health are well established.

[78] Nuclear use of concrete and steel (reenforced and other): UNECE report, figure 62;
Wind use of concrete and steel: https://www.wind-watch.org/documents/metals-and-minerals-in-wind-turbines/ ;
93% capacity factor for nuclear and 26% capacity factor for land-based wind

[79] UNECE report

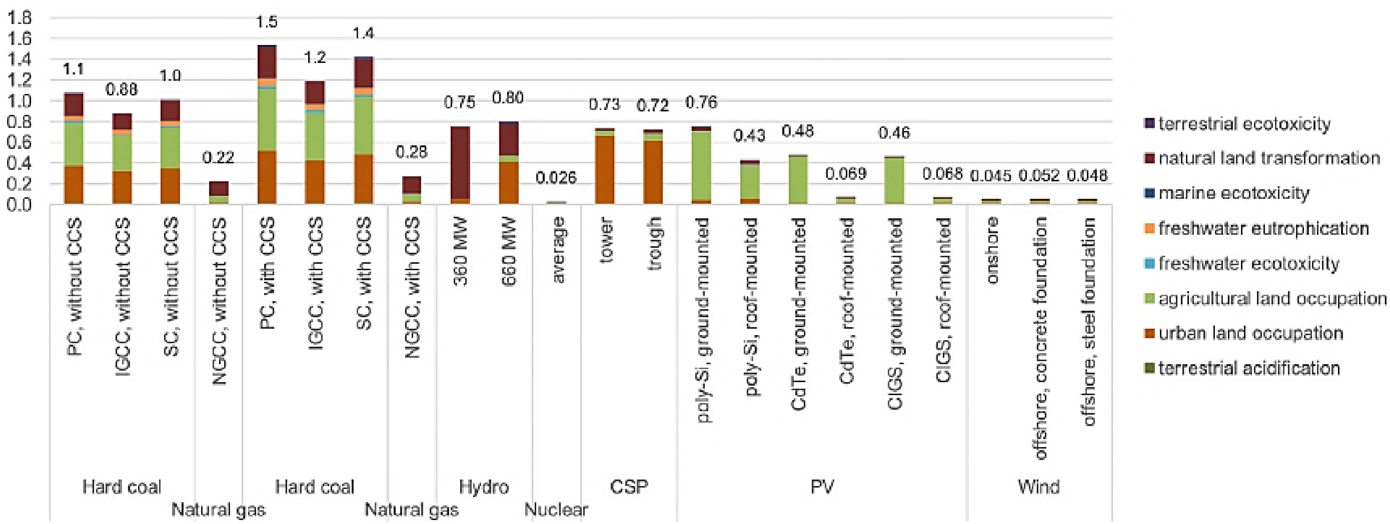
[80] For example, to continue using solar panels and materials from China, a widespread campaign has been launched by the renewable lobby to pressure the Biden administration to look the other way on unlawful tariff and unethical forced labor practices.

However, if deployed at immense scales as proposed in the draft scoping plan, "renewables" like solar and wind will also cause significant direct, indirect and cumulative harm to the environment.  As previously discussed, based on simple math, the widespread buildout of industrial-scale solar prescribed in the draft plan will consume hundreds of square miles of land--farmland or nature—encompassing an area larger that all five boroughs of New York City. Likewise, the cumulative effect of thousands of wind turbines will impact birds, including listed species. In addition to the direct loss of habitat, the sprawling nature of distributed solar and wind generation, as well as the labyrinth of additional transmission accompanying it, threatens ecosystem functionality through habitat fragmentation.

When the scale of impacts associated with different energy choices are understood, it becomes very clear that nuclear power offers not only the best hope for tackling climate change, but also for protecting nature. The following shows how nuclear power compares with other forms of energy with respect to lifecycle ecosystem impacts.

***Lifecycle impacts on ecosystems for different energy sources, excluding climate change***

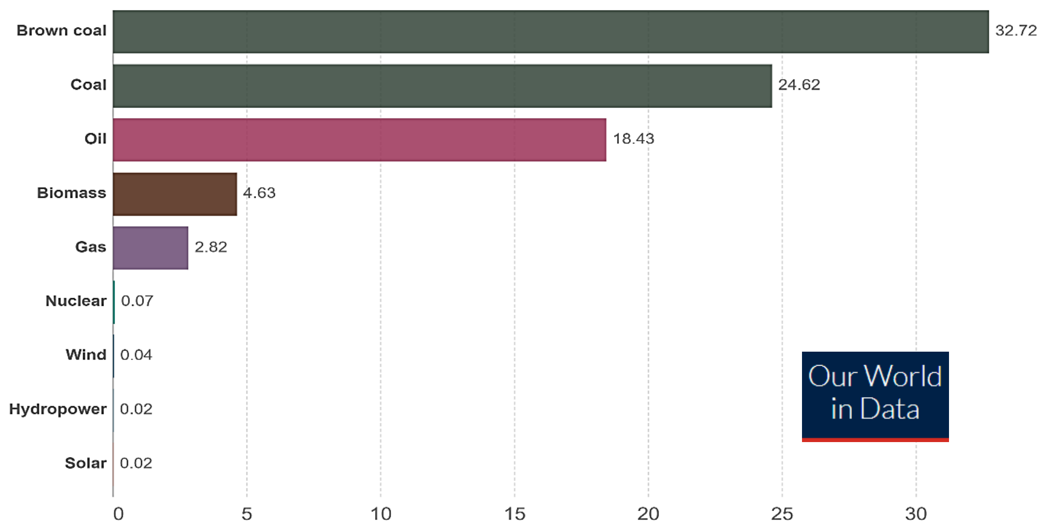
(1 point equivalent to the impact of 1 person over one year)



Perhaps the most misunderstood of issues associated with nuclear power relates to safety and human health. Here again, an objective review of facts is essential. Compiling statistical data from credible sources like the World Health Organization (WHO), Oxford found that on a deaths per terawatt-hour basis, nuclear power is comparable to wind and solar, and far safer than fossil fuels or biomass.[81]

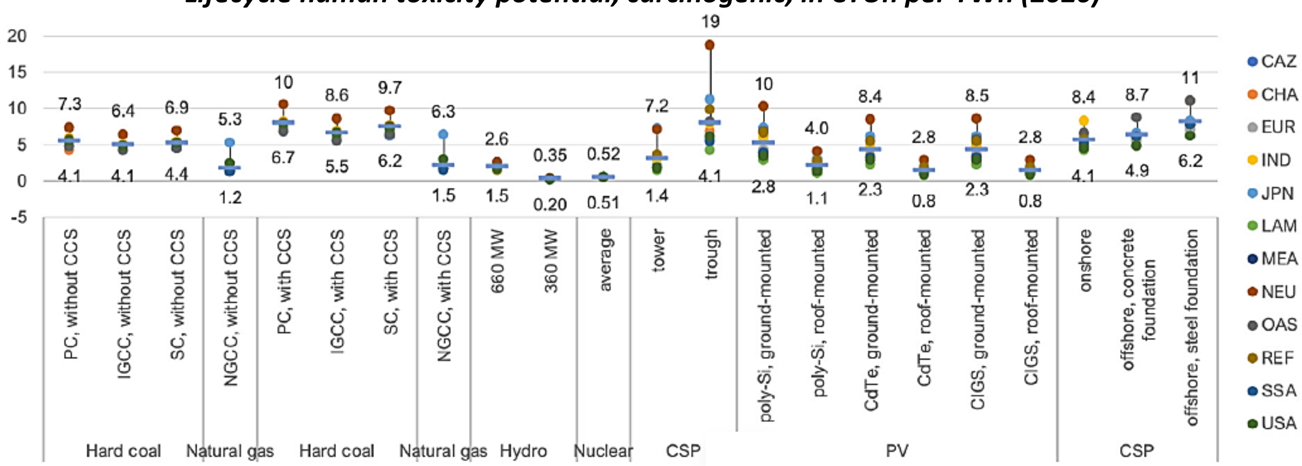
***Death Rates per Unit of Electricity Production***

(based on deaths from accidents and air pollution per terawatt-hour)




The same applies to the potential for human toxicity (carcinogenic) effects from nuclear power. As seen below, other sources of energy including solar and wind pose a greater threat.[82]

***Lifecycle human toxicity potential, carcinogenic, in CTUh per TWh (2020)***



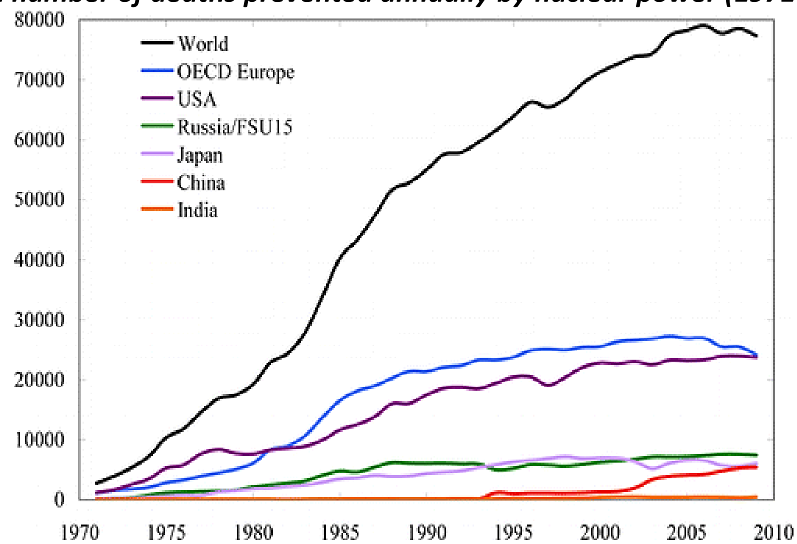

[81] Oxford, *Our World in Data* https://ourworldindata.org/nuclear-energy#what-are-the-safest-sources-of-energy Notably, this includes the effects from Chernobyl, which involved a reactor design that is not comparable to those in the United States. It also incorporates the scientifically discredited, but still used, Linear No Threshold (LNT) hypothesis which presumes effects of very low levels of radiation without evidence of such.

[82] UNECE report

The fact is that air pollution caused by fossil fuel combustion contributes to eight million deaths globally each year.[83] Emission-free nuclear power does not do this. Unlike the fossil fuel industry which dumps its waste into the atmosphere, nuclear power is required to take responsibility for the small amount of compact waste it produces and contain it. Over the entire history of nuclear power, commercially stored waste from spent fuel has killed nobody. Furthermore, that "waste" can be recycled, either through reprocessing—like France has done for years—or used as fuel in next-generation reactors. In this respect, nuclear "waste" is the best kind of waste to have.

In 2013, renown climate scientist Dr. James Hansen and his colleague Pushker Kharecha with the Columbia University Earth Institute calculated that by displacing fossil fuels, nuclear power has prevented 1.84 million deaths due to air pollution and avoided 64 Gigatonnes of $CO_2$ equivalent greenhouse gas emissions.[84] Through continued operation, these figures have gone up since. The bottom line is that nuclear power saves lives.

***Mean number of deaths prevented annually by nuclear power (1971-2009)***




Perhaps the most incredulous allegation against nuclear power is that it cannot be deployed fast enough to tackle the climate crisis. History demonstrates otherwise. France and Sweden decarbonized their grids years ago in a little over a decade with nuclear power. Nowhere on earth has this occurred with intermittent solar and wind, despite the fact that these resources have been in existence the same amount of time. As seen below, the fastest scale-up of zero-carbon energy anywhere has been with nuclear power. As with any technology, first-of-its-kind deployment is initially more time consuming and expensive. This will probably be the case with advanced nuclear, too. However, with prudent government support and a constructive regulatory environment, similar to that which renewables enjoy, nuclear power can grow as well. Most importantly, by including firm nuclear power in the mix of supported zero-carbon technologies, New York and the nation will have hope of achieving their aggressive climate goals, which are not realistically attainable otherwise.

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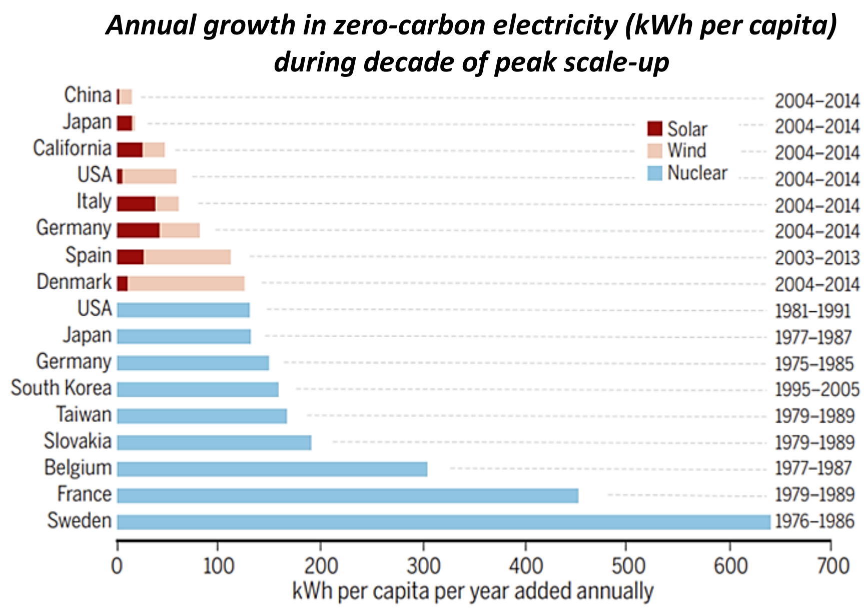
[83] https://www.seas.harvard.edu/news/2021/02/deaths-fossil-fuel-emissions-higher-previously-thought

[84] 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




Source: Cao, Cohen, Hansen, Lester, Peterson, Xu (2016)

Throughout the nation and world, awareness is growing on the need for nuclear power to tackle the climate crisis while providing ample energy to meet the needs of modern society. Recently, French President Macron pledged support for a new generation of advanced reactors. So has the United Kingdom, the Netherlands, and Canada. Recognizing the need to reduce their reliance on Russian oil and gas, eastern Europe is investing in nuclear power which will use American technology. In Asia, construction of new nuclear plants is already well underway.

Here in the United States, in addition to the projects previously discussed, several states have taken action to in protect existing nuclear plants and enable future construction. With bipartisan support, Illinois recently passed legislation to ensure ongoing operation of the state's Byron and Dresden nuclear plants, thereby avoiding 26 million tons of greenhouse gas emissions ($CO_2e$) annually, and West Virginia recent voted to allow the development of new nuclear plants. So have Montana, Kentucky, and Wisconsin. The Tennessee Valley Authority (TVA) plans to add additional nuclear power to its fleet as well. Significantly, this year in the northeast, New Hampshire voted to establish a commission for the purpose of exploring advanced nuclear power.[85]

In Washington, 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. 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.*[86]

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[85] https://news.bloomberglaw.com/environment-and-energy/nuclear-bans-tumble-as-once-skeptical-states-seek-carbon-cuts

[86] https://uk.finance.yahoo.com/video/energy-secretary-jennifer-granholm-says-101700201.html ; see also https://twitter.com/hashtag/NuclearSciWeek?src=hashtag_click&f=video

Shedding past prejudices, most Americans now also support nuclear power. In fact, in a 2021 ecoAmerica survey, support among Democrats had grown the most, from 37% in 2018 to 60% 2021.[87] Likewise, a recent survey by the Associated Press found that two thirds of state governments accept that nuclear power in some fashion is needed to replace fossil fuels.[88]

Importantly, the United Nations Intergovernmental Panel on Climate Change (IPCC) includes nuclear power in all four illustrative pathways for limiting global warming to 1.5° Celsius. In addition to its clean energy and climate benefits, nuclear power generates high-wage employment with the highest percentage of union jobs in the energy sector.

New York, especially upstate, 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. New Yorkers have the skills, manpower, and spirit of innovation to build upon that foundation—and should not be deprived of the opportunity to do so. If the Climate Action Council and NYSERDA truly want to lead in the fight for a carbon-free future, they will become informed by facts, set outdated ideologies aside, and embrace the outstanding potential that nuclear power has to offer. New nuclear should be included as a candidate resource.

## Small-Scale Hydropower

An additional type of firm carbon-free electricity that should be included as a candidate resource is small-scale hydropower. Although the potential for additional hydro capacity within the state is far less than for nuclear, we mention it because it is another opportunity that the scoping plan overlooks. In the past, waterways such as the Hudson, Mohawk, as the Susquehanna were important sources of energy and local power to upstate communities. Constructed in the late 19th and early 20th centuries, many were "run-of-river" hydropower plants, meaning that they relied on the steady flow of water to generate electricity instead of requiring large impoundments. Although a few remain operational today, with the advent of large centralized fossil fuel plants, many eventually fell into disrepair and went out of service. If refurbished or replaced, many of these former sources of reliable power could once again become useful. Further, with modern enhancements, small-scale hydro plants operating today could produce even more electricity.

A prime example of this is the Green Island Hydroelectric Power Station on the Hudson River in the Village of Green Island, New York. Original built by Henry Ford in 1921, the run-of-river facility was acquired by the Green Island Power Authority (GIPA) in 2000 and rehabilitated by Albany Engineering Corporation in 2001.[89] One of only three public power authorities, GIPA was created by the New York State legislature in 1986.[90]

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[87] ecoAmerica. *Energy Attitudes: Americans Support Clean Energy*. American Climate Perspectives, Volume V 2021. https://ecoamerica.org/wp-content/uploads/2021/11/acps-2021_energy-attitudes-report.pdf

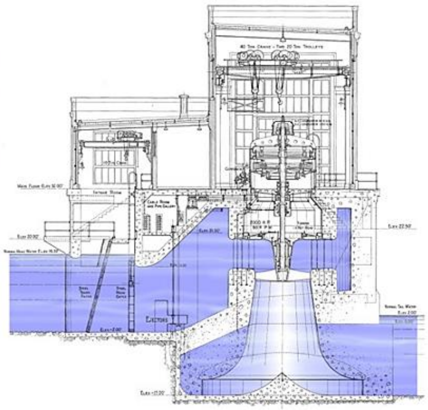
[88] J. McDermott, *Majority of US States Pursue Nuclear Power for Emission Cuts*, Associated Press, January 18, 2022. https://apnews.com/article/climate-technology-business-nuclear-power-environment-and-nature-cfb21ab68a9e7005cc08873f2a5a7031

[89] https://www.albanyengineering.com/greenisland.htm

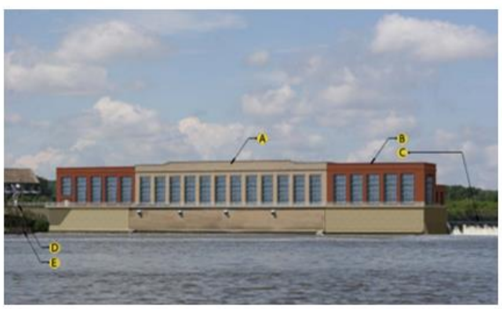
[90] https://villageofgreenisland.com/gipa/

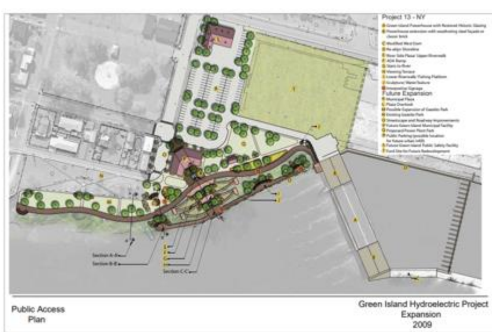
Today, Green Island Power Station consists of four 1.5 MW turbines capable of producing 6 MW of power. Ever since 2009, GIPA has proposed expanding the facility to 48 MW by replacing the four existing turbines with 6 MW modern turbines and adding four more. In addition to providing a reliable source of renewable carbon-free electricity in proximity to the state's capital, the design would include a public park and incorporate new fish-exclusion technology, thereby making the plant more ecologically friendly.[91] However, for lack of state-level support, progress has languished.

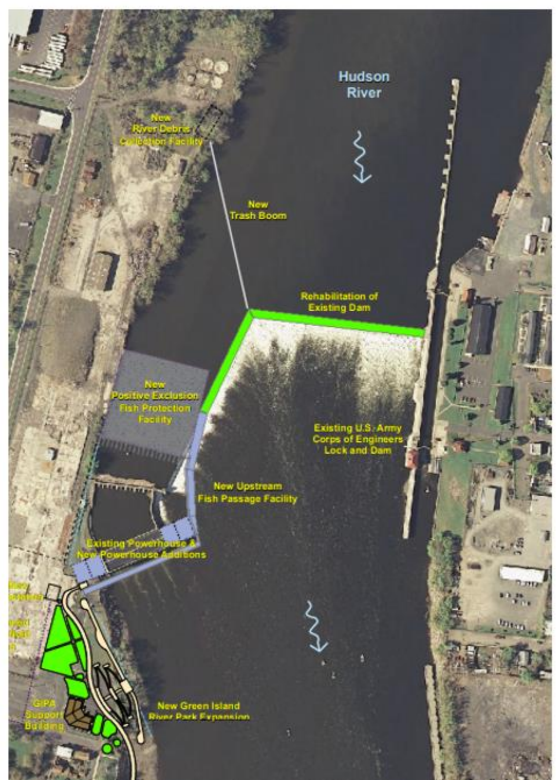
***Existing Green Island Hydroelectric Power Station*** 6 MW (4 x 1.5 MW turbines)



***Proposed Green Island Hydroelectric Power Station Expansion Project*** (8 x 6 MW turbines)






91 https://villageofgreenisland.com/gipa/expansion-plans/

The overall energy output of a run-of-river hydropower plant may fluctuate seasonally, and this can affect capacity factor. Nonetheless, because those fluctuation are predictable—as opposed to solar and wind which experience sudden sporadic changes in output—the electricity produced by hydropower, including run-of-river plants, is more useful to the grid and contributes to system reliability. The fact that beneficial, shovel-ready projects like Green Island have remained stagnant three years after adoption of the CLCPA while those which challenge grid reliability are being expedited is indicative of a process shaped by political influence rather than sound management or any disciplined attention to goals.

For New York to successfully meet CLCPA goals, projects cannot be simply considered in a vacuum, measured by nameplate capacity or annual watt-hours of generation. Attention must be given to the particular attributes of performance that different sources provide. It has been estimated that 1-2 GW of additional reliable electricity could be brought online through the expansion and refurbishment of small-scale hydropower projects throughout the state. Furthermore, older hydro facilities (including some over a hundred years old) will require support to ensure that they are able to continue providing clean energy to the grid. These needs should be incorporated into draft plan.

Pumped storage

Although not a type of "net" generation, pumped storage is another form of hydropower that contributes to system-wide reliability. New York currently has two pumped storage facilities, both operated by the New York Power Authority: the Blenheim-Gilboa plant in the Catskills and the Lewiston pump-generating station which is part of the Niagara hydropower facility upstate. [92] They operate by using electricity to pump water from a lower elevation to a reservoir located at a higher elevation where it is temporarily stored and then released through turbines to produce electricity later. "Round-trip" efficiency loss at Blenheim-Gilboa is approximately 25%. Although today, pumped storage is often used to store energy from cheap electricity produced at night for later use during the day, in the future pumped storage—like batteries—could be useful to supply electricity during periods of intermittent generation from renewables. Although not the case for Clean Path, depending on storage capacity and throughput, it is also possible that very large projects might offer some element of long-term storage.

Another type of pumped storage with potential merit involves the underground storage of water at different elevations within abandoned mines. As with all energy projects, benefits must be weighed against ecological impacts, which can be significant and cumulative. Nonetheless there may be opportunities for additional pumped storage in New York's future. We include pumped storage because it, too, is overlooked in the draft plan.

[92] https://www.nypa.gov/power/generation/blenheim-gilboa-pumped-storage; https://www.nypa.gov/power/generation/niagara-power-project

## VI. Recommendations

The draft scoping plan by the Climate Action Council and NYSERDA requires significant changes in order to become a usable template for achieving CLCPA goals. Problems with the document, its strategy of relying predominantly on intermittent sources, and the underlying Integration Analysis presented by NYSERDA to justify that strategy cannot be resolved with minor word-smithing. So instead of attempting to provide specific edits to text throughout the document, we focus here on overarching key issues with hope that the Governor, legislature, and state agencies will consider solutions capable of succeeding and establish a technically-based, apolitical structure through which those solutions can be developed.

1. Remove prejudicial bias against zero-carbon solutions

**Prejudice is the harboring of preconceived negative beliefs about persons or things that one does not understand and does not attempt to understand**. It is appropriate that the CLCPA gives special attention to how communities historically impacted by prejudice bear the brunt of adverse impacts caused by exposure to fossil fuel pollution. However, it is tragically ironic that the scoping plan itself is rife with ***technical prejudice*** regarding solutions for greenhouse gas reduction from the electricity sector. By dismissing the potential of viable technologies, this prejudice not only jeopardizes CLPA goals, but threatens to perpetuate environmental injustice by condemning the state to a future that remains shackled to fossil fuels.

The purpose of the CLCPA is to achieve deep decarbonization across all sectors of the economy and carbon-free electricity for the entire state in 17 years. Although it has an interim goal of 70% renewables in 2030, the Act by no means limits carbon-free solutions to renewables. Yet the plan focuses almost exclusively on promoting resources defined as “renewable”, even to the exclusion of others. This extremely shortsighted approach takes the eye off the ball by ignoring the value of all forms of carbon-free generation, especially proven firm nuclear power.

It is important to understand that the word “renewable energy” is not a technical term. The first law of thermodynamics states that energy (or its mass equivalent) is neither created nor destroyed. It is only transformed—whether at a molecular level during an exothermic chemical reaction like combustion, by atomic fission within a nuclear reactor, as a band gap transition caused by photons impacting a semiconductor crystal, or by kinetic energy from moving air or water. The word “renewable energy” is basically a marketing term, one that seeks to attribute virtue to energy sources that do not rely on fuel. The implication is that this makes them less harmful to the environment. However, this simplistic view does not reflect reality. Indeed “fuel” is stored energy, the need for which renewables do not avoid.

As we have discussed at length, if solar and wind build-out occurs at the immense scales proposed in the draft scoping plan, significant environmental damage will result. New York stands to lose hundreds of thousands of acres—farmland and nature replaced with glass, copper, and steel, thereby fragmenting habitat and communities across the state. Adding to this will be carbon emissions and environmental damage in other parts of the world where most of the mining and manufacturing to produce “renewables” occur with little attention to human welfare. By contrast, the facts actually show that nuclear power is among the safest and environmentally responsible forms of energy on Earth. As previously discussed, nuclear power has the lowest lifecycle emissions and smallest land footprint of any energy source. It is also among the least impactful with respect to mining, materials, and toxicity.

Aside from pointing out the carbon-free aspects of nuclear power, the draft plan makes no effort to address misconceptions about the technology. Instead, it fosters them as seen in the very first appearance of the word "nuclear" in Chapter 13 on electricity:

> *New York's electricity sector is comprised of traditional fossil-fuel fired power generation facilities, nuclear generation facilities, along with **clean** energy generation such as wind, solar, hydropower, energy storage, and transmission infrastructure.*[93]

Using the word "clean", the text seeks to distinguish wind, solar, and storage from nuclear power, despite the fact that nuclear ranks as high as any other source of energy with respect to environmental protection, health, and human safety. Likewise, throughout the document, wherever nuclear power is mentioned, it is treated as resource of last resort. This not only ignores environmental truths about nuclear power. It also ignores the distinct advantages nuclear has to offer in decarbonizing the electric grid in a technically feasible and cost-effective manner.

Indeed, throughout Chapter 13, the draft plan avoids discussing any carbon-free solutions that do not involve "renewables" or storage. For example, the third paragraph of Key Strategy E1 relating to the retirement of fossil fuels power plants describes what "transitioning to zero-emissions" will require. However, it only mentions additional renewables, storage, and transmission. It conspicuous omits what is absolutely essential for a transition to zero-emissions to be successful: firm carbon-free generation. As we discuss in our other recommendations, the most disparaging treatment of nuclear power is in Key Strategy E10.

Applied science and objective decision-making are not served by marketing terms that supplant critical thought. **In order to correct this technical bias throughout the document and put proper focus on climate objectives of the CLCPA, we recommend that wherever the word "renewable" appears as part of a greenhouse gas reduction strategy, it should be replaced with the words "zero-emission" or "carbon-free". Otherwise, the plan should consistently refer to "renewables and other carbon-free sources". Only where specific reference is being made to the CLCPA's 70% by 2030 goal should the word "renewable" apply exclusively.**

**Similarly, programs identified within the scoping plan that arbitrarily focus only on renewables should be broadened to support CLCPA climate goals.** For example, Key Strategy E5 discusses Community Choice Aggregation (CCAs) as a mechanism for signing communities up for "100% renewable" energy.[94] A fallacy in the thinking of some CCA enthusiasts is a belief that simply convincing enough local or state governing bodies to sign all of their residents up to "100% renewable"

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[93] The sentence could more accurately say: "New York's electricity sector is comprised of traditional fossil-fuel fired power generation, nuclear generation, renewable energy generation such as wind, solar, and hydropower, as well as energy storage and transmission infrastructure". Alternatively, "clean" could be simply deleted.

[94] Although CCA's are characterized as offering choice, in practice they deprive individual energy consumers of choice and place it into the hands of political entities. The CCA "opt-out" provision provides only limited relief for this, since it requires additional new action by the electricity consumer in order to "opt-out" (analogous to onerous voting and registration requirements intended to make voting more difficult).

CCAs will eventually lead to a 100% renewable grid. Instead, what this can lead to is a grid that is neither 100% renewable, carbon-free, nor reliable because sources of energy that are critical to maintaining reliability and actually attaining a carbon-free grid have been shut out of the market.[95] The CLCPA contains no mandate for "100% renewables", so communities should not be burdened with one either. Consistent with the CLCPA's greenhouse gas reduction objectives, the scoping plan should encourage CCAs that are broadly inclusive of carbon-free sources.

2. <u>Consider Alternative Scenarios with greater role for firm carbon-free generation, including the comprehensive analysis of impacts</u>

The four scenarios considered in NYSERDA's Integration Analysis do not constitute a comprehensive set of decarbonization options. Each takes a narrow approach to the problem, placing overwhelming emphasis on the deployment of intermittent generation and batteries. As previously discussed, such an approach is also the most risky, land intensive, unreliable, and expensive when system-level costs are considered. We strongly recommend that additional scenarios be considered which include a more significant role for firm carbon-free generation, specifically nuclear power—a proven source of reliable baseload and dispatchable generation throughout the world and within New York.

**We recommend that scenarios be modeled, like other studies have done, to consider different levels of intermittent and firm generation.** The impetus to build new nuclear facilities will grow in coming years as the public demands an alternative to energy sprawl and as states that invest early in nuclear make greater progress than New York in reducing fossil fuel use. **The 2030-2040 timeframe will be a critical period for bringing more nuclear power on board if the state hopes to meet its 2040 goal.**

**Importantly, all scenarios should include a substantive evaluation of projected land requirements and cost to ratepayers.** Both of these are key parameters which the draft scoping plan shockingly fails to quantify. For example, the consulting firm Energy and Environmental Economic (E3) has studied the potential for nuclear power elsewhere, including within the state of Washington, providing specific analysis on the amount of land that could be conserved and the savings to ratepayers if nuclear power were to be included in the state's portfolio. E3 also contributed to NYSERDA's Integration Analysis using its RESOLVE model. Therefore, not performing this type of analysis for New York is a blatant omission—one that creates the appearance of bias by NYSERDA, the Climate Action Council, or both. Consistent with this, we also recommend that Key Strategies E2 and E4 be revised to explicitly acknowledge the direct, indirect, and cumulative impacts of large-scale wind and solar development on wildlife and habitat, ecosystem functions, and rural communities.

3. <u>Provide explicit support for sustaining existing firm carbon-free resources, including nuclear power</u>

Next to hydropower, nuclear is by far the largest contributor of carbon-free electricity in the state, and a cornerstone of upstate New York's low-carbon grid. However, the draft scoping plan takes a misleading and schizophrenic approach to the future of this remarkable asset.

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[95] As an example of this, PG&E in California sited renewable CCA's as one of the reasons for closing the Diablo Canyon nuclear power plant. However, this has not caused California to achieve a carbon-free grid. Instead, California is building additional gas plants and devising plans to important dirty electricity from other states.

Key to all four scenarios identified in NYSERDA's Integration Analysis is an assumption that the Ginna, Fitzpatrick, and Nine Mile Point nuclear plants will be relicensed for another 20 years. In fact, NYSERDA even admits that this will result in a saving of $9 Billion. In fact, NYSERDA uses the relicensing of all three plants to improve the Social Cost of Carbon and cost-benefit analyses which it performs to justify the draft plan. (This is because the assumed "reference case" does not include their relicensing). Yet elsewhere in the body of the plan, nuclear power is treated as more of a problem than a solution. The benefits of Tier 1, Tier 2, and Tier 4 of the Clean Energy Standard are all discussed in the draft plan. However, Tier 3, which establishes the Zero Emission Credit program for nuclear power in New York and has since served as a model for other states is not mentioned. Instead, in Key Strategy E10, the draft plan states:

> *Nuclear power generation is a complex technology with potential impacts on host communities as well as questions relating to the impacts of nuclear waste on health and the environment.*

This is not a strategy, or even a useful statement. It is a vague assertion alleging potential harm or "questions" about harm without actually identifying any. The value of a scoping plan is to provide information that can contribute to useful decisions. However, instead of discussing the relative impact of different technologies to show how nuclear actually compares, without reason the document treats nuclear power as undesirable, calling for an analysis to determine "whether" it will be needed to meet the 2040 goal and "whether more cost effective and environmentally friendly alternatives are available". Health, safety, community impacts and the environment are broadly named as concerns—but again nothing is said about what any of those concerns actually are.

As we have documented, a plethora of credible analyses, including by the World Health Organization and United Nations, conclusively demonstrate that nuclear power poses no greater threat, and in many respects less of a threat to the environment and people than renewables. Yet instead of acknowledging this, the draft plan provides fodder for baseless fear, offers no useful information about nuclear technology or its potential, and tosses New York's most reliable source of abundant carbon-free energy into a future public arena for debate. At the end of Key Strategy E10, the draft says that a special public comment process should occur if the licenses of New York's upstate plants are considered for extension.

It is disturbing that the draft plan singles out nuclear power for scrutiny, while saying nothing at all about public commenting that should occur if the licenses of fossil fuel power plants—which actually contribute to climate change and pollute the environment—are proposed for renewal. Based on actual harm to the environment, large-scale industrial solar and wind facilities arguably deserve special hearings as well.

The state already has ample reason to find that Ginna, Fitzpatrick, and Nine Mile Point provide a valuable service to New York and, subject to approval by federal regulators, should continue operating. **The fact is that even if New York were to miraculously reach its 70% by 2030 renewable goal, abruptly shuttering nuclear power at the end of this decade would cancel out virtually all gains in greenhouse gas reduction from the electric sector between now and then**—essentially resetting the clock on climate action when there is no time to spare.

In light of this, **we urge the Climate Action Council to provide a clear, unambiguous statement of positive support for extending the licenses of New York's three upstate nuclear facilities and to encourage state agencies to cooperate with the plants' owner in applying for federal relicensing. The Council should also provide clear support for extension of the Zero Emission Credit (ZEC) program so that the benefits of carbon-free generation provided by all three of New York's nuclear plants can continue.** Given timeframes involved in obtaining federal permits and steps that may be required to extend operations, these efforts should begin soon instead of waiting until 2029.

The last sentence of Key Strategy E10 states that New York's four upstate reactors which employ hundreds of people are "scheduled" for shutdown. This is false. They will only be scheduled for shutdown if their licenses are not renewed or extended.

With respect to public input, NYECA absolutely recognizes and respects the importance of public comment from interested parties. However, we believe that certainly no less attention is warranted when the operating permits of fossil fuel power plants are renewed. To address this, **we recommend that the Climate Action Council strike the language narrowly focused on public comment about nuclear power and instead craft language within a dedicated portion of the document to address a future public comment process that fairly applies to the renewal of licenses or operating permits for all major generators of electricity.**

Although less significant in their contribution to carbon-free generation, smaller hydropower resources in the state are also at risk. Tier 2 of the Clean Energy Standard is intended to support the continued production and delivery of electricity into the New York market from existing renewables. However, the program is more tailored to wind and solar than hydropower. As a result, several instate hydropower plants are having to sell out-of-state instead of providing RECs that contribute to New York's climate goals. Recognizing the additional element of reliability that hydropower provides, the draft plan should assess how existing hydro can be better supported.

4. <u>Invest in new technology, including nuclear power</u>

The Climate Action Council admits that new technologies will be key to meeting the state's climate and energy goals. This makes the last section of Chapter 13 titled "Investing in New Technology" extremely important. Unfortunately, it is also one of the most flawed parts of the document. The section contains a single key strategy, E10 "Explore Technology Solutions". However, instead of providing a useful discussion of the benefits that new carbon-free technologies can offer, the text talks about how the Climate Justice Working Group does not like them. That is not a strategy for success. It is a strategy which guarantees the ongoing need for fossil fuels, to the detriment of both the planet and Environmental Justice communities. Most disappointing is that the potential of advanced nuclear power is neglected entirely. Rather than presenting useful information on how new nuclear can make the difference between success and failure of the CLCPA, E10 contemplates abandoning the state's existing fleet.

**We urge the Climate Action Council and NYSERDA to rewrite this section and give it substance by actually discussing the benefits of investments in new technology, including advanced nuclear.** As previously discussed, throughout the country and around the world, state governments and nations are actively exploring advanced nuclear power such as modular reactors with passively safe technology and advanced fuels as they develop decarbonization plans that ensure reliable, abundant energy vital to economic growth and society at large. The information that NYECA has provided in the previous section of these comments is relevant to this. We recommend that this type of useful information be included in the document.

Consistent with this, **we also recommend that the state establish a commission to proactively study nuclear power and nuclear reactor technology that may be applicable for New York. Such a commission should include experts with working experience in nuclear technology and operations management of nuclear power facilities. Existing nuclear facilities are logical locations for new reactors due to their trained workforce and location within communities that appreciate their value. Therefore, the commission should also include existing nuclear power operators within the state and labor representation.**

**Elsewhere within the document where the decarbonization of other sectors is discussed, we encourage including information on how nuclear technology can provide carbon-free process heat for industrial applications, high-volume production of hydrogen, and the production of synthetic fuels with a net-zero-carbon footprint.**

With respect to hydropower, we recommend that the document include a discussion of how modern technology can improve the performance of existing hydropower plants, the restoration or reconstruction of former facilities, and the potential for new construction where impoundments or spillways exist. We also recommend exploration of opportunities for pumped storage, including underground, where feasible and environmentally appropriate.

5. Establish an effective structure for climate action

The draft scoping plan is the product of members who serve on the Climate Action Council and its advisory committees. That includes several who represent or are ardent supporters of the wind, solar, and battery industry. It also includes individuals who are openly hostile to nuclear power. With the exception of Independent Power Producers of New York (IPPNY), an organization that represents many forms of generation, the council lacks members with expertise in firm carbon-free electricity. As such, it is not surprising that the plan which has been proposed looks very much like those in California and Germany. Unfortunately, evidence suggests that if pursued, such a plan will also mirror the failures seen there.

Effective collaboration requires a diversity of input, interests, and expertise. Yet the composition of the Climate Action Council and its working groups does not have this. We also realize that evaluating alternative scenarios—as we have recommended—will be of no value unless the process is supported by informed individuals capable of interpreting findings with an open mind, reconsidering past assumptions, and setting a credible path forward. We believe our concerns are shared by others. Last year, IPPNY and AFL-CIO petitioned the Public Service Commission in support of carbon-free firm generation, and NYISO suggested technical forums to consider the same in furtherance of the 2040 CLCPA goal. Yet to date, those appeals have also been ignored.[96]

[96] Link to petition and NYECA response

The Climate Action Council is an artifact of a former political administration. We strongly recommend that today's governor improve the composition of the council, power generation working group, and other subgroups by including competent technical representation by experts involved in the operations and development of firm carbon-free generation, including but not limited to nuclear power and hydropower. We also support proposals by NYISO and AFL-CIO for the creation of working groups and technical forums to consider effective solutions for the provision of firm carbon-free generation, essential to meeting CLCPA goals.

6. Evaluation of Environmental Impacts and Mitigation

The large-scale development of industrial solar and wind projects across rural parts of the state threatens to dramatically transform the landscape of New York, degrading ecosystems, sacrificing wildlife and habitat, carving up agricultural lands, and spoiling the historic and scenic value of upstate communities. Just the buildout of solar projects pursuant to NYSERDA's Integration Analysis would blanket hundreds of square miles with glass, copper, and steel. The cumulative impact of thousands of wind turbines across the state also poses a threat to bird populations and the integrity of forest and ridge ecosystems. Further, the very nature of low-energy density, low-capacity factor distributed generation necessitates a widespread expansion of transmission infrastructure that threatens to fragment ecosystems and wildlife corridors. Similarly, batteries are short-lived pieces of equipment containing toxic chemicals that are hazardous to the environment and require proper disposal.

**Understanding these facts and the potential severity of accumulated impacts if the widespread deployment of industrial-scale "renewable" projects and their associated infrastructure occur, the Department of Environmental Conservation (DEC) should perform a comprehensive environmental analysis of scenarios which have been proposed in the draft plan. Such analysis should be made available for public review and comment, and used to inform future plan revisions and actions by the Climate Action Council, state agencies, and other decision-making bodies.**

**To mitigate the impacts of large land conversions resulting from solar, wind, and other forms of energy development, we recommend that DEC establish and oversee a program requiring the permanent preservation of natural lands of comparable type and value within the affected region of projects that are approved. We recommend a mitigation ratio of at least 1:1 and that land preservation be ensured through a legally-binding conservation easement held by the state or by fee-simple dedication of land to the state or an approved land conservation entity.**

**So that solar and wind projects do not turn into hundreds of square miles of industrial brownfields in the future, we recommend that the DEC or another appropriate agency require the creation of a fund paid for by the project owner to covers the costs of eventual decommissioning, disposal, and site restoration.** Notably, this already is a required of the nuclear industry.

**CONCLUSION**

In passing the Climate Leadership and Community Protection Act, New York announced to the world that it intends to be a leader in combating climate change. Importantly, the people of New York—its businesses, research facilities, investment firms, and work force—also possess the skills, motivation, and innovation to deliver on that promise while building a strong economy fueled by clean energy. However, New Yorkers need and deserve a plan that actually works— for all New Yorkers. They do not deserve a plan that outsources our energy production to China, destroys farms and nature, deprives communities of the right to decide their future, and ultimately will not even solve the problem that it purports to address.

Since adoption of the CLCPA, the state has gone backwards. By shuttering downstate nuclear power, the state sacrificed over 16 terawatt-hours of reliable carbon-free "made in New York" electricity every year, increasing carbon emissions from the electric sector by millions of tons annually, and exposing downstate environmental justice communities to even more air pollution from fossil fuel power plants. It also delivered pink slips to hundreds of union workers in the clean energy sector.

Progress means learning from past mistakes. However, as currently written, the draft scoping plan prepared by the Climate Action Council is poised to repeat them. Following in the footsteps of California and Germany, the draft proposes to build an electric grid that relies on intermittent generation—wind and solar— for 80% of the state's electricity, even as the demand for electricity doubles. If such a plan is pursued, New York will suffer the same outcomes as California and Germany: unaffordable, unreliable electricity and fossil fuel power plants that don't go away.

The most "unjust" transition is the one that does not happen. If New York's Climate Action Council is serious about decarbonizing the electricity sector in the next seventeen years, it will embrace "firm" carbon-free power, not just as "backup" to a bloated buildout of underperforming intermittent generators, but as a significant contributor of energy to the state's electric portfolio. It will support extending the state program of Zero Emission Credits and the relicensing of New York's reliable fleet of nuclear plants to protect the clean jobs of workers there. Moreover, it will join other states and nations throughout the world that are now actively exploring the remarkable potential of advanced nuclear power for the future.

Success is possible, but it will require setting aside outdated ideologies and prejudice about energy. It will require bringing competent people to the table who understand and appreciate the benefits of new technology, including nuclear power.

A robust plan that works for New York will be one that welcomes more energy from all carbon-free sources: wind, solar, hydro, and nuclear. If the governor, appointed bodies, and agencies craft one—setting politics aside and engaging the state's powerful workforce in the process—New York can demonstrate true leadership, meet its climate goals, deliver abundant energy for economic growth, and ensure environmental justice for all New Yorkers.

**Filings by NYECA and members in NYS Clean Energy Standard proceeding, Case 15-E-0302**

6/24/20 - Letter by Dr James Hansen and other to CAC on Importance of Nuclear Power
https://www.nuclearny.org/wp-content/uploads/2020/07/letter-to-CAC-on-importance-of-nuclear-power.pdf

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

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}

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

9/28/20 – 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}

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}

12/15/20 – 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}

3/5/21 - Response to Order Adopting Modifications to the Clean Energy Standard
https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={4DD5A7F5-F87A-40A7-88F0-1BC9A9B08FD5}

9/20/21 - Response by parties to Petition of IPPNY, NYS Building & Construction Trades Council, and NYS AFL-CIO relating to establishment of a zero-emission energy system program under the CES
https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7BA0ADE7FC-5CCC-485A-96E3-06300E6C2A90%7D

12/7/2021 - Reconciliation of NYSERDA analysis with CES: Questions regarding NYSERDA Integration Analysis
https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={A8B19CB0-2102-436B-848E-6A00F733D41F}

12/8/21 - Comments from parties relating to recommendations by Joint Utilities and NYISO for technical conference in response to Petition of IPPNY, NYS Building & Construction Trades Council, and NYS AFL-CIO relating to establishment of a zero-emission energy system program under the CES
https://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={B492C9E8-0675-4694-9372-5BBC0A30714D}