Policy Opportunity Brief: Clean Firm Power

Background

Maintaining electric system reliability while meeting environmental goals cost-effectively is likely to require the deployment of clean firm power. "Clean electricity that is available on demand, for as long as it is needed, whenever it is needed," clean firm power includes nuclear, geothermal, hydropower, renewable natural gas, natural gas with carbon capture and sequestration (CCS), and hydrogen. Clean firm power can serve an important role in "a broader generation portfolio that relies on much lower cost wind and solar most of the time."

Advantages

1. *Avoids over-building wind and solar capacity.*

Reliably supplying electricity through wind and solar alone would require sizing that capacity to meet peak seasonal and daily demand. However, during peak wind and solar generation, supply would often surpass demand, likely requiring curtailment even after excess supply was directed to storage resources or to hydrogen generation. Modeling conducted for the state of California found that, "An ambitious but achievable investment in clean firm power, with installed capacity similar in magnitude to our existing gas fleet – or roughly 25-40 gigawatts (GW) – could eliminate the need for ten times that amount of wind and solar capacity."

Variable renewable energy resources are often dispersed, requiring transmission lines that connect each facility to the larger grid. Including clean firm power resources in a diversified energy portfolio could reduce transmission needs to one-third of that required by a system served by wind and solar alone. Because clean firm power can allow states to avoid over-building wind and solar resources, clean firm power also reduces reliance on critical minerals and reduces the landscape footprint of electricity generation.

2. *Reduces reliance on energy storage.*

Ensuring a reliable system without clean firm power could require building out "extensive storage capacity." One estimate finds that 33 terawatt hours (TWh) of storage would be needed in the Western Interconnection to meet the "energy gap" that could result from relying on wind, solar, and hydropower alone. While battery energy and long duration storage solutions will remain an important part of the system, utilizing these technologies as complements to rather than replacements for clean firm power is likely to provide a more cost-effective solution.

3. *Reduces system costs in the longer term.*

Adding clean firm resources to a diverse portfolio would likely reduce system costs, as compared to a wind and solar only system. Modeling completed for the state of California found that a diverse portfolio of wind, solar, storage, and multiple sources of clean firm generation could deliver electricity at "about one-third less than the cost of an all-wind-and-solar approach."

Disadvantages

1. *Higher upfront capital costs.*

The capital costs of clean firm technologies are currently more expensive than renewable energy (Long, et al. 2021b). The table below reflects U.S. Energy Information Administration (EIA) estimates of the overnight capital cost[1] of construction for a variety of resources.

[1] The overnight capital cost is an estimate of the cost of building a plant immediately, "as if no interest were incurred during its construction."

2. *Lack of public familiarity.*

Solar and wind are mature technologies, enjoying "substantial public support" and familiarity. Many of the resources associated with clean firm power, especially nuclear energy, "face challenges in public acceptance" (Long, et al. 2021b).

3. *Siting challenges.*

A lack of familiarity with clean firm resources could result in siting difficulties. Challenges to siting could emerge through public opposition to these less familiar resources or due to shortfalls in public agencies' capacity, including regulatory authority, to successfully manage the permitting process for newer resources with which staff is less familiar. However, repurposing existing generation sites with access to transmission could reduce some of these obstacles.

Cost Comparisons – New Generation

Technology Type	Overnight Capital Cost ($/kW)
Onshore Wind	$1,489
Solar PV with Single-Axis Tracking	$1,502
Lithium-Ion Battery Energy Storage	$1,744
Combined Cycle Gas with 95% Carbon Capture	$2,365
Geothermal	$3,963
Hydroelectric	$7,073
Advanced Nuclear (sited on a brownfield)	$7,861
Small Modular Reactor	$8,936

Source: EIA 2023, "Capital Cost and Performance Characteristics for Utility Scale Electric Power Generating Technologies." (p. III)

Policy Opportunities

1. Initiate investigatory dockets or studies to gather information on technology status, cost, and pathways or timelines to deployment.

2. Uncertainty about the right mix of clean firm resources cautions against requiring that specific resources be developed over others. "Leaving the form of clean firm power up to the utilities themselves – with oversight from [regulators] will allow experimentation and learning."

3. Set a clean firm portfolio standard. Similar to existing clean energy portfolio standards, states could adopt requirements that utilities procure, or deploy themselves, a set capacity target by a certain date, dependent on state policy goals. Interim targets can be used to ensure the target will be met and to allow policy evaluation and adaptation in response to the system costs and reliability impacts of clean firm resources.

4. Develop or strengthen state incentives for the development and deployment of clean firm resources. These incentives could be designed to complement the clean electricity investment tax credit (CEITC) established by the Inflation Reduction Act. For instance, allowing a state tax incentive to be stacked with federal incentives could attract investment.

5. Work with utilities, members of the public and other state agencies to identify opportunities for energy communities to host and benefit from clean firm generation. The CEITC provides a multiplier for projects sited in an energy community.