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Proceeding on Motion of the Commission Regarding the Grid of the Future.

NERC, Sweden, Harvard, and NYISO: high costs, low reliability, and questionable carbon-cutting efficacy of solar and wind power

I. NERC analyses and warnings on reliance on energy imports and exports

The North American Energy Reliability Corporation (NERC) lists five risks to the bulk power system. Risk #1 is a bad energy plan and risk #2 are changes made to the grid to implement a bad plan.[1] A 'renewable' based grid will need a whole new transmission structure – bigger than the current grid -- which someone will have to pay for. It will need full-capacity dispatchable backup and expensive BESS. Any wind, solar, and BESS resources installed today will need replacement by 2050. New York may not be able to shutter significant fossil-fuel power plants but may, rather, be obliged to build more. California – two decades ahead of New York in pursuit of solar and wind -- has extended the operations of three gas power plants until 2026 to maintain energy reliability and affordable rates.[2] California will add another GW of gas power this year. [3]

NERC warns that an energy policy that bases fiscal efficacy on sales of excess solar or wind but requires energy imports for reliability is a bad plan.

> **Capability for imports does not necessarily mean that energy from imports is available and these limitations should be included in an energy reliability assessment. The availability of imports is dependent on energy issues or demand requirements in external regions. Coordinated studies would show the assumptions of imports and exports at adjoining interfaces, ensuring that energy is available to support exports to an area that is depending on the corresponding imports, and is not counted in multiple energy reliability assessments. Conflicting assumptions could leave operators unexpectedly energy deficient.[4]**

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[1] https://www.nerc.com/comm/RISC/Related%20Files%20DL/RISC_ERO_Priorities_Report_2023_Board_Approved_Aug_17_2023.pdf
[2] https://www.energyindepth.org/to-meet-demand-california-delays-closure-of-natural-gas-plants-again/
[3] https://www.powermag.com/hundreds-of-new-gas-fired-power-units-planned-as-u-s-gas-output-soars/
[4] https://www.nerc.com/comm/RSTC_Reliability_Guidelines/CLEAN_ERATF_Vol_1_WhitePaper_17MAY2023.pdf

NERC has also issued a series of alerts for systems reliant on inverter-based resources (IBRs) – like solar and wind -- which will be examined below.[5]

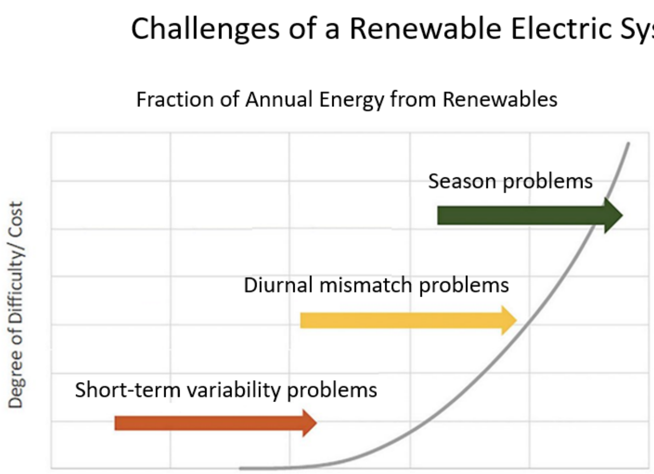
Starting in 2023, the grid operator, NYISO, warned of about a ½ gigawatt (GW) energy shortfall in metro NY this summer (2025) in normal weather.[6] Sure enough, Queens went black this July.

These are documents and reports which people charged with energy planning should have read.

II. Academic studies and empirical evidence do not support New York's renewable push

Academic studies as well as empirical evidence do not support claims that wind and solar will prove economical or reliable. Recent studies suggest wind may raise surface temperatures offsetting any carbon-cutting advantage in the technology.

Below, a National Renewable Energy Laboratory (NREL) chart shows the asymptotic costs of a system as penetration of renewables increases. Expensive BESS can somewhat solve the "sort-term" variability of intermittent resource generation. But there is no day-night or seasonal solution.



Harvard has completed several studies questioning the carbon-cutting contribution of wind power. "In agreement with observations and prior model-based analyses, US wind power will likely cause non-negligible climate impacts." [7] In brief, Harvard found that wind turbines might increase warming.[8]

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[5] NERC Alert on IBR performance https://www.nerc.com/pa/rrm/bpsa/Alerts DL/Level 3 Alert Essential Actions IBR Performance and Modeling.pdf

[6] https://www.nyiso.com/-/press-release-%7C-nyiso-study-finds-reliability-need-in-2025-for-new-york-city-region

[7] https://www.cell.com/action/showPdf?pii=S2542-4351%2818%2930446-X

[8] https://www.americanexperiment.org/harvard-study-finds-wind-turbines-will-cause-more-warming-in-minnesota-than-emissions-reductions-would-avert/

"In two papers … Harvard University researchers find that the transition to wind or solar power in the U.S. would require five to 20 times more land than previously thought, and, if such large-scale wind farms were built, would warm average surface temperatures over the continental U.S. by 0.24 degrees Celsius."[9]

"For wind, we found that the average power density — meaning the rate of energy generation divided by the encompassing area of the wind plant — was up to 100 times lower than estimates by some leading energy experts," said Miller, who is the first author of both papers. "Most of these estimates failed to consider the turbine-atmosphere interaction. For an isolated wind turbine, interactions are not important at all, but once the wind farms are more than five to 10 kilometers deep, these interactions have a major impact on the power density."[10]

III. NERC warns that IBRs can undermine grid reliability

It is easy to find instances demonstrating that the increased penetration of inverter-based resources undermines grid reliability. Around noon on a sunny day this past April, much of Spain, Portugal, and even a bit of France went dark, as if someone had switched off the lights. Solar and wind generate direct-current (DC) electricity. But electric grids run on alternating current (AC). Inverters convert power from DC to AC and attempt to regulate voltage and frequency on the grid. Variations in solar or wind output, load imbalances, power demand surges, or frequency fluctuations may cause inverters to disconnect from the grid.

The North American Energy Reliability Corporation (NERC) issued its highest alert to transmission owners, planners, and generator operators, urging an investigation into how deployed IBRs will respond to grid disturbances.

> **Since 2016, NERC has analyzed numerous major events totaling more than 15,000 MW of unexpected generation reduction. These major events were not predicted through current planning processes. Furthermore, NERC studies were not able to replicate the system and resource behavior that occurred during the events, indicating systemic deficiencies in industry's ability to accurately represent the performance of IBRs and study the effects of IBR on the bulk power system (BPS).[11]**

NERC's alert references almost a decade of inverter performance failures. IBRs should continue to operate through a power-line fault or power-plant shutdown but current inverter settings instead may trigger a complete shutdown. As solar and wind resources supply a larger share of electricity, improper inverter settings increasingly risk cascading failures. But those settings may be locked behind manufacturer-issued passwords. Many deployed inverters come from manufacturers no longer in business, posing a further challenge in reconfiguring settings.

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[9] https://news.harvard.edu/gazette/story/2018/10/large-scale-wind-power-has-its-down-side/

[10] https://news.harvard.edu/gazette/story/2018/10/large-scale-wind-power-has-its-down-side/

[11] Ibid NERC Alert on IBR performance https://www.nerc.com/pa/rrm/bpsa/Alerts DL/Level 3 Alert Essential Actions IBR Performance and Modeling.pdf

Consequently, it may be impossible to predict how IBRs will respond to fluctuations in voltage or frequency.

What happened in Spain was not the first such failure. In Odessa, Texas, in 2021 a combined-cycle power plant went offline, triggering shutdowns of more than 1 GW of solar generation. Inverters were operating with settings from a decade earlier. However, in Texas, 56% of its electricity came from traditional synchronous generation and a major outage was avoided. At the time of Spain's event, the grid was powered over 70% by solar: a chain reaction of disconnects occurred, blacking out the Iberian Peninsula. This is a significant warning about New York's own 70-by-30 renewable energy target.

Hydro, nuclear, and fossil-fuel power plants have big spinning generators and do not need inverters. A constant speed produces alternating current (AC) at a controlled frequency. Slight modifications in rotating speed enable generators to adjust to voltage or frequency changes.

Spinning generators have lots of inertia which enables them to power through load changes. Solar and wind resources have no inertia. A synchronous condenser, which looks very much like a rotating generator, uses energy from the grid to keep spinning. As noted in a recent report from Sweden,

> **Synchronous generators in hydro and nuclear power plants, due to their large rotating mass, are proactive, i.e., prevent disturbances from occurring. In contrast, "synthetic" inertia, which is often promoted as a solution for wind power, is reactive and must constantly correct disturbances that have already occurred. This adds both complexity and cost to the system. To assist wind power, large rotary converters are also installed to stabilize the grid and manage reactive power. They basically act as synchronous generators but without producing any electricity; instead, they consume electricity and incur an additional cost.**[12]

Synchronous condensers add inertia to a grid powered by intermittent resources. Their job in averting grid failure is to supply voltage for a very brief period. If a solution to the fluctuations in voltage or frequency can be determined quickly enough—that is, in a matter of seconds -- condensers might help to keep the lights on. Clearly, they do not guarantee the grid won't go down.

IV. Sweden, and others, do not see intermittent resources reducing costs or adding reliability

Costs do not fall but rather, rise, as intermittent resources are added to the grid. California has pursued a renewably powered grid for twenty years and, behind Hawaii, has the second highest energy costs in the US. Germany has been at this for thirty years and relative to EU energy costs, Germany's are only eclipsed by Ireland.

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[12] Swedish-policy-institure-Electricity-at-Any-Price-upd.-250613.pdf

> **Countries with a high share of solar and wind power have major system problems and are partly forced to ensure the functioning of the system by means of fossil fuel power plants. To manage the intermittency of wind and solar power, there must be other power sources that can be switched on and off whenever needed to balance supply and demand. The more wind and solar power in the system, the more capacity must be available in balancing power plants to replace solar and wind power when the sun is not shining and/or there is insufficient or no wind. The capacity utilization of this balancing power will be lower the more wind and solar power is installed, which means that its revenue will be lower. To compensate for this fact, either the balancing power prices have to be higher, or the owners of the balancing power have to get paid for their availability. Therefore, even if intermittent power were cheaper than traditional baseload power, it will not only lead to more volatile prices but also to higher electricity prices overall. Average household electricity prices have therefore increased in countries with high shares of wind and solar power.**[13]

Sweden provides a cautionary tale of what reliance on, and accommodations for, wind power can mean. In New York, as in Sweden, hydro and nuclear are already fully "booked." If California and Germany have not provided sufficient reason to eschew an intermittent-powered grid, maybe Sweden's example will provide a further admonition.

> **With continued expansion of wind power in Sweden, the country cannot rely on hydropower as balancing power; hydropower is already largely more or less fully booked as balancing and regulating power. From 2020 to 2022, balancing costs increased by more than SEK 5 billion as wind power increased by 4.6 billion kWh. Although not all of the increase is linked to wind power, it is the main cause, and it corresponds to a balancing cost on the margin that exceeds the value of the LCOE adopted by the Council.**[14]

In fact, over a megawatt of dispatchable generation is necessary for every megawatt of renewable added to the grid: "a 1% percent increase in the share of fast-reacting fossil generation capacity is associated with a 0.88% percent increase in renewable"[15] To put this in other words, a 340 MW project like Alle-Catt will need almost 390 MW of dispatchable backup. We will be building, not shutting down, fossil-fuel power plants. California and Germany found that dependence on solar and wind meant building more gas and coal power plants and relying, increasingly, on energy imports.

Beyond the solar panel or turbine price tag, solar and wind need battery backup. Low-capacity-factor solar and wind require overbuilding resulting in a bloated grid. Remote resources must have full nameplate transmission to a three-phase line or substation. RAPID allows developers

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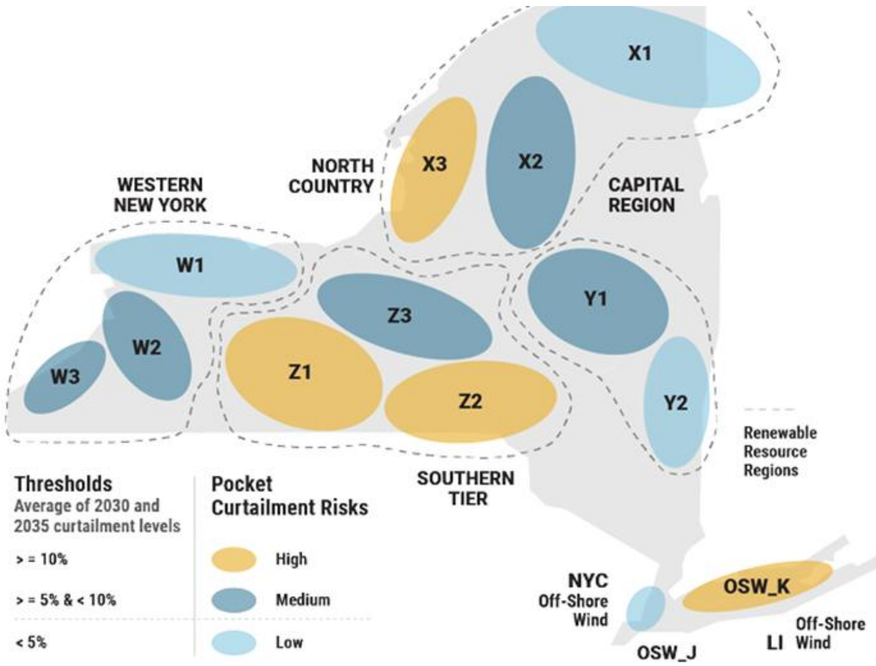
[13] See e.g. Hannesson, Rögnvaldur (2025). "An electricity market model with intermittent power". Energies vol. 18, no. 6, p. 1435. also (Karlsson, Svenolof (2025), "Enormous costs for renewables in Germany". Second Opinion, January 2. The installed capacity of solar power in Germany now exceeds the maximum power requirement by a wide margin.)

[14] Ibid Swedish-policy-institure-Electricity-at-Any-Price-upd.-250613.pdf

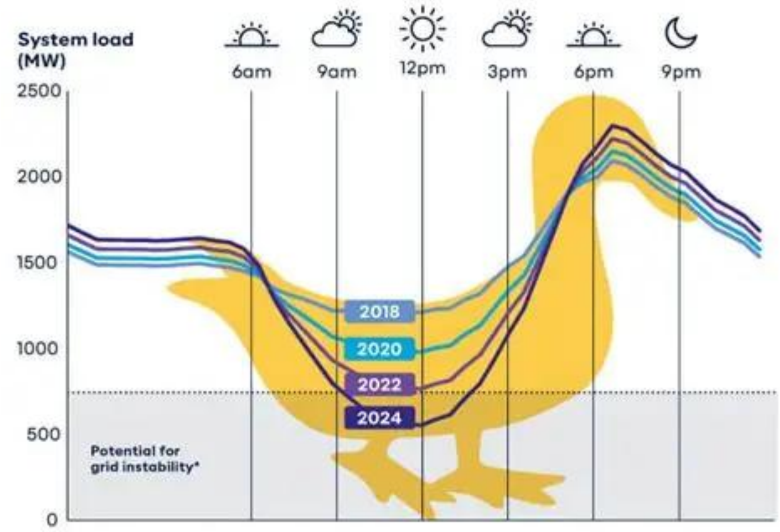
[15] https://www.nber.org/system/files/working_papers/w22454/w22454.pdf

to take land by eminent domain to run poles and wire. Solar and wind need a whole new fiscal model: We must pretend that we can sell our overbuilt solar in the summer and import energy the rest of the year. As noted earlier, NERC tells us that a grid whose reliability hinges on imported energy will likely mean lights out for residents in summer and perhaps in winter, too. California dumped 3.4 terawatt hours of renewable generation last year[16] and still experiences blackouts when expected imports don't arrive. The NYISO, in its 20-year outlook, indicates that statewide transmission constraints (across Finger Lakes, LI, and Southern Tier, see brown pockets below) could last for years:[17]



Wind curtailments doubled between 2021 and 2023.[18] Wind and solar generation do not track demand – hence California's "duck curve:" a tragic and worsening picture of money wasted on intermittent resources, dumped energy, and the 2 GW of gas backup needed to fill the energy shortfall.[19]

[16] https://www.canarymedia.com/articles/solar/california-waste-clean-energy-curtailments
[17] https://www.nyiso.com/documents/20142/33384099/2021-2040-Outlook-Report.pdf
[18] https://www.nyiso.com/documents/20142/2223020/2024-Power-Trends.pdf p. 47
[19] Images of CA duck curve widely available, this one from https://www.barclaypearce.com.au/blog/absi-duttons-energy-plan-is-a-nuclear-duck



As wind assets are added, but transmission, storage, export, and demand do not align with generation, this will get worse. We may find ourselves dumping solar or wind energy generated in central or western New York – or off Long Island -- even as the metro region experiences outages. And we will want synchronous condensers, bumping initial costs by 10%.

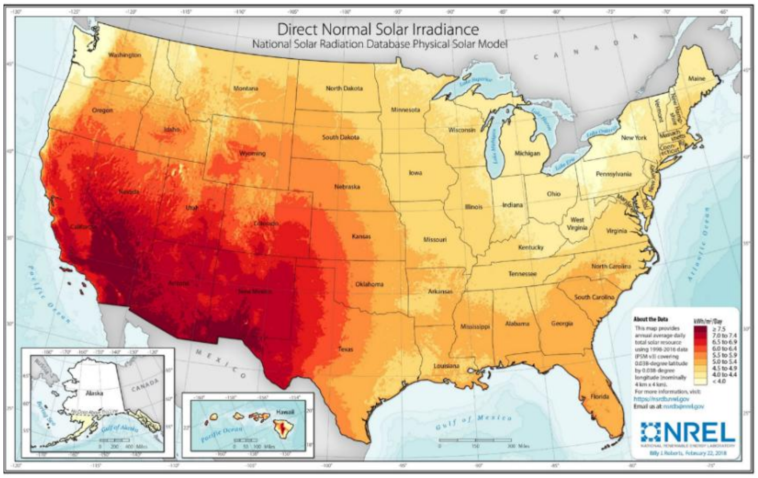
1.2 million rate payers are already in arrears.[20] Electric bills will continue to rise as the state overbuilds solar and wind resources and adds synchronous condensers to supply inertia; and installs thousands of miles of transmission for resources which, mostly, generate nothing at all. We'll pay for electricity to keep condensers spinning but will continue to experience blackouts as reliability declines.

V. The grid operator, NYISO, has repeatedly warned of reliability issues

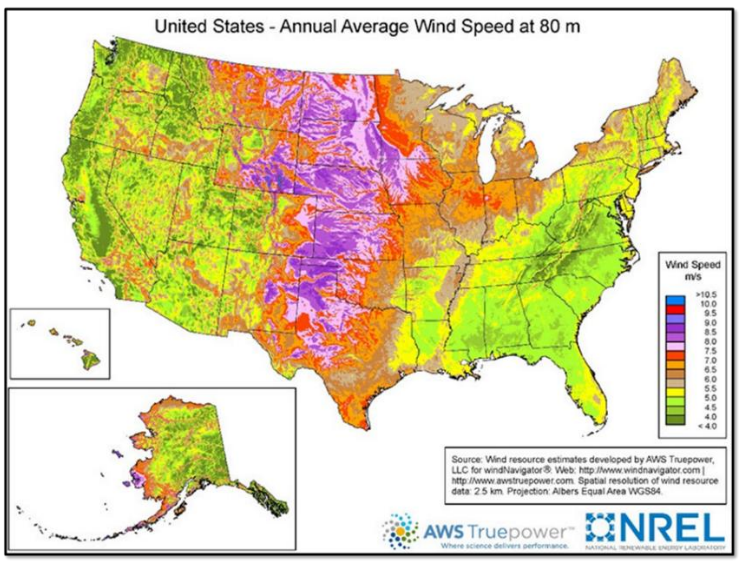
The New York State Independent System Operator (NYISO) released its annual Power Trends report. In 2024, the state used about 131 terawatt-hours of electricity. Fossil fuels generated about half. Although hydro and nuclear resources represent about 20% of installed capacity, they produced 42% of the state's energy. The state's 3.3 gigawatts of nuclear generated 27.5 terawatt-hours – representing a capacity factor almost exactly 95% of nameplate. On the flip side, solar and wind produced about 8% of state energy in 2024.

According to NYISO reporting, New York has a wind capacity factor of about 22%. Solar capacity factor in NYS is under 13%. Solar and wind are resources which generate a small fraction of nameplate, not necessarily when it is needed. As the chart from NREL indicates, solar in NYS is about the same as in Alaska:

[20] https://www.wnypapers.com/news/article/current/2022/07/18/151651/dinapoli-number-of-new-yorkers-behind-on-utility-bills-soared-during-pandemic



Wind capacity factor in NYS is half of what it is in Nebraska.



According to Power Trends, since 2019, over four gigawatts of dispatchable high-capacity-factor resources were decommissioned while a little more than two GW of intermittent resources were added. NYISO is concerned that policy mandates undermine reliability.

> **As traditional fossil-fueled generation deactivates in response to decarbonization goals and tighter emissions regulations, reliability margins on the grid are eroding. Further, the remaining fossil-fueled generation fleet, which provides many of the essential reliability services to the grid, is increasingly made up of aging resources, raising further concerns about grid reliability. Strong reliability margins enable the grid to meet peak demand, respond to sudden disturbances, and avoid outages. They also support the grid's ability to respond to risks associated with extreme weather conditions. As these margins narrow, consumers face greater risk of**

outages if the resources needed for reliability are unavailable due to policy mandates or failures associated with aging equipment.[21]

The "reserve margin," meant to buffer us from outages, has been halved, dropping from over 4,000 MW (2019) to about 2,000 MW (2024). Have we cut fossil-fuel use? No. Since 2019, fossil-fuel use has risen dramatically. Fossil fuels generated 52,300 GWh in 2019. This climbed to 67,298 GWh in 2024, almost a 30% increase. Against this background, NYISO expects power demand to more than double in the next 20 years from about 30,000 MW currently, to over 60,000 MW in 2045.

> **High-tech manufacturing is expanding in New York. Several projects are underway or on the horizon, promising to create thousands of jobs for New Yorkers while also highlighting the need for large investments in energy infrastructure. The challenge for policymakers and industry stakeholders is how to continue to power our society and economy in a way that is reliable, affordable, and sustainable — even while much of the clean generation technologies mandated by state policies are weather-dependent and thus variable in nature.**[22]

The Iroquois ExC project was approved to fuel the Cricket Valley power plant, enabling it to run at capacity. We see Williams's NESE and Constitution pipelines' discussion resurfacing as grid reliability plummets and gas demand grows.

"The transition of the electric system presents a set of challenges that can only be solved through a coordinated effort of industry, government, and stakeholders." [23] Parties to this proceeding are stakeholders in New York's energy planning. The state must allow us to play a role in the decision process.

New York is a "tale of two grids:" 90% of upstate energy is zero emission, running on nuclear and hydro while downstate runs on about 90% fossil-fuels. The Comptroller noted that a million ratepayers are currently in arrears but confronting increasing costs as the state pursues an energy plan focused on renewable buildout requiring hundreds – perhaps thousands – of miles of new transmission. The Business Council wrote Governor Hochul, "While New York can and should take steps to reduce greenhouse gas (GHG) emissions, its goal should be to present a model path forward, not a cautionary tale of unaffordable costs, harmful economic disruptions, and threats to future economic growth."[24] The Public Service Commission admitted in its biennial report that on our current trajectory we will not meet the upcoming (70%-by-2030) decarbonization target and, as the Business Council noted, this puts all the CLCPA goals in jeopardy. Fortunately, the 2040 goal in CLCPA is a carbon-free grid with no renewable quota.

Dozens of countries, and not a few states, realize we will need nuclear power. "Governor Hochul [directed] the New York Power Authority (NYPA), in coordination with the Department of Public Service (DPS), to develop and construct at least one new zero-emission [one gigawatt]

[21] https://www.nyiso.com/documents/20142/2223020/2025-Power-Trends.pdf/
[22] Ibid Power Trends
[23] Ibid Power-Trends
[24] https://www.bcnys.org/sites/default/files/2024-07/Final%20CLCPA%20%20sign%20on%20letter%20.pdf

advanced nuclear power generation facility in Upstate New York, either alone or in partnership with interested private entities."[25] While this is a move in the right direction, it represents a tiny fraction of the investment in nuclear the state must undertake. An effort to replace today's fossil-fuel capacity and, in 20 years, to provide the 60 gigawatts NYISO believes will be needed, requires a fundamental change in New York's thinking about energy. Nuclear generators would require a tiny fraction of the land needed for wind and solar, and can operate on the existing grid. Nuclear installations would provide thousands of high-paying jobs, and emission-free baseload energy at a 95% capacity factor. According to Oxford nuclear is as safe as solar or wind.[26] According to the UNECE, nuclear has the lowest lifecycle environmental impact of any generating source.[27]

An efficient, fiscally sound grid would not rely on intermittent resources and batteries, while full capacity carbon-free baseload backup sat idle. Existing hydro and new nuclear as the backbone of the grid, along with a modest solar and wind component, would economically, reliably, enable us to meet the "100%-carbon-free grid by 2040" state target. The state should reject large-scale wind projects and begin building a carbon-free grid powered by hydro and nuclear.

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[25] https://www.governor.ny.gov/news/governor-hochul-directs-new-york-power-authority-develop-zero-emission-advanced-nuclear-energy
[26] https://ourworldindata.org/nuclear-energy
[27] https://earth.org/nuclear-energy-carbon-emissions-lowest-among-electricity-sources-un-reports/