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# Three Key Challenges for Northeastern and Mid-Atlantic States Scaling Up Off-Shore Wind Generation

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This first in a projected series of off-shore wind related Northeast-Midwest Institute (NEMWI) Issue Briefs summarizes the Biden Administration's off-shore wind development initiative and discusses three key challenges to its execution.

On March 29, the Biden Administration announced a new off-shore wind initiative, aimed at deploying some 30 gigawatts of new offshore wind energy in the United States. This initiative is part of a larger effort to reduce greenhouse gas emissions worldwide by setting an example. President Biden told world leaders that the United States expects to reduce emissions by 50 to 52 percent by 2030.

The Administration is limited in what it can attempt or accomplish within existing legal authorities. Yet, off-shore wind development and deployment is an area where the Federal government has useful discretionary authority. Still, the legal regime for off-shore wind is complicated, and as in many government activities, the details are usually consequential.

While the United States has built over 100 gigawatts of wind energy capacity over the past 20 years, less than 0.4% has been off-shore. There are no off-shore projects currently under construction. Meanwhile, the United Kingdom has installed more than 10 gigawatts of off-shore capacity, and Germany now has about 5 gigawatts. Off-shore winds are typically stronger and less variable than on-shore winds, and thus permit larger capacity turbines with higher capacity factors.

Nonetheless, the Administration appears to have the necessary legal authorities to undertake this initiative. Some observers believe that a conjunction of available technologies, willing investors, available customers, and a favorable tax and policy regime make rapid progress in development and deployment of generation capacity in this part of the clean energy spectrum along the northeastern and Mid-Atlantic seaboard a realistic opportunity.

## Encouraging Off-shore Wind Utility Customers

There is clearly a substantial unmet regulatory requirement for off-shore wind power on the United States' Atlantic Coast. Ten coastal states—Connecticut, Delaware, Maine, Massachusetts, North Carolina, Rhode Island, New Jersey, Maryland, New York, and Connecticut—have enacted renewable portfolio standards for electric power generation accounting for 25 percent (Delaware) to 70 percent (New York) of electric power to be supplied from renewable sources by 2030 (Figure 1) . Virginia requires 100 percent renewable power by 2050. Four adjacent inland states (DC, Pennsylvania, New Hampshire, and Vermont) also have adopted renewable portfolio standards. The total requirement for newly constructed capacity through 2030 in all 30 states with such standards is about 90 gigawatts, and as of 2019, states or their utilities have issued solicitations for 11 gigawatts, with another 7.6 gigawatts anticipated for 2020-2021.

*Figure 1. Summary of RPS policies by State as of 2020 Source: (Barbose/LBNL, 2021)*


The regional transmission organizations for New England and the Mid Atlantic -- ISO New England, ISO New York, and PJM -- are reportedly all actively planning to receive and transmit this power.

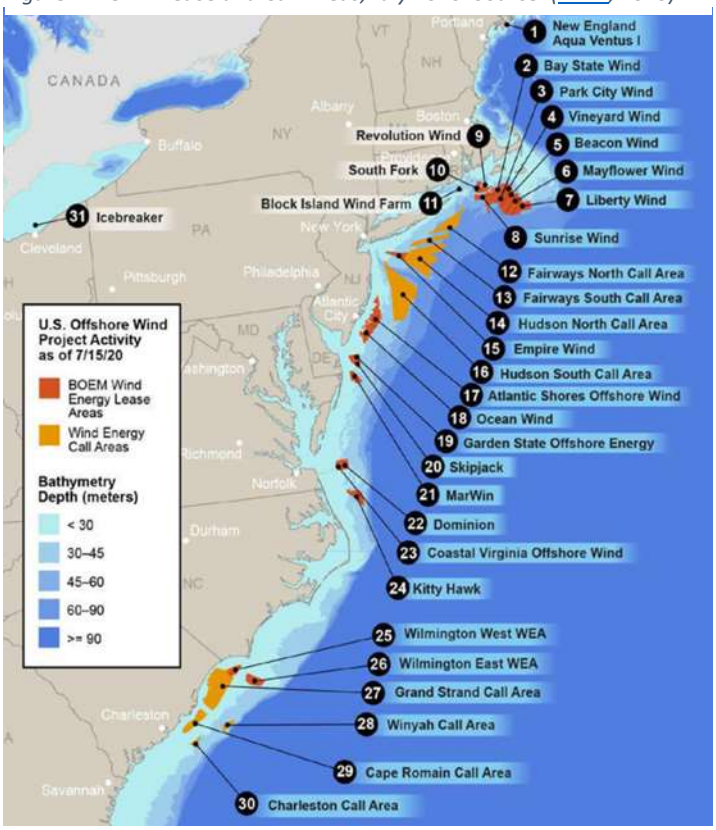
## Siting and Permitting of Off-shore Wind Projects

On the supply side, there is strong interest in undertaking projects to supply power to comply with the various renewable portfolio standards. Off-shore wind energy rights beyond the three mile limit are vested in the Federal Government. The Department of the Interior's Bureau of Ocean Energy Management (BOEM) may lease tracts, usually via periodic lease auctions with competitive bidding.

The Bureau has leased tracts for 23 projects, totaling some 23.8 gigawatts (Figure 2). Of these, 11 projects, with a total capacity of 6.4 gigawatts, are being permitted, with listed operational dates from 2023 to 2025. Many of the leases are held by large, well-financed firms, including Dominion, PSE&G, BP Shell, and US Wind.

Wind projects currently qualify for substantial tax credits, including a production tax credit of $0.015 per kilowatt-hour, which is available to projects that begin construction by December 31, 2021, and an investment tax credit of 30 percent of investments for projects that begin construction by the end 2025. The expiring production tax credit, originally enacted in 1982, has been extended every few years for as long as anyone can remember, so potential investors can be forgiven for believing it to be immortal.

*Figure 2. BOEM Lease and Call Areas, July 2020. Source: (NREL, 2020)*



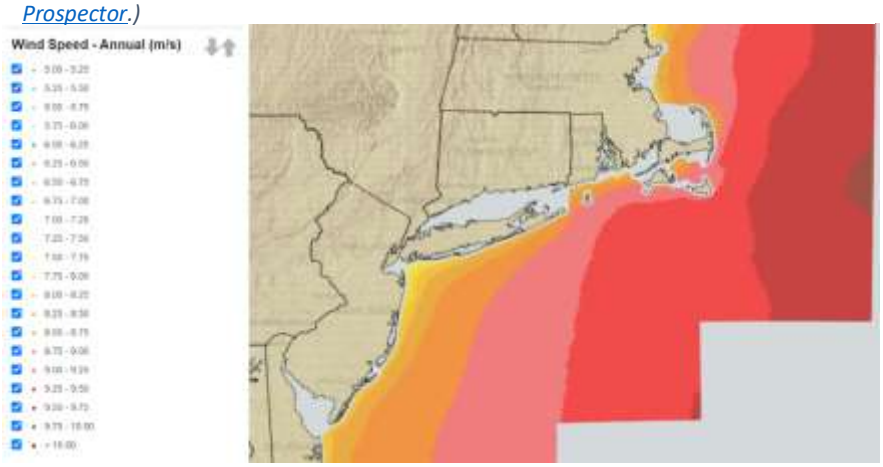

The Biden Administration's announcement focuses on three unleased "Wind Energy Areas" off of New York City. The Bureau has identified five blocs within these areas where one or more firms have formally expressed interest in bidding for leases. These five blocs have a potential capacity of about 9.8 gigawatts.

The Bureau's next step will be to conduct an Environmental Assessment of future "site characterization activities." Since such activities generally have little impact, the Assessment is likely to be done quickly. However, the subsequent site assessment activities, which require off-shore field work and data collection, themselves can consume several years. The information collected, however, will considerably reduce the risk that any projects will subsequently be affected by the results of environmental impact statements, as well as provide much of the baseline information required for the engineering design and costing of any future wind project.

One risk for all of these projects is what NEMWI's Tom Cochran calls NIMOV, an acronym for "Not in My Ocean View." The experience of the Cape Wind project has been chastening for off-shore wind customers, regulators, and suppliers alike.

However, the Bureau has tended to construct Call Areas so that they are at least 15 nautical miles offshore. Cape Wind was five nautical miles off-shore at its closest approach, and had land on three sides. At 15 nautical miles, only objects taller than about 75 feet will loom above the horizon.

*Figure 3. Annual average offshore northeast wind speeds. Source: (NREL, Wind Prospector.)*

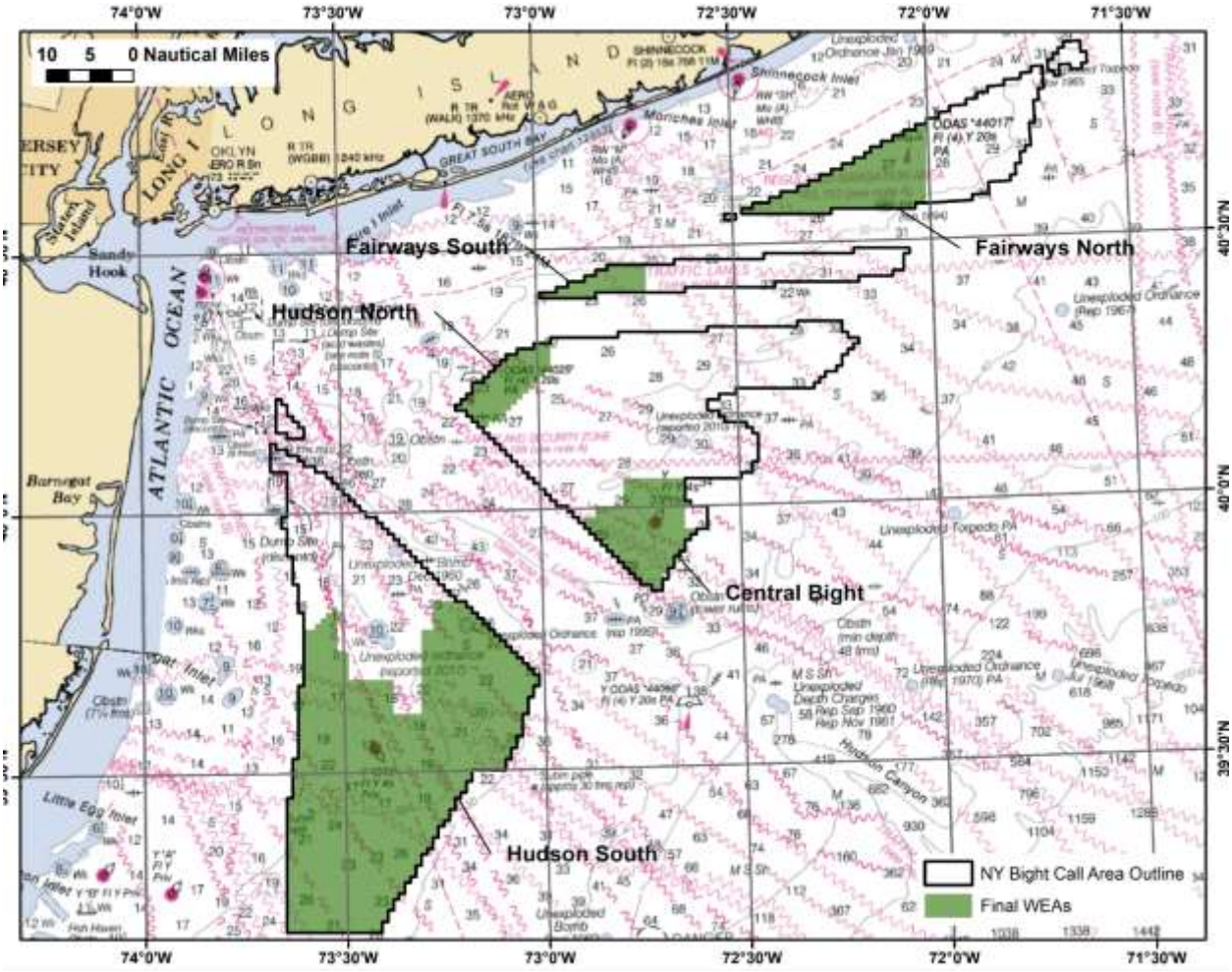



In any current project, there are likely to be fewer, larger turbines per square mile compared to Cape Wind. The greater the distance, the more commonly the turbines will be hidden by weather and atmospheric moisture. In addition, operators may decline to lease or build in areas close to shore, or restrict turbine height and capacity where they are closest to land. Generally wind speeds, and hence optimal turbine sizes, will be greater farther out to sea.

The constellation of public opinion may be different for both the New York Bright and for other off-shore projects than for Cape Wind. Perhaps the highest risk for NIMOV among the various projects currently under consideration is the not-yet-leased Fairways North bloc in the New York Bight, the northern edge of which is 15 nautical miles from the Hamptons

The Bureau's selection of lease areas is intended to limit conflicts with other prospective stakeholders, including fishermen and merchant shipping. However, that does not ensure the absence of conflicts.

*Figure 4. Wind Energy Areas Selected for Further Study in 2021. Source: (BOEM, 2021)*




The success of the Biden Administration's venture does not, however, depend on the success of any single project. It seems unlikely that every proposed project will be started or completed, but with 24 gigawatts in the pipeline, relatively few additional large projects will be needed to build out 30 gigawatts by 2030. If any single large off-shore project becomes operational, additional projects in adjacent locations will become more feasible. By the time the New York Bright areas are ready to begin construction, there should be a number of projects operational and much more infrastructure in place than at present.

The bigger challenge may be the speed with the Bureau of Ocean Energy Management can complete the necessary preliminary studies, especially environmental impact statements, in a situation where the agency cannot afford to cut corners.

The available evidence, however, suggests that the Biden Administration may be able to move quickly. In December 2020, the Trump Administration moved to halt consideration of the most advanced of the current large-scale wind leases, the 800 megawatt Vineyard Wind – 1, located offshore Cape Cod. Since then, the Biden Administration has taken the following actions:

- On March 8, the Bureau of Ocean Energy Management completed its Final Environmental Impact Statement for the Project.
- On May 10, BOEM approved the project's Construction and Operations Plan;
- On May 19, the EPA Region 1 granted an Air Permit for the Construction and Operations Plan.

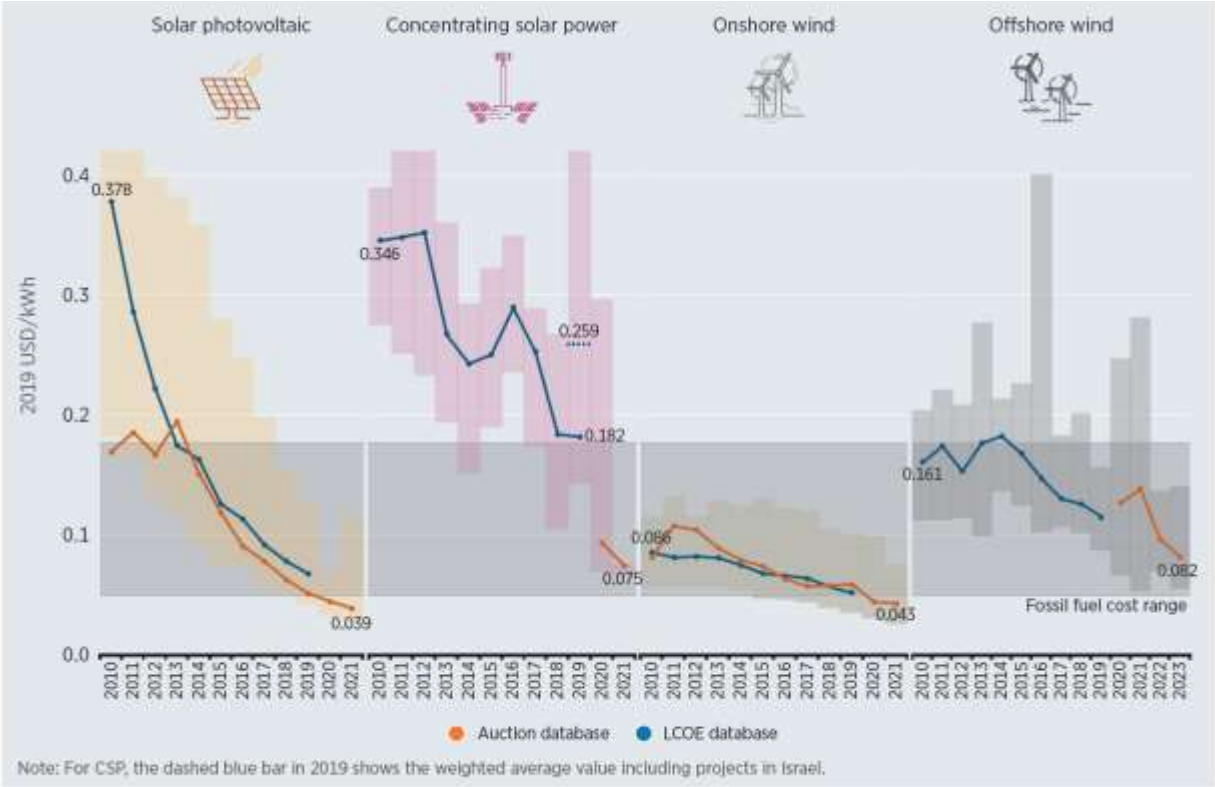
The Administration's Permitting Dashboard suggests that the remaining Federal permits (Marine Mammal Protection Act) and the Rivers and Harbors Act and Clean Water Act) may be expected soon.

The Vineyard Wind project will use GE's giant new Haliade X turbines, with 12-14 MW capacity. This will be an important test of whether increasing turbine size will continue to deliver cost reductions. The operator's current schedule calls for the project to be operational by 2024.

## Competition to Off-shore Wind from Solar

The off-shore wind projects are likely to face competition from other renewables to provide power for the renewable portfolio standard segment of regional electric markets, particularly solar energy, which appears very cost competitive with wind (Figure 5).

*Figure 5. Worldwide Weighted Average Levelized Cost of Electricity (LCOE) and Auction or Power Purchase Agreement Prices for Renewable Electricity Projects by Year of Project Completion, 2010-2019. Source: (International Renewable Energy Agency, 2020)*

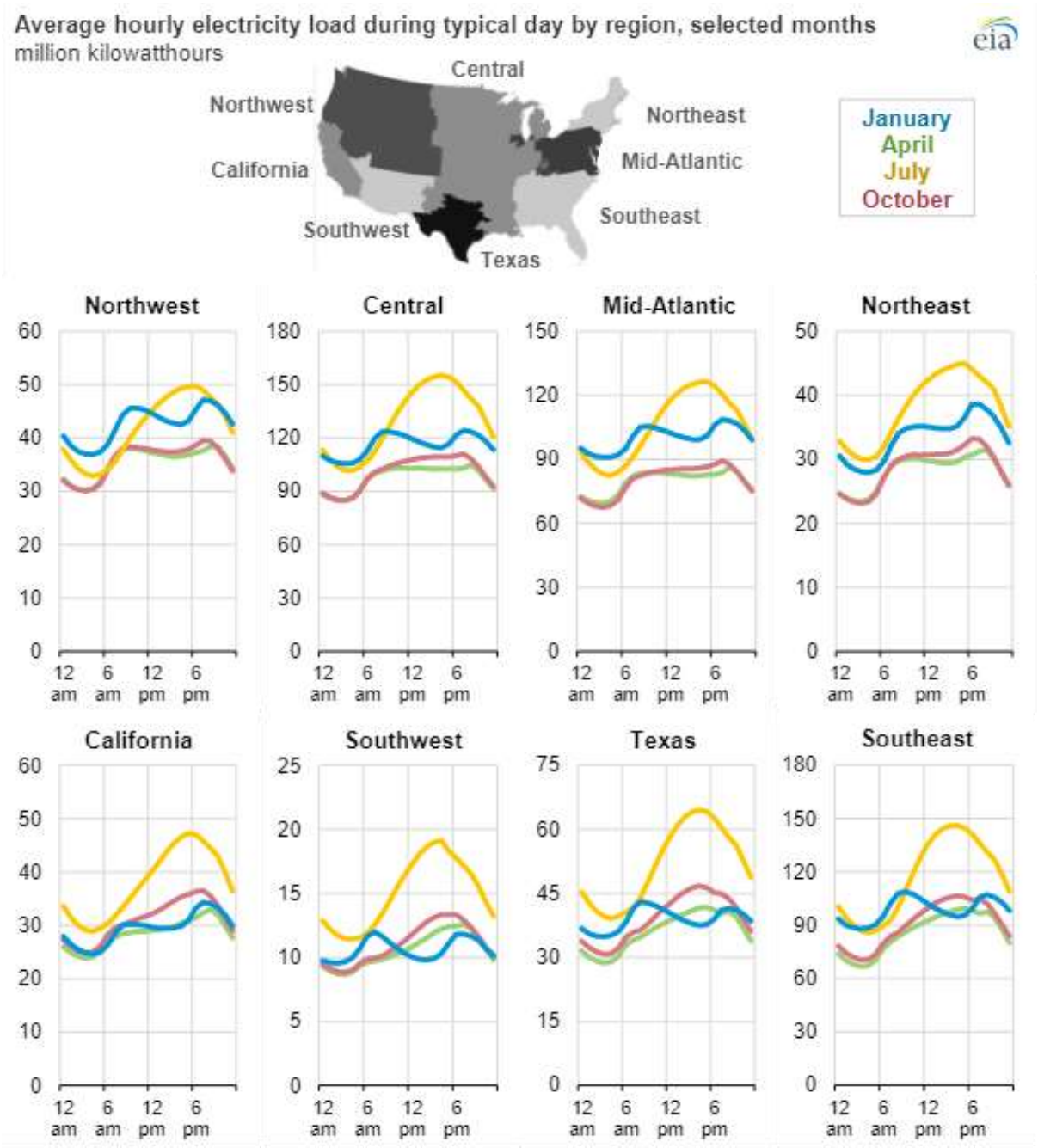



*Note: The thick lines are the global weighted average LCOE, or auction values, by year. The grey bands that vary by year are cost/price range for the 5th and 95th percentiles of projects.. For the LCOE data, the real WACC is 7.5% for OECD countries and China, and 10% for the rest of the world. The band that crosses the entire chart represents the fossil fuel-fired power generation cost range.*

Solar power has its own strengths and limitations, but is generally most attractive in end use sites and where there is lots of sunshine and a big summer air conditioning peak.

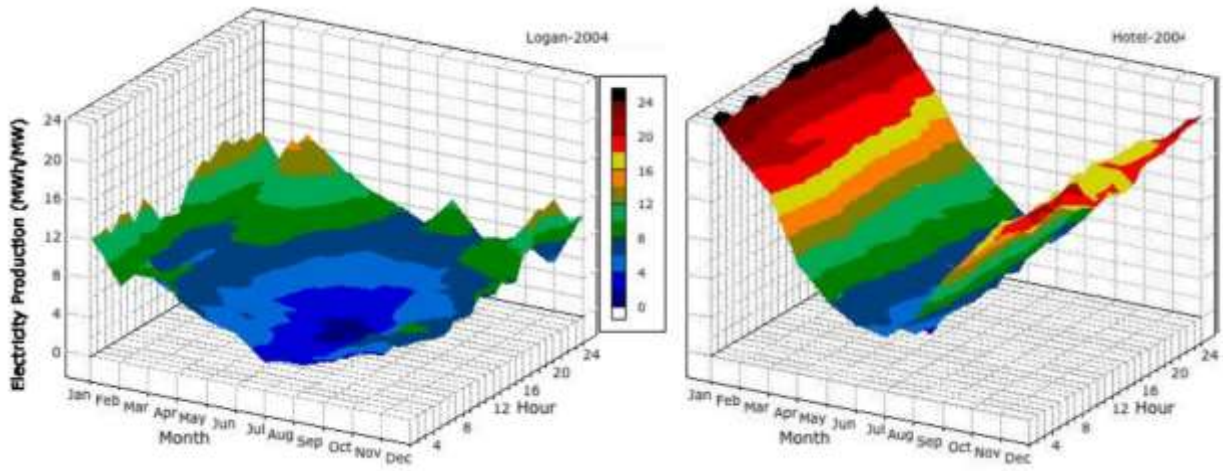
However, as one goes farther north, both summer air conditioning peaks and the productivity of solar cells decline (Figure 6). It is also difficult to site big, utility-scale solar facilities in the often hilly, wooded and densely populated northeast. Thus, on the whole it seems likely that the PV market in the northeast United States may be self-limiting, and more attractive in the Mid-Atlantic states and points south.

*Figure 6. Electricity load patterns in U.S. Regions. Source: EIA*



0ff-shore wind has its own seasonal issues. On-shore wind production in the eastern United States is lowest in June-August, and highest in November-April. On the other hand, daily variations in output appear to be much more muted (Figure 7). When wind accounts for a small fraction of total generation, these seasonal patterns can be accommodated along with other sources of variation in electric power

*Figure 7. Modeled Diurnal and Seasonal wind power generation from two hypothetical wind projects: Logan Airport, Boston, using wind data from 2004. (Source: (Berlinski & Connors, 2006)*




production and consumption. However, as large-scale off-shore wind projects come on line, prices received for wind power may decline as the winter market becomes increasingly saturated.

Storage technologies such as batteries may be useful for managing daily variations in load and the demand for dispatchable power. However, they are much less attractive for managing seasonal variations.

## Competition to Off-shore Wind from Hydro-Québec

Another potential source of low emissions power is Hydro-Québec, the giant provincial hydroelectric utility to the north. Hydro-Québec reportedly has excess hydro power to sell, and is anxious to develop markets in the United States. There are, however, several potential challenges.

It is not clear whether Hydro-Québec's interest in exporting power is based on diverting electricity from sales of ordinary kilowatt-hours into higher-value renewable kilowatt-hours or in selling unused electricity. If it is the former, then one would have to consider the economic and emissions consequences of the alternatives available to Quebec's ex-customers as well as the alternatives for the new customers.

Hydro-Québec power is generally not eligible for sale under Renewable Portfolio Standard laws, because they largely exclude output from existing large-scale hydro projects.

Power imported from Hydro-Québec does qualify under the new "Tier 4" program created to support green energy development in New York City. Following the closure of the Indian Point Nuclear Power Plant in April, the Public Service Commission recognized that "absent new transmission capacity, the

addition of new upstate renewable developments will fail on its own to increase the penetration of renewable energy consumed in New York City." On May 12, developers submitted a Tier 4 application for their "Champlain-Hudson Power Express" (CHPE) power line to add transmission capacity between Quebec and New York City. This project has been in gestation for more than a decade. The New York State Energy Research & Development Administration will release award notifications in the third quarter of 2021. Transmission of hydroelectric power falls within the scope of the Tier 4 program, so it appears likely that the CHPE will qualify under New York's Clean Energy Standards Program.

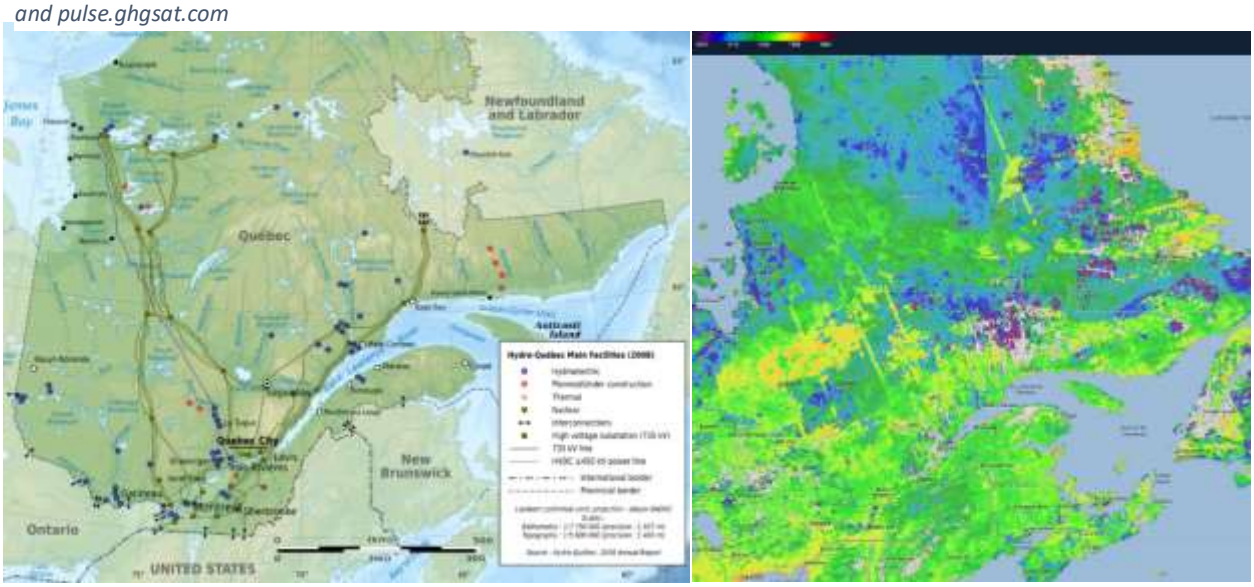
In addition to the New York project, the Appalaches–Maine Interconnection Line, a new transmission linked to the sale of 10 terawatt-hours annually to Massachusetts and Maine, was approved by the Quebec Provincial Government on April 15. This project still needs to be approved by the Canadian Federal Government, and there may be other permitting issues as well.

As the Champlain-Hudson Power Express example suggests, state governments will have to make a regulatory decision about the emissions status of Hydro-Québec power, and the extent to which it should have preferred access to U.S. electricity markets based on environmental benefits, or continue to compete against generic electricity.

Biomass flooded by reservoirs decomposes anaerobically over decades, releasing methane into the atmosphere. Hydro-Québec claims that decomposition in the cold water of Quebec reservoirs is very slow: consequently annual greenhouse gas emissions per kilowatt-hour are fifty times lower than fossil fuel plant emissions. This may be special pleading, but methane concentration imagery from the new GHGsat suggests Hydro-Québec reservoirs are not obvious large methane sources (Figure 8).

In any case, once a dam is put in service, the decomposition of any trapped biomass is not likely to be affected by changes in electric power output. The marginal change in emissions caused by operating an existing hydro plant is probably near zero.

*Figure 8. Hydro-Québec facilities, 2008, and methane concentrations over Quebec, June 6, 2020. Source: Wikimedia Commons and pulse.ghgsat.com*

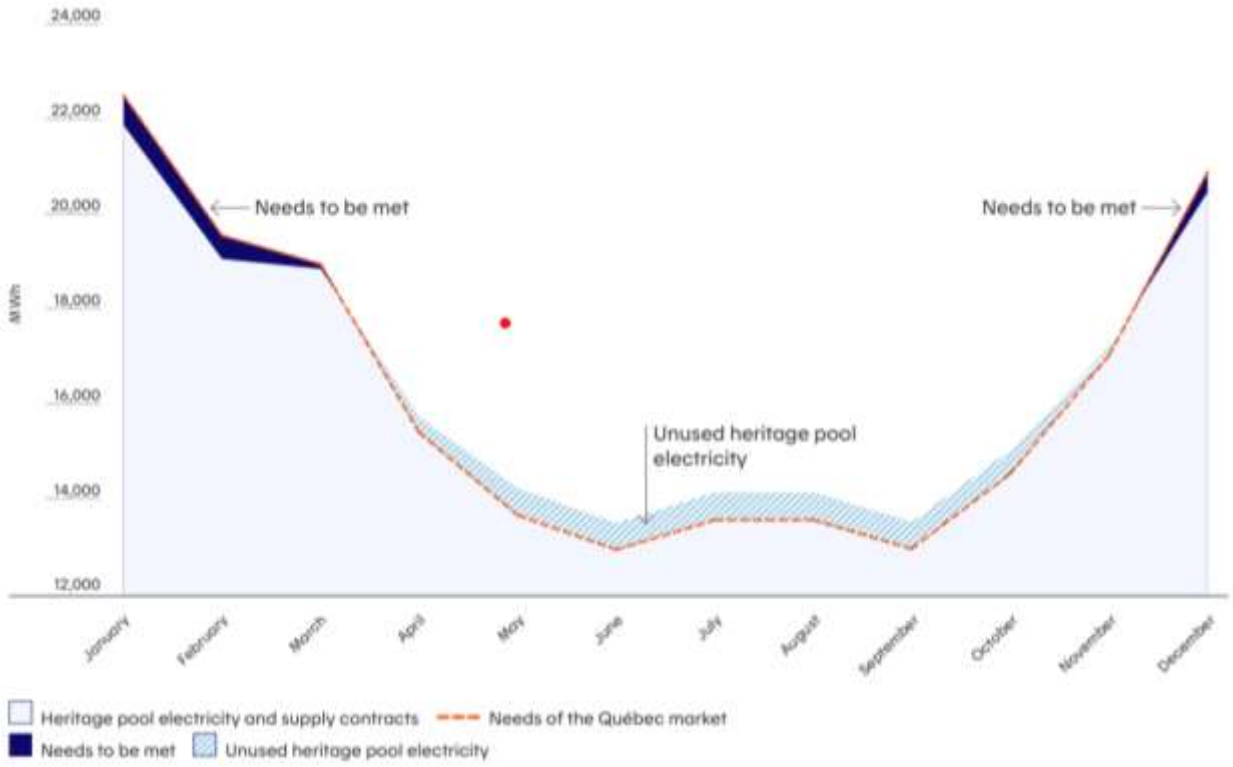


There is opposition to large-scale Canadian hydropower exports on both sides of the border. Environmental groups have diverse views. Riverkeeper and the Natural Resources Defense Council (NRDC) initially opposed the CHPE project, but in 2017 accepted it as part of a deal for closing Indian Point. Riverkeeper withdrew their support in 2019, while NRDC has been quiet, though a recent blog post suggests NRDC accepts CHDE as an element in New York State's larger clean energy policy.

Several environmental groups oppose exports on various grounds, including a cross-border coalition of First Nations, the Sierra Club, and the North American Megadam Resistance Alliance. The salience of particular issues varies by coalition member, but include: that the Hydro-Québec dams were built on stolen land for which no compensation has ever been paid; the risk that Hydro-Québec might be inspired to build more dams in the future; the environmental threat posed by users of water downstream from the dams; specific issues with building transmission lines in particular locations, such as the Penobscot River in Maine; procedural failings; and unwillingness to consult with the First Nations. The amounts of "additional" electricity that Hydro-Québec has available are unclear, as is the extent to which Hydro-Québec would add capacity if new big export markets appeared. Hydro-Québec's 2019 ten-year electricity supply plan shows a small shortfall in the late 2020s, but does not indicate any substantial planned capacity additions in the next ten years.

There is, however, one particularly interesting fact about Quebec electricity. Quebec has no summer air conditioning peak. Due to Canadian climate, public policy, and low electricity rates, Quebec has a big winter electrical heating peak, with low electricity use in the summer (Figure 9).

*Figure 9. Hydro-Québec Seasonal Pattern or Monthly Electricity Sales (Source: Hydro-Québec)*



This creates an interesting opportunity for seasonal electricity swaps, in which Quebec uses spare hydro capacity to help meet the U.S. summer air conditioning peak, while the United States uses spare wind capacity to help meet the Quebecois winter heating peak. While there are several approaches to managing daily swings in electric power use, managing seasonal fluctuations has generally required expensive and high emissions generation capacity sitting idle for much of the year.

## What Is To Be Done?

The Biden Wind Energy Initiative uses existing legal authorities and builds on current tax incentives, on-going state programs, and particularly Renewable Portfolio Standards. Given the number and scale of projects currently in the pipeline, prospects for success seem reasonably good. However, the initiative can also go off the track for essentially local causes. The Administration, however, bears responsibility for contributing several largely Federal prerequisites for success. For example, it should quickly:

- Invest political capital in trying to extend the Production Tax Credit for a few more years.

- Impress on the management of the Department of the Interior and the Bureau of Ocean Energy Management that this is a priority program, and ensure that BOEM sets and meets ambitious but achievable timetables.

- Appoint a powerful White House Tsar to chair an Intergovernmental Off-shore Wind Task Force to keep the White House informed, to coordinate and motivate the various Federal agencies with a role in permitting off-shore wind projects, and to negotiate if federal-state relations reach an impasse.

- Explore whether the creation of a new Federal Power Marketing Association specialized to facilitate the development and sale of off-shore wind energy to northeastern and mid-Atlantic state markets would help speed the development, deployment, and transmission of off-shore wind power.

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Future Issue Briefs will explore other challenges to executing the Biden off-shore wind energy generation plan in the northeastern and mid-Atlantic states, including the critical areas of:

- Technical, manufacturing, labor, and logistical capacity for large scale off-shore wind installation in northeastern and mid-Atlantic coastal waters;

- Off-shore output collection and transmission and on-shore interconnection and transmission;

- Reliance on private sector financing for the majority of equity and debt capital needed to finance 30 GW of projects.