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Impacts of North Carolina Offshore Wind Proposals

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Executive Summary

Legislation¹ passed in 2021 requires carbon dioxide (CO₂) emissions from electric generation in North Carolina be reduced 70% from 2005 levels by 2030. An estimate of 2021 emissions shows emissions have already fallen almost 55% from 76.7 million metric tons to 35 million. That means another 12 million tons of reduction. Two divisions of Duke Energy already plan to close four coal-fired power plants by 2029 that emitted about 9 million tons in 2021. Governor Roy Cooper's 2021 Executive Order² to build 2,800 megawatts (MW) of offshore wind power by 2030 off the coast of North Carolina would approximately replace the power from the closed plants. The same order sets a goal of 8,000 MW of offshore wind by 2040. Besides having questionable legal standing, the order specifying offshore wind turbines will have large negative consequences:

- Residential electric rates may rise \$180/year by 2030, and \$514/year by 2040³
- Industrial electric rates may rise \$36,000/year by 2030, and \$103,000/year by 2040³
- Annual state electric premiums of up \$1.9 billion by 2030 could cost over 23,000 jobs¹⁰
- An area about three times the size of Raleigh⁴ will be closed to commercial fishing which adds \$300 million a year to the state's economy and 5,500 jobs⁵, and may increase vessel collisions, kill endangered whales and migratory birds, and may injure marine life at the bottom of the food chain⁷
- Views of offshore wind projects threaten the \$731 million a year tourism industry in Brunswick County, NC and the associated 4,475 jobs⁶ with losses as high as \$2.9 billion over twenty years and 1,700 jobs. Studies showing negative viewshed impacts on tourism used visualizations of 579' to 600' tall turbines, but turbines now could be as tall as 1014'⁸. New York created a 20 mile exclusion zone⁷, and Brunswick County wants the same 24 nautical mile limit as the Kitty Hawk lease area
- A projected CO₂ savings of 4 to 8 metric tons a year will reduce global temperatures at most an undetectable 0.0004 degrees F⁹, at a cost of up to \$648/ton¹⁰ when carbon offsets are selling for about \$16/ton¹¹
- Actual seasonal Virginia wind generation data shows power produced when it is least needed¹²
- The first major offshore wind project at Block Island, RI has suffered issues with surfacing buried cables, and "stress lines" in the steel towers that led to shut downs indicating there may be durability issues¹³
- BOEM did not adequately address cumulative impacts of surrounding lease areas⁷. The Biden Administration just tightened the requirement to consider cumulative impacts¹⁴.

The state's forests and crop lands cover 83% of the state¹⁵ and absorb up to 54 metric tons of CO₂ every year¹⁶. Electric industry emissions have fallen almost 55% (42 million tons) compared to only 39% nationally¹⁷. The EPA declared the entire state in attainment for air quality in 2017¹⁸. This was accomplished as the real electricity price fell almost 6%²⁰. North Carolina may have other serious problems but the state of its air is not one of them.

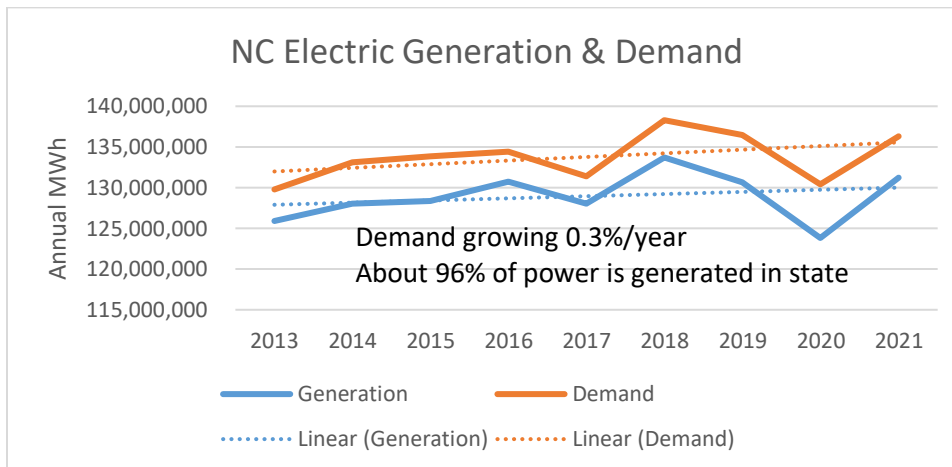
If the state government wants to continue down the path of emission reductions there are better ways to get there than offshore wind. About 65% of the emissions reductions seen since 2005 can be attributed to switching from coal to natural gas¹⁹ while saving money. The other 35% can be attributed to switching from coal to increased generation of hydroelectric, nuclear, and solar generation. The state can continue to follow this same path at no premium cost by adding more natural gas generation. For a much lower premium cost than offshore wind the goal can also be met with utility scale solar, onshore wind, and nuclear. Another alternative is to add flue gas CO₂ capture at existing coal and natural gas fueled power plants which can be done at 7% the cost premium of offshore wind, with a net cost of about \$44/ton²¹.

Background

As shown in Chart 1 below electricity demand is only growing at about a 0.3% a year rate that is expected to continue. About 96% of power is generated from in state in 2021 with 4% imported from Duke Energy power plants in South Carolina. Both states have a very low emission rate of about 0.27 tons/megawatt-hour (MWh)²².

Duke Energy Carolina, and Duke Energy Progress serve 97% of North Carolina customers. The same Duke companies serve most of South Carolina. Since peaking in 2005 North Carolina electric industry CO₂ emissions have dropped almost 55% from 76.7 million metric tons to 35 million in 2021 compared to only a 39% decrease nationally. High CO₂ coal and oil generation has been replaced by low emission natural gas, and zero emitting nuclear, hydro, and solar. The average system mix dropped from 0.59 in 2005 to an estimated 0.27 in 2021, also a 55% decline.

Chart 1



Source: US Energy Information Agency (EIA) Annual State Data

Table 1 Change in generation MWh, demand and emissions tons from 2005 to 2021

<u>Year</u>	<u>2005</u>	<u>2021</u>	<u>Change</u>	<u>% change</u>
coal	78,435,700	20,405,000	(58,030,700)	-74.0%
Petroleum	518,869	186,000	(332,869)	-64.2%
Natural Gas	3,159,377	47,116,000	43,956,623	1391.3%
Other	302,737	282,000	(20,737)	-6.8%
Nuclear	39,981,739	43,118,000	3,136,261	7.8%
Hydro	5,249,997	7,596,000	2,346,003	44.7%
Bio	98,442		(98,442)	-100.0%
Wood	1,708,706	2,134,000	425,294	24.9%
solar	-	10,373,000	10,373,000	
Wind	-	505,000	505,000	
Total Generation	129,455,567	131,210,000	1,754,433	1.4%
Demand	128,335,377	136,270,000	7,934,623	6.2%
CO2 Emissions	76,747,984	34,915,136	(41,832,848)	-54.5%
coal	74,265,341	19,343,230	(54,922,111)	-74.0%
Pet & Other Gases	997,696	152,371	(845,325)	-84.7%
NG	1,484,947	15,419,535	13,934,588	938.4%
Average System Mix Tons CO2/MWh	0.59	0.27		-55%

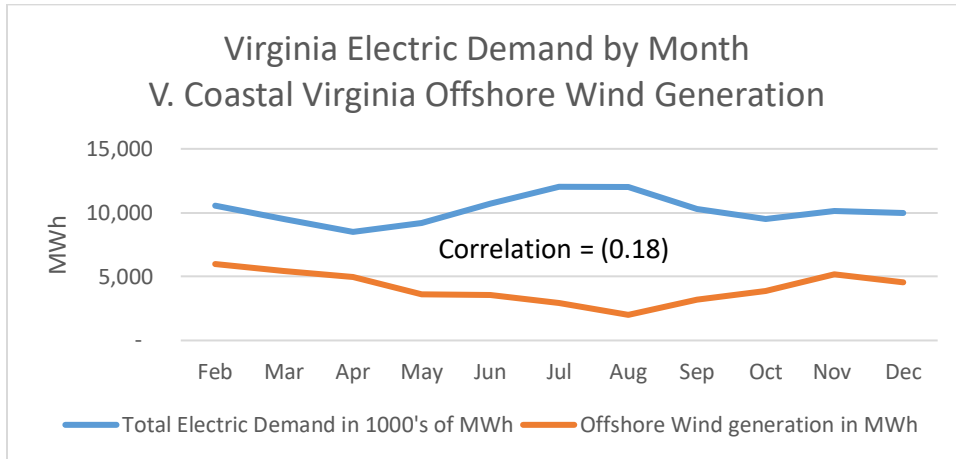
Source: US EIA Detailed State Data

Lessons learned from other offshore wind projects

Dominion Energy's Virginia Coastal Offshore Wind (VCOW) is the only project being developed by a public utility and consequently has somewhat more transparency. It has already built two 6 MW turbines that have been operating for just over one year. Generation details from the US EIA on Form 923²³ twelve month show generation totaled 51,022 MWh

with a 48.5% capacity factor. Similar data from five 6 MW turbines off Block Island, RI show an average capacity factor of 44.5% over a four year period. Chart 2 below compares monthly Virginia electric demand compared to monthly generation. The correlation between the two is (0.18) indicating a disturbing pattern of offshore wind generation occurring when it is least needed. Unfortunately, Dominion Energy will not release daily/hourly generation patterns compared to daily demand peaks to determine the correlation between generation and demand.

Chart 2



Source: US EIA Detailed State Data and Form 923 generation by Power Plant

In the sixth year of operation the Block Island project was found to have developed “stress lines” in four of the five turbine towers¹³ and generation was halted in those four turbines in June, 2021 and was still not back to full operation by December, 2021. Developer Ørsted has provided no details of the cause, seriousness, or corrective action taken with the turbines. Cables bringing power ashore were buried 6’ below the seabed and beach but came to the surface several years ago. The cost to rebury the lines up to 20’ deep was estimated to be over \$30 million and has not been completed. This first US experience suggests there may be reliability issues with offshore wind.

Dominion Energy recently increased the cost estimate to build its 2,640 MW CVOW project from \$8 billion to \$10 billion²⁴. Legislation supporting the project established a cost cap of \$125/MWh. The State Corporation Commission is currently reviewing whether the project meets this cost cap. It is not certain whether the SCC will consider the cost of needed onshore transmission construction (\$2.5 billion)²⁵, and the cost of planned battery backup (\$1 billion)²⁶. The cost estimate also depends on the forecast of future electric demand. Dominion has forecasted 20 million MWh’s of new demand from potential new Data Centers. These centers are one of the most energy intense customers for a utility and require absolute reliability. An earlier estimate by the SCC showed electric prices in Virginia would increase 60% if the Virginia Clean Economy Act was implemented²⁶. High electric rates would most likely preclude building

Data Centers in Virginia, and the higher demand forecast should not be used in the cost calculation.

Should the CVOW be rejected it is unlikely an offshore wind project off the coast of North Carolina would find support at a Virginia Utility. Kitty Hawk North developer Avangrid Renewables owns the lease area 27 miles off the northern Outer Banks. They plan to use 40% of the lease area to build an 800 MW project targeted for 2024 construction with power going ashore in Virginia Beach, VA. They have already submitted a Construction & Operations Plan²⁷ (COP) to the US Bureau of Ocean Energy Management (BOEM). BOEM has begun a required Environmental Impact Study (EIS) that will lead to a decision of whether to approve the project, or not. Avangrid is expecting to sell power to Dominion Energy with approval by the SCC. Avangrid cannot simply build the project and sell power into the regional grid on a competitive basis as the revenue would not be adequate to justify the project.

In the COP Avangrid states a plan to use 69 turbines each with 14 to 16 MW capacity. However, in the description of the turbine size they give dimensions compatible with 20 to 21 MW turbines. Also, in the Department of Energy “Offshore Wind Market Report 2021”²⁸ Kitty Hawk North is listed as having a total capacity of 1,485 MW, again compatible with 69, 21 MW turbines. What we have seen elsewhere, such as the Maryland Skipjack and Marwin projects, developers move to larger turbines as they become available. The first 20 MW turbines are being specified in Europe²⁹.

The first industrial sized project approved by BOEM was the Vineyard Wind Project off the coast of Nantucket. Five lawsuits have been filed⁷ against BOEM and other federal agencies for violating several federal laws and procedures:

- Loud installation and turbine operations threaten the critically endangered North Atlantic right whale, a violation of the Endangered Species Act. New studies found more frequent whale sightings, and more operational noise interference from larger turbines. These same whales migrate through North Carolina waters.
- Turbine blades sweep an area the size of eight football fields with blade tips whirling at up to 180 mph posing a hazard to birds in the Mid-Atlantic Flyway. Larger turbines may be used off North Carolina’s coast sweeping an area of 14 football fields, hundreds of miles of cables will bring power ashore. Acres of concrete and rocks will be placed on the seabed, to prevent scouring changing the ocean habitat risking death to marine life at the bottom of the food chain. No studies have been done to estimate potential loss of marine and avian life.
- Thousands of Chrysler Building sized turbines could occupy Vineyard Wind and six other adjoining leases covering an area the size of Rhode Island. Tourists may not return to beaches with visible turbines. A BOEM study with smaller 600 ‘ turbines determined they would “dominate” the horizon at 15 miles, and a second study showed up to 38%

of beach renters would not return if turbines were visible. BOEM ignored both studies. Instead BOEM used a tourism impact study that one of its authors has stated is not applicable for planned larger turbines. Turbine sizes may increase from 853' tall to 1014' in North Carolina.

- Experience in Europe and BOEM’s own remarks suggest commercial fisherman will abandon prime fishing grounds covered with turbines. Concerns over potential damage to fishing gear, increased vessel collisions and the higher cost of insurance are the driving factors. So is a federal government determination Coast Guard Search & Rescue operations will be compromised adding to safety concerns.
- Turbines also eliminate the ability to do estimates on the population of commercial seafood species to establish “take” limits. BOEM decided finding a new population estimate procedure would take too long. Timing on a solution was left indeterminate, if ever.
- BOEM did not adequately address cumulative impacts of surrounding lease areas. The Biden Administration just tightened the requirement to consider cumulative impacts.

Ørsted estimates 857 temporary jobs will be created during the construction of the 846 MW Skipjack 2 project recently approved by the Maryland Public Service Commission³⁰. This is very similar to the 799 temporary construction jobs projected by Avangrid for the 800 MW Kitty Hawk North Project. Since the turbines are manufactured in Europe, shipped to the US on European vessels, and installed by European experienced crews it is likely 50% to 60% of those temporary jobs will be in Europe. The Skipjack project only estimates 25 permanent jobs will be created for operation and maintenance of the project.

North Carolina Lease Areas

Excluding Kitty Hawk North there are three lease areas potentially available to meet Governor Cooper’s 8,000 MW offshore wind goal for 2040.

Table 2

Project Name	Acres	Miles To Shore	# of Turbines	Capacity with 14MW Turbines	Capacity with 21MW Turbines
Kitty Hawk South	74,296	38	107	1,498	2,247
Wilmington East	133,590	18	192	2,688	4,032
Wilmington West	51,595	12	74	1,036	1,554
Total	259,481		373	5,222	7,833

Table 3

Turbine size	Rotor Diameter Feet	Hub Height Feet	Tip Height Feet	area swept Sq. Ft.
12 MW	722	492	853	408,880
14 MW	725	446	804	412,826
16 MW	761	489	869	454,842
21 MW	935	574	1042	686,616

The Kitty Hawk lease area was moved out to 27 miles based on a request from the National Park Service as they didn't want turbines visible from Kitty Hawk National Park. The County Council of Brunswick County, NC has requested an exclusion zone of 24 nautical miles³¹ (27 statute miles), or equal to the Kitty Hawk North distance. That would exclude Wilmington West and about half of Wilmington East. That would still accommodate Governor Cooper's 2,800 MW 2030 goal when coupled with the Kitty Hawk South lease area, but not the 2040 goal.

Governor Cooper's 2,800 MW capacity target might generate 10.8 million MWh of power with a 44.5% capacity factor, or about 8% of total 2021 North Carolina electric demand. The 8,000 MW of capacity might generate 30.8 million MWh of power, or about 23% of electric demand.

Costs and Benefits

The Dominion Energy CVOW project is similar to Governor Cooper's 2030 goal for North Carolina. As mentioned earlier the CVOW project will likely require a capital investment of \$13.5 billion (\$10 billion in the lease area, \$2.5 billion for transmission upgrades, and \$1 billion for battery backup). That investment might be considered a benefit. However, we need to deduct \$3 billion of federal Investment Tax Credit that comes out of US citizen's pockets, and up to \$5 billion that will end up in Europe for turbines, shipping and installation costs. The remaining direct benefit might only be \$5.5 billion, or \$10.5 if the value likely going to Europe is included.

Direct costs are the electric premiums that will be paid every year for the next twenty years. A 2,640 MW project will generate 10.3 MWh a year at a 44.5% capacity factor. We can estimate the premium price. The US EIA provides a recent Levelized Cost of Electricity³² (LCOE) in its 2022 Annual Energy Outlook for each type of generating source. The estimate for offshore wind is \$136.51/MWh while solar is \$36.49. So the premium cost for offshore wind is \$100.02/MWh. There is an additional premium cost for adding battery storage to solar of \$16.04 and we can assume the same charge can be added to offshore wind to deal with its intermittency bringing the premium cost to \$116/MWh. The EIA estimate does not include the recent extreme material cost rise that is lifting the cost of solar, wind, and batteries by up to 25%²⁴. In addition, offshore wind is expected to add another 25% to costs for the massive increase in onshore transmission infrastructure according to the Federal Energy Regulatory

Commission²⁵. The premium cost of offshore wind could be as high as \$174/MWh. The Net Present Value cost at a 7% discount rate might range between \$12.6 to \$19 billion, so costs outweigh benefits about two to one.

Higher electric rates will reduce employment. Money spent on higher utility bills reduces the money available to spend on everything else like going to a restaurant, or the movies. The impact may be similar to any other policy that takes money out of people's pockets, such as a tax increase. A 2021 study by the Congressional Budget Office³³ showed a job might be lost for every \$76,900 increase in payroll taxes. A Beacon Hill Institute study³⁴ showed a job would be lost for each \$83,600 increase in a carbon tax. Governor Cooper's 2,800 MW goal by 2030 may therefore cost between 15,660 and 23,490 permanent jobs (10.8 million MWh X \$116 or \$174/MWh / \$80,000). The 8,000 MW target could cost 45,000 to 67,000 jobs. Additional jobs may be lost to negative impacts on tourism and commercial fishing. The temporary jobs created during offshore wind construction, and a few hundred permanent jobs needed for Operations & Maintenance pale compared to these losses.

Brunswick County faces potential lost tourism. A study by North Carolina State University³⁵ states 38% of summer renters in the Outer Banks will not return if turbines are visible. A 38% loss to the county's \$731 million a year tourism industry with the associated 4,475 jobs⁶ would have a Net Present Value of as much as \$2.9 billion over twenty years along with 1,700 lost jobs. It is important to note the study states visitors may simply move to other beaches in the Outer Banks. However, mitigation for Brunswick County would require a state petition to BOEM to cancel the Wilmington West lease area and shrink the Wilmington East lease area by about half as was done by New York state³⁶ in canceling the Fairways lease area 15 miles off the Hamptons. The state could also legislate a restriction power would not be permitted to come ashore from any wind turbine located less than 24 nautical mile from shore. The combination of the remaining Wilmington East lease area combined with Kitty Hawk South is large enough to meet Governor Cooper's 2,800 MW by 2030 goal.

Similar cost premiums could be seen using the EIA LCOE of \$40.23 for new onshore wind, and \$39.94 for natural gas. Costs can be converted into a cost/ton of each reduced ton of CO₂. Governor Cooper's 2.8 MW capacity target may cost up to \$648/metric ton saved (\$174/MWh X 10.8 million MWh generated / 2.9 million metric tons CO₂ saved). The emissions savings are calculated by multiplying the 10.8 million MWh generation times the state generation system mix of 0.27 tons/MWh, or 2.9 million metric tons. A Department of Energy study²¹ shows carbon capture from flue gas in coal fired power plants will cost about \$74/ton, and the CO₂ might be sold for \$30/ton for a net cost of \$44/ton, fifteen times less than reducing emissions with offshore wind.

Conclusion

Offshore wind is the highest cost method to generate electric power. It has high impact on the environment including endangered species, commercial fishing, navigation, and tourism for an unmeasurable reduction in global warming. Electric premiums may result in tens of thousands of job losses. Dramatic improvements have been made in reducing carbon intensity mainly by allowing markets to work with a modest level of government regulation. Following the same path in the future makes sense. An offshore wind mandate is simply the wrong choice for North Carolina.

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