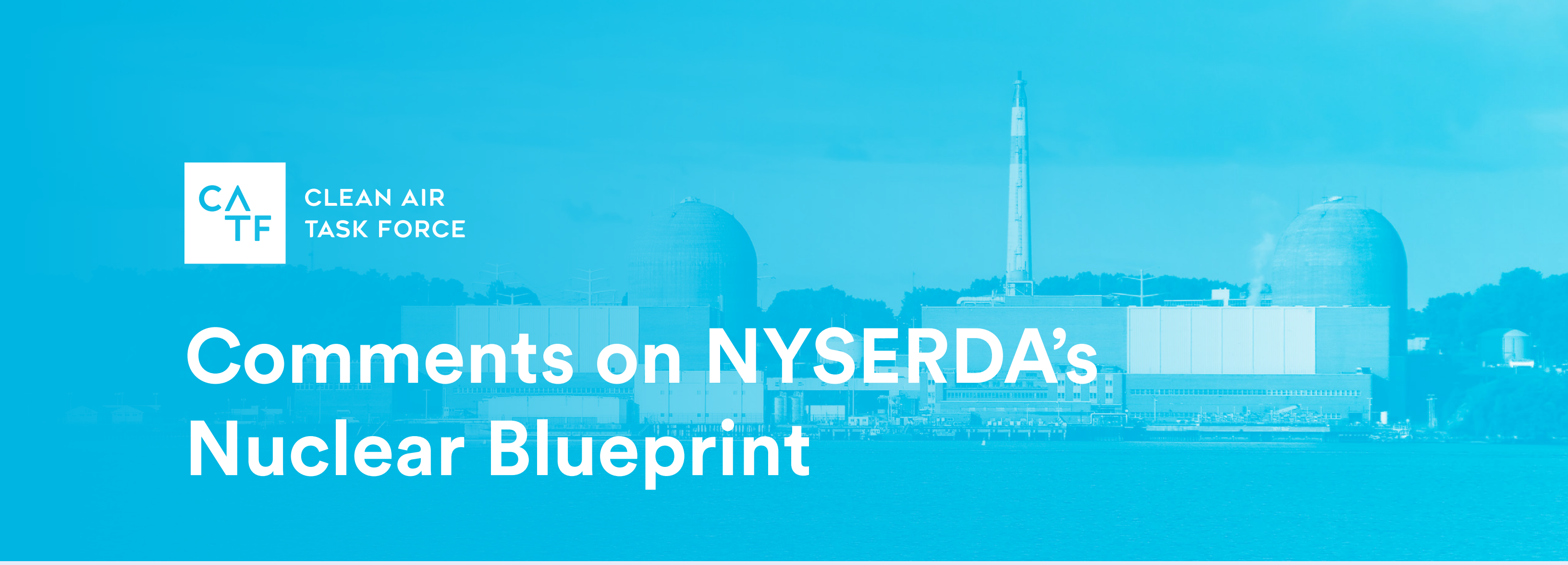

CLEAN AIR TASK FORCE

Comments on NYSERDA's Nuclear Blueprint

Summary of recommendations

1. New York's clean firm capacity need should be firmly established to enable NYSERDA to lead an RFP process. The analysis should include evaluating potential sub-zonal transmission cost savings and land-use implications for the inclusion of nuclear energy.
2. Clearly appraise the value of nuclear technologies in the New York power system, assessing alternatives or fallback options to guide decisions on level of support to be provided to nuclear energy and its role in the state's power system. Policies should be pursued to provide a clear signal to investors and the nuclear energy supply chain to prepare for scale-up.
3. Develop a technology selection framework that will allow policymakers to narrow down the designs to be supported based on the specific use cases and role nuclear is to play in the New York power and energy system.
4. Outline a fleet approach to fully realize the cost reduction potential of new build nuclear (e.g. New York evaluates options and strategies for establishing or participating within a government-backed orderbook and evaluates public loan and ownership options to reduce the cost of capital).
5. Consider different delivery pathways including a potential role for the government in championing deployment through a purpose made vehicle or other alternative pathways.

Overview

CATF welcomes the steps NYSERDA has taken toward informing its decisions on the climate transition and securing sustainable, reliable, and cost-effective power system solutions. Nuclear technology and other clean firm technologies[1] will be a key part of the transition alongside solar and wind power across many jurisdictions including New York.

With the adoption of the Climate Leadership and Community Protection Act of 2019 (CLCPA), New York committed itself to an economy-wide 40% reduction in greenhouse gas emissions by 2030 from a 1990 baseline, an economy-wide 85% reduction in greenhouse gas emissions by 2040, an electricity sector powered by 70% renewable energy by 2030 and 100% zero-emission electricity by 2040.

---

1 Clean firm (CF) power refers to power sources that generate electricity on-demand, regardless of weather or time of day, with minimal emissions. CF technologies can achieve very high-capacity factor. Technologies such as nuclear fission, fusion, geothermal (incl. superhot rock geothermal), combustion with carbon capture and storage, zero carbon fuel combustion are considered to be clean firm (this is not an exclusive list). These technologies are key to achieving deep decarbonization of the energy systems by delivering a number of benefits including lower total system cost of the transition, lower need for costly and rarely called upon long-duration energy storage, lower requirement for transmission grid buildout and overbuilding of the power infrastructure. More information is available here.

In order to reach these targets, New York will need to deploy a range of clean technologies and embrace nuclear power alongside other clean generating resources. The draft Nuclear Blueprint has laid out the technological landscape of advanced nuclear technologies. The next iteration of the document could delve deeper into a number of questions which will direct NYSERDA in informing next steps in the state's transition.

1. Need for clean firm power to unlock deep decarbonization

Clean firm power technologies are crucial to unlocking deep decarbonization of power systems without the expensive, and perhaps insurmountable, challenges related to overbuilding renewable capacity and energy storage to account for intermittency and variability. Those challenges include land use competition, permitting delays, and widespread transmission congestion which will drive up the system costs of the transition as well as reduce the likelihood of meeting climate targets on a reasonable timeframe.[2,3]

CATF applauds NYSERDA's focus on clean firm power and provision of the analytical baseline for likely clean firm needs by 2050. The clean firm capacity likely to be required for the state's climate goals was placed at 20 – 40GW and will require a rapid and robust strategies to bring these often nascent technologies onto the system at pace. Amongst other clean firm generating technologies, only nuclear is currently demonstrated at the scale needed to reach tens of GW scale deployment in the next two decades. Although technologies such as gas with carbon capture and storage (CCS), geothermal, and other innovative technologies show promise and are likely to be crucial elements of the solution, nuclear technology is poised to lead the way.[4]

NYSERDA's exploration of clean firm options aligns well with the Public Service Commission process, initiated in 2023, regarding the 2040 100% zero emissions target contained in the CLCPA. That process should eventually result in an order modifying the existing Clean Energy Standard, which includes a Renewable Energy Standard, an Offshore Wind Standard, and Zero-Emissions Credits (which are used to support existing nuclear generation facilities).

Future analyses need to go beyond traditional zonal capacity expansion modeling to understand clean firm needs and benefits. Zonal capacity expansion modeling may miss a significant portion of costs (e.g. sub-zonal transmission) relevant for technology decisions. Analyses should also evaluate in detail sub-zonal reliability challenges of a decarbonized power grid across a wide range of plausible weather and load conditions to properly assess cost tradeoffs of different technology portfolios.

Similarly, the costs of nuclear energy should be anchored in the value this technology provides based on the whole system cost assessment. Whilst the draft Nuclear Blueprint refers to the importance of clean firm power on the system, it does not delve into consideration of value of this technology to the network beyond focusing on CAPEX.

Last, clean firm energy sources should be evaluated from the perspective of land-use implications and speed of the transition. Clean firm technologies are often land-dense, which may significantly reduce land-use necessary for energy infrastructure and accelerate decarbonization by reducing the number of projects that need to be developed.

To properly assess the potential costs and benefits of nuclear, the state must fully evaluate the following scenarios across a wide range of plausible infrastructure and fuel cost, weather, load, and transmission buildout sensitivities:[5]

1. Failure to deploy clean firm power technologies resulting in fallback to unabated fossil generation equating to 20GW alongside associated social costs (such as health effects of fossil generation).

2 An audit of ORES found an average of 3.7 years between initial application to issuance of the final siting permit. https://www.osc.ny.gov/state-agencies/audits/2024/04/24/application-review-and-site-permitting-major-renewable-energy-projects

3 Analysis from Americans for a Clean Energy Grid rates New York's transmission planning and development poorly, particularly for Capacity Available for new resources. https://www.cleanenergygrid.org/wp-content/uploads/2023/06/Report-Card-Score-Details-New-York.pdf

4 Solution such as hydrogen to power is likely to play a limited role due to likely low availability of low-carbon and affordable hydrogen, which should be prioritised for use in hard to abate sectors.

5 These two scenarios are intended to define boundary conditions for nuclear deployment rather than predict the most realistic future outcomes.

2. Deployment of remaining clean technologies (without nuclear) to ensure reliability, including costs of associated infrastructure (e.g CCS or hydrogen pipelines and storage) and assessment of likelihood of achieving such ambitious buildout of power infrastructure and other nascent technologies in the next two decades.

Recommendation: CATF recommends that New York evaluate and establish a minimum clean firm capacity need based on a robust set analysis that includes evaluating potential sub-zonal transmission cost savings and land-use implications for the inclusion of nuclear.

2. Role of nuclear as a clean firm technology and its value in New York

Given the need for clean firm capacity in New York, nuclear power is one of most readily available sources.

Failure to deploy nuclear technology will result in reliance on other often nascent clean firm technologies (such as gas with CCS or hydrogen combustion), or, in absence of those, a fall back on fossil fuel dispatchable generation and failure to decarbonize.[6] Lack of significant or well characterized geologic storage in New York may limit CCS unless a regional carbon dioxide pipeline network is developed. Meanwhile, power generation with clean hydrogen is highly costly, suffers from significant infrastructure buildout, and utilizes a limited supply of clean hydrogen that could be used to offset industrial emissions and sectors without other decarbonization options. As such, nuclear energy presents itself as a readily available option.

Given the available information, New York should assess the readiness of technology options and simulate the system costs of including the procurable options. The costs associated with these counterfactuals should be estimated and ultimately be the threshold guiding NYSERDA's decisions pertaining to fostering technologies in the state.

Recommendation: CATF recommends providing further context and framing of costs and opportunities nuclear technology offers to New York. To the extent that technologies can be assessed via analysis, CATF recommends that New York provide a clear signal to investors and the nuclear supply chain to prepare for scale-up. Clear federal and state long-term robust policies are key in fostering investor confidence which will ultimately drive deployment.

3. Nuclear technology

The draft Nuclear Blueprint focuses on advanced nuclear technologies, which although are currently heavily marketed as ready for deployment in early 2030s, are still in early stages of development, with only one small modula reactor (SMR) design by NuScale currently holding a design certification from the Nuclear Regulatory Commission (NRC).

Considering the size of the market for clean firm technologies in New York and speed at which these technologies need to be deployed, it may be prudent to widen the spectrum of potential technologies to include gigawatt scale reactors such as GenIII+ Westinghouse AP1000, recently completed at Vogtle in Georgia. Although a number of challenges were encountered during the construction project, vast learning was acquired during delivery that could and should be captured and built on to capitalize on this domestic competence. Additionally, construction cost reduction between units 3 and 4 signals further potential to drive down the costs of nuclear electricity via a learning-by-doing route.

Advanced reactor technologies are offering an attractive mix of a smaller scale investment, increased construction efficiency due to factory build, and a wider set of potential applications. Currently over 80

6 Nuclear and weather dependent technologies are complementary and do not fulfill the same function in the power system. Hence, solar and wind technologies, event firmed up with a few hours of electricity storage are not a meaningful counterfactual to nuclear in this context.

designs are being pursued worldwide, with a number of them being developed in the U.S. The spectrum of technological approaches to power rating, fuel and coolant choices leads to varying levels of suitability for applications[7], creating an opportunity to foster technologies which are most suitable for decarbonization challenges of New York. Advanced technology offerings, although prolific, will need consolidating to focus economic efforts on the most promising solutions for specific applications and use cases.

Deeper understanding of use cases for nuclear energy beyond electricity should be performed to offer further insight into opportunities nuclear enegy offers in decarbonizing hard-to-abate sectors such as industrial heat, district heat, and others. Currently, New York industrial facilities consume 329.5 trillion Btu of energy, accounting for approximately 10% of the state consumption and emitting 30,788 thousand metric tons of CO_2. In depth analysis where these fossil generators could be replaced with nuclear carbon-free power could inform the state's support for the SMRs which still need to descend down the cost curve.

Recommendation: Keeping in mind the wide technological offerings and range of applications where nuclear can contribute to New York goals, CATF recommends the next version of the Nuclear Blueprint includes a technology selection framework that will allow policymakers to narrow down the technologies to be supported based on the specific use cases and the role nuclear energy is to play in the New York power and energy system. Such a framework could be useful in segmenting New York's need for grid connected nuclear generation (gigawatt scale or advanced technologies) and capacity to be co-located with industry and closer to population centers (advanced technologies).

4. Deployment and risk sharing driven cost reduction

CATF supports concept of a 'between-of-a-kind' (BOAK) cost metric and underscores the importance of fleet approach, or a pooled orderbook of 5-10 units, to fully realize the cost reduction potential of both large-scale water reactors as well as advanced technologies. Although many frameworks can be used to characterize cost reduction for nuclear plants, two prominent pathways emerge:

- Broadly understood learning-by-doing resulting in increased efficiency, minimizing rework and ultimately shortening the construction period leading to optimal Overnight Construction Cost (OCC).
- Minimizing cost of capital – which lowers the potential impact of delays and inefficiencies during the construction period.

In a recent report cost reductions of about 45-60% in overnight capital cost were estimated between the first and third plant deployed of a given reactor concept. This highlights the importance of multi-plant orders to drive down nuclear energy costs. Multiple-unit orderbooks will drive investment into domestic supply chains and allow sufficient number of repetitions to minimize errors and inefficiencies which extend duration of the construction and hence drive the cost escalation of nuclear projects. of nuclear projects.

The impact of the duration of the construction phase on the total project costs cannot be underestimated. Construction being comparatively the highest risk stage of the nuclear project is a source of significant risk premiums for the project at a time where no revenues are available. With cost of capital often dominating the Levelized Cost of Energy (LCOE) of nuclear electricity, any delay amplifies the total cost of the project often beyond the original budget. Cost of capital can be minimized by appropriate allocation of the project risks between public and private parties, accessing affordable government backed financial solutions such as under the Department of Energy's Loan Program Office (LPO) and derisking the projects by securing firm offtake arrangements such as PPA.

Recommendation: To fully realize the cost reduction potential of new build nuclear, CATF recommends that New York evaluate options and strategies for establishing or participating within a government-backed orderbook and evaluate public loan and ownership options to reduce the cost of capital.

7 Such as grid electricity, electricity and/or heat for industrial users, hydrogen generation, off-grid applications, system services.

5. Nuclear development pathways – role of the state

Despite an obvious need for new low-carbon, clean, firm electric capacity in the U.S., and bipartisan enthusiasm, new nuclear build in the U.S. is at a standstill after the completion of Vogtle 3 and 4. Binding constraints lie mainly in development and financial risks accentuated with the 2x cost overruns and 5-year delay at Vogtle, which were real but not inherently a representation of the technology's current or future costs. SMRs could provide some risk mitigation because of their smaller size and offsite manufacturability, but they still represent an unknown. Accelerating load growth also might serve to reduce the relative attractiveness of smallness per se and increase interest in economies of scale. A one size fits all legislative approach might not address all key variables and diverse risk profiles among utilities, vendors, and off-takers and therefore result in continued lack of uptake of federal new build incentives.

The most successful large Western nuclear builds (e.g. in France, South Korea, Canada) have been repeat versions of standardized designs, supported by national programs carried out by state-owned or -directed entities and underwritten with state financial support. In liberalized energy markets, strong national policy is needed to effect standardization and absorb risk. Hence, the fastest pathway to a large U.S. nuclear build might be for a government entity to take the lead, not just in providing financing or other incentives, but in bringing new plants to fruition. An entity with experience in commissioning and constructing plants, and nuclear plants in particular, is an attractive candidate for this role.

Imperfect analogies of state champion include NASA's role in birthing a new era of commercial space launch through its COTS program, as well as defense procurement and early solar and wind renewable portfolio standards, which substantially mitigated the risk of early builds. Other examples of government entities building and operating generation and transmission:

- New York State Power Authority (NYPA) owns and provides 25% of NY electricity generation (6,000 MW capacity); 70% hydro, remainder is fossil
- South Carolina Public Service Authority ("Santee Cooper") distributes federal SEPA power
- California DWR, primarily water supply, but owns generation, and refinanced bankrupt IOUs after Enron power crisis in 2000
- Salt River Project (AZ)

New York state must also outline a policy roadmap to evaluate and establish nuclear as a DEFR option that is necessary. This would include establishing a DEFR minimum requirement, issuing a request for proposals to meet that need, evaluating proposals, and selecting winning bids via comprehensive evaluation.

Recommendation: The Blueprint should consider different delivery pathways including a potential role for the government in championing deployment through a purpose made vehicle or other alternative pathways.

Summary of comments and recommendations

Clean firm technologies, and nuclear in particular is likely to be a key piece of the puzzle on the path to a carbon neutral future. The draft Nuclear Blueprint offers a strong base for consideration of potential future nuclear technologies have in the state. The final iteration of the document could be improved by exploring paths forward to development and technology choices based on the value these different technologies provide and the opportunity cost of not pursuing it as a solution.

For further information please contact: Malwina Qvist, Nuclear Program Lead, CATF at mqvist@catf.us or John Carlson, Senior Northwest Regional Policy Manager, CATF at jcarlson@catf.us