BY JON SANDERS
with Mitch Rolling and Isaac Orr

BIG BLOW:

OFFSHORE WIND POWER'S DEVASTATING COSTS AND IMPACTS ON NORTH CAROLINA

locke

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Offshore Wind Power's Devastating
Costs and Impacts on North Carolina

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Executive Summary

One of President Joe Biden's day-one executive orders sought to double offshore wind by 2030, and North Carolina Governor Roy Cooper issued an executive order for developing 2.8 gigawatts (GW) of offshore wind by 2030 and 8 GW by 2040. Both Biden and Cooper justified their orders by declaring they would fight climate change, create jobs, and grow the economy.

Such an extreme, rushed government intervention in the critical energy sector makes it imperative for policymakers and the public to ask hard questions about it, which this paper seeks to do. It is indebted to the work of Mitch Rolling and Isaac Orr from the Center of the American Experiment in analyzing and estimating the cost to North Carolina's electricity consumers building and operating 8 GW of new offshore wind capacity. It also offers several areas worth further exploration.

Here in brief are some of the major findings and areas worth greater examination as highlighted in this paper:

Cost and Impacts to Electricity Consumers of Building and Operating 8 GW of Offshore Wind

- This report shows that the cost of building 8 GW of offshore wind capacity in North Carolina would range from $55.7 billion to $71.5 billion.
- By 2040 electricity rates would increase by 28 percent to 36 percent over their 2020 levels. It would result in an average cost increase of $330 to $425 per year per consumer, reaching as high as $641 and $823 per consumer in 2040.
- New offshore wind energy facilities are highly expensive sources of electricity generation to build, from $137.00 to $164.39 per megawatt-hour (MWh). In contrast, North Carolina's nuclear plants generate electricity at a small fraction of the cost: $21.71 per MWh. North Carolina's natural gas plants generate electricity for $35.83 per MWh.

CO_2 Emissions and Climate Impact

- The Bureau of Ocean Energy Management (BOEM) acknowledges that "regional climate impacts are a function of global emissions" and that "there would be no collective impact on global warming as a result of offshore wind projects."
- North Carolina occupies only 0.00027 of the surface of the Earth and therefore can make no measurable impact on the planet's climate, even if we stopped producing everything. That said, throughout the 21st century energy-based CO_2 emissions have been falling dramatically in North Carolina already.
- Even with the estimated reductions of 11.9 million metric tons of CO_2 per year, it would take *nearly 27 years* just to offset the additional CO_2 added by China in one year — not even counting the

greater emissions from all the new coal-fired electricity generation China has announced since 2020.

- No dispassionate analysis would find offshore wind to be a viable solution to energy-based CO_2 pollution in North Carolina. A focus on zero-emissions energy that favored lower costs, higher capacity factors, reliability, and dispatchability would invariably favor more nuclear generation. Focusing on lowering emissions and costs while retaining reliability and dispatchability would favor more natural gas generation.

Job Creation and Economic Growth

- North Carolina regularly ranks at or near the top in economic and business climate rankings. Years of North Carolina policymakers choosing to cut taxes and regulations, keep the state budget in line with inflation and population growth, and add to the Savings Reserve brought about dramatic improvements in the state's employment and economic growth and had the state better positioned than most other states for the economic upheaval of the Covid-19 pandemic and governmental responses to it.

- State revenue growth as a result of new economic activity has resulted in large budget surpluses *annually* since 2014-15.

- New analysis estimated that building and operating 8 GW of offshore wind energy generation off the coast of North Carolina could cost 45,000 to 67,000 jobs from electricity price hikes and their downstream effects on the economy.

- Nothing suggests North Carolina lacks the job creation and economic growth to justify such a hurried and demonstrably risky government intervention on behalf of a particular industry to the exclusion of others.

Impacts from large electricity price hikes, especially on the poor

- Electricity price increases behave like regressive tax hikes.
- The upper limit for home energy prices to be considered affordable is six percent of household income, but a significant number of North Carolina residents already spend between six to nine percent of their income on energy.
- In 2021 the poorest families in North Carolina devoted as much as 29 percent of their income to energy costs — money they could therefore not use for food, clothing, rent or mortgage, medication or medical care, savings, or other important ways to help their families.

Impacts on coastal tourism

- A 2016 survey from N.C. State found that North Carolina beach tourists are *highly sensitive to viewshed disruption by wind turbines*. A majority (54 percent) would not rent a vacation home if turbines were visible at all, and the rest would only do so with discounted rates (and 26 percent wanted completely unrealistic discounts).
- A 2015 BOEM study found that wind turbines of 577 feet tall would "dominate" the horizon within 15 nautical miles from shore. Turbines under consideration for offshore North Carolina are up to 1,042 feet tall — *80 percent taller*. By way of comparison, the tallest building in N.C. is the Bank of America Corporate Center in Charlotte at 871 feet.
- At 172 square miles, the Wilmington East wind energy area 15 nautical miles off the coast of Bald Head Island would be more than three times the size of the City of Wilmington (53 square miles).

- This problem of viewshed disruption poses potentially very large negative impacts on affected communities' tourism economies and property values. When developments similarly threatened to disfigure ridgelines and harm mountain tourism and property values by dotting North Carolina mountaintops with condominiums and hotels, legislators quickly passed the Mountain Ridge Protection Act to prevent it.

Impacts on commercial fishing, sensitive habitats, and endangered whales, fish, turtles, and birds

- 1,665 members of fishing communities in every coastal U.S. state warned BOEM about offshore wind energy's threat to their industry and marine habitats, biodiversity, and oceanography, and BOEM's decision for the Vineyard Wind project even anticipated commercial fishing would abandon those sites and lose income.

- Negative effects on many different fish and mammal populations from offshore wind facilities include population impacts and habitat disruption from site selection, construction, and operational noise. These effects could go *unobserved* even as turbines interfere with the ability to estimate commercial seafood populations for determining sustainable harvest levels.

- The oceanic waters off the coast of North Carolina are home to certain highly unique features and sensitive habitats that would suffer unknown and barely studied disruptions from offshore wind energy development.

- Offshore wind turbines would threaten the habitat and migration of several endangered whales, turtles, fish, and birds.

- Turbines are known bird killers, but while it is possible to survey and estimate how many and what kinds of birds turbines kill onshore, there is no way to count the carcasses of dead birds dropped in the ocean.

Marine vessel radar disruption and military radar interference

- Wind turbines pose a significant danger of disrupting marine vessel radar, which all ships use for navigation, including especially commercial and for-hire recreational fishing vessels. The electromagnetic reflectivity of the large metallic structures can interfere with radar systems in their vicinity, cluttering displays, creating the potential for deadly open-seas collisions, and even interfering with maritime search and rescue operations near offshore wind facilities.

- Turbine heights and radar interference also threaten to disrupt military Air Traffic Control and Fire Control radars, limit local air combat training and supersonic flights, and create a significant vulnerability around the Port of Wilmington.

The unique problem of hurricanes

- Research has estimated that nearly half the turbines in a wind farm placed in the most vulnerable areas would face destruction from hurricanes within a 20-year period.

- The waters off North Carolina are frequently revisited by hurricanes, the greatest frequencies along the Atlantic Coast rivaled only by the southern tip of Florida.

"Forever waste" from retired and damaged turbine blades

- Retired or damaged turbine blades are already a significant and growing environmental waste problem. The blades are unrecyclable and unrepurposable "forever waste" that require either hauling away to landfills or burning in kilns. Current landfill space is quickly being exhausted.

- Not only has the bulk of blade retirements not yet occurred, but adding 8 GW of offshore wind production would obviously require

large arrays of turbines and with them, the near-future, sizable increase to this already significant waste problem.

Lessons and questions from other offshore wind operations

- At the nation's first offshore wind farm, the Block Island Wind Farm off Rhode Island, stress lines in four of five turbines have already caused lengthy shutdowns. Block Island has also had an ongoing problem of undersea cables being exposed owing to the current, possibly endangering nearby underwater species and also costing electricity consumers via passthrough surcharges to pay for reconstruction.

- Damages to rotors and turbine blades can lead to "no-sail zones" forbidding all maritime traffic (including commercial fishing) around not only the affected facilities but also similar facilities elsewhere.

- Offshore wind projects can attract strident opposition in the courts from affected communities, ratepayers, interest groups, conservationists, and even environmental advocates. The Vineyard Wind project currently faces five lawsuits. Affected North Carolina communities have already signaled willingness to seek redress with the courts depending on BOEM's choices.

- Dominion Energy's Coastal Virginia Offshore Wind (CVOW) pilot project, completed in September 2020, is intended as a research project for gathering information about offshore wind facilities in the U.S., including turbine installation and operation, power output, hurricane resilience, operating and maintenance costs, supply chain issues, effects of close placement of turbines, and environmental effects. Over time it could yield important information for North Carolina policymakers.

Summary and Recommendations

For all those reasons and more, North Carolinians need their elected officials to give this issue sober consideration.

Study, watch, and wait

- The General Assembly should call for a study to give full consideration of the issues raised here, and the governor should support this good-faith effort. It would include collecting information and data on the experiences with Block Island and the CVOW pilot project, listening to coastal communities' concerns, and giving researchers time to undertake more comprehensive studies of potentially affected marine ecologies, habitats, and creatures, and making careful study of the potential impact of hurricanes.

Consider fully the tradeoffs involved and vigorously protect electricity consumers

- Policymakers should give careful consideration to the tradeoffs between energy-based emissions and energy costs as well as the tradeoffs between energy costs and people's quality of life. See if there are more optimal ways to balance those considerations. The legislature, the Public Staff of the Utilities Commission, and the courts should also vigorously defend consumer protections built into state law.

Without those steps, the proposition before North Carolina policymakers is essentially this: to jack up electricity rates on everyone, create subsequent price increases on everything because of the pervasive effect of electricity rate hikes, cause people to spend an exorbitant amount of money throughout the coming years paying for these facilities, inflict some unknown amount of harm to coastal communities' fishing and tourism, disrupt sensitive underwater habitats, kill an uncountable number of birds, disrupt vessel navigation as well as search and rescue

operations, introduce more intermittency and unreliability on electrical grids, and all to put the most expensive form of electricity generation with enormous towers and unrecyclable wind blades into the nation's most hurricane-prone waters and say it's to reduce North Carolina's climate emissions, create jobs, and grow the economy — ongoing achievements North Carolinians have already been enjoying without it.

Introduction

"With 'unparalleled opportunity' from offshore wind energy, NC aims to create jobs,"[1] announced a February 9, 2022, headline in the *News & Observer* of Raleigh. The "news" story was planted by an environmental organization in a financial "partnership" with the newspaper, part of a recent trend.[2] Notwithstanding blatant industry advocacy being recast as legitimate news, why is "North Carolina" seeking to build offshore wind energy?

In an executive order issued June 9, 2021, North Carolina Gov. Roy Cooper "ordered" that "The State of North Carolina will strive for the development of 2.8 gigawatts ("GW") of offshore wind energy resources off the coast of North Carolina by 2030 and 8 GW by 2040."[3] Cooper's leading justification for the order is that "clean energy resources create North Carolina jobs, grow our economy, and help reduce climate change pollution."[4] The scope of the order is enormous; 8 GW is the equivalent of 23 percent of North Carolina's existing capacity.

Cooper's EO followed suit from one of Pres. Joe Biden's first-day executive orders as president. As part of an order to address what Biden called

a "profound climate crisis," he ordered a "goal of doubling offshore wind by 2030."[5] In a White House fact sheet related to that order, which stated it is "[i]n particular … committed to expand opportunities for the offshore wind industry," Biden administration National Climate Advisor Gina McCarthy delivered the president's position: "President Biden believes we have an enormous opportunity in front of us to not only address the threats of climate change, but use it as a chance to create millions of good-paying, union jobs that will fuel America's economic recovery, rebuild the middle class, and make sure we bounce back from the crises we face."[6]

Both politicians issuing executive orders to bring offshore wind energy development off the coast of North Carolina therefore say they are doing so for three reasons:

1. Fight climate change
2. Create jobs
3. Grow the economy

Their hurry to establish offshore wind energy facilities in several places off the coast of North Carolina owes to a looming federal moratorium on "any leasing for purposes of exploration, development, or production," including not only for oil and gas but also for offshore wind.[7] This moratorium will take effect on July 1, 2022, and last for 10 years. The rush to establish wind is therefore based in political considerations, not market pressures.[8]

In the fall of 2021, the General Assembly passed House Bill (H.B.) 951, a "stakeholders" energy bill that put into law the governor's arbitrary goal of a 70 percent reduction in CO_2 emissions (from 2005 levels) by 2030. Among other things, the law directed the North Carolina Utilities Commission to "take all reasonable steps" to achieve this goal, and it also included some other potential electricity consumer protections, depending upon how strictly its text is followed concerning the "least cost mix"

of generating sources and the protection of consumers from being "unreasonably harmed" and "unreasonably" subject to "rate shock."[9]

Given Cooper and Biden's stated rationale for speeding along offshore wind development and the extreme step of the federal and state governments deciding to intervene so hurriedly and dramatically in the energy sector — interventions that will affect not only competing energy providers but also households, small businesses, even large industrial firms in their roles as electricity ratepayers as well as government taxpayers — it is incumbent for policymakers and the public to ask hard questions about it. They must include:

- How much would it cost North Carolina electricity consumers to build and operate 8 GW of offshore wind energy capacity?
- How would those costs impact electricity consumers, and are they worth it?
- What is happening in North Carolina regarding climate change and pollution?
- How would offshore wind energy development affect the state's contribution to carbon dioxide (CO_2) pollution?
- Inasmuch as energy-based CO_2 pollution is a problem in North Carolina, is offshore wind a viable solution?
- How is North Carolina doing regarding job creation?
- How is North Carolina doing regarding economic growth?
- How would offshore wind energy development affect job creation and economic growth in North Carolina?
- Inasmuch as job creation and economic growth are problems for North Carolina, is offshore wind energy development a viable solution?

- Are there other impacts of — or questions surrounding — offshore wind energy development worth considering, and if so, what are they?

This paper will provide an examination of those questions. It is indebted to the work of Mitch Rolling and Isaac Orr from the Center of the American Experiment in analyzing and estimating the cost to North Carolina's electricity consumers of building and operating 8 GW of new offshore wind capacity. This report will also offer several areas worth further exploration before policymakers commit to significant federal and state disruption in the energy sector and overall economy in favor of offshore wind energy development off the coast of North Carolina.

This paper will show that, despite Cooper, Biden, and others' rush to get offshore wind energy facilities built off the coast of North Carolina, the proper course of action for North Carolinians is a measured approach, studying and collecting data and experiences from the new offshore wind farms off the Eastern Seaboard, and waiting for more comprehensive research into expected impacts of the facilities, such as on coastal tourism, commercial fishing, marine habitats and creatures, endangered animals, seabirds and migratory birds, hurricanes, and more. It requires taking full consideration of the tradeoffs between energy-based emissions and energy costs as well as people's quality of life and seeking the most optimal balance.

COST OF 8 GW OF OFFSHORE WIND AND IMPACTS ON ELECTRICITY CONSUMERS

By Mitch Rolling and Isaac Orr

This analysis sought to isolate the cost of building and operating 8,000 MW of offshore wind capacity on North Carolina's current system through 2050 to assess long-term ratepayer impacts of building offshore wind facilities, which are some of the most expensive energy sources in the world.

Methodology and Assumptions

The timeframe considered in this report is 2021 (as the base year) to 2050.

This report maintains the current grid by keeping existing power plants online throughout the course of the model. Initial capacity totals were based on data provided by the U.S. Energy Information Administration's (EIA) state electricity profiles.[10] This study then adds 8,000 MW of offshore wind incrementally in the years 2026 (1,400 MW), 2030 (1,400 MW), 2034 (2,600 MW), and 2040 (2,600 MW).

Annual generation was held constant at current levels by using current 2020 capacity totals for each energy source and three-year averages for capacity factors. This method was utilized to alleviate concerns regarding 2020 data, as generation and capacity factor values for that year are likely heavily influenced by the Covid-19 pandemic and may be suboptimal indicators to use in the future. This resulted in an average annual generation total of just above 130 million megawatt-hours (MWh), consistent with historical trends.[11]

Capacity factors for new offshore wind facilities were assumed to be 43.3 percent based on assumptions for offshore wind facilities being built in Virginia by Dominion Energy.[12] This is the best available example of capacity factor estimates for offshore wind facilities located in the United States and near North Carolina.

Cost estimates for new offshore wind facilities were derived from regional EIA cost estimates in the assumptions to the Annual Energy Outlook (AEO) for the Base-Cost scenario[14] and cost estimates by Dominion Energy in Virginia for the Low-Cost scenario.[15] LCOE values for existing power facilities were obtained using Form 1 data provided by the Federal Energy Regulatory Commission (FERC).[16]

The capital structure for every scenario was 52 percent equity with a 9.9 percent return and 48 percent debt with a 4.59 percent return based on the most recent approved structure for Duke Energy Carolinas.[17] The property tax percentage utilized was 1 percent.

The Cost of Building 8 GW Offshore Wind in North Carolina

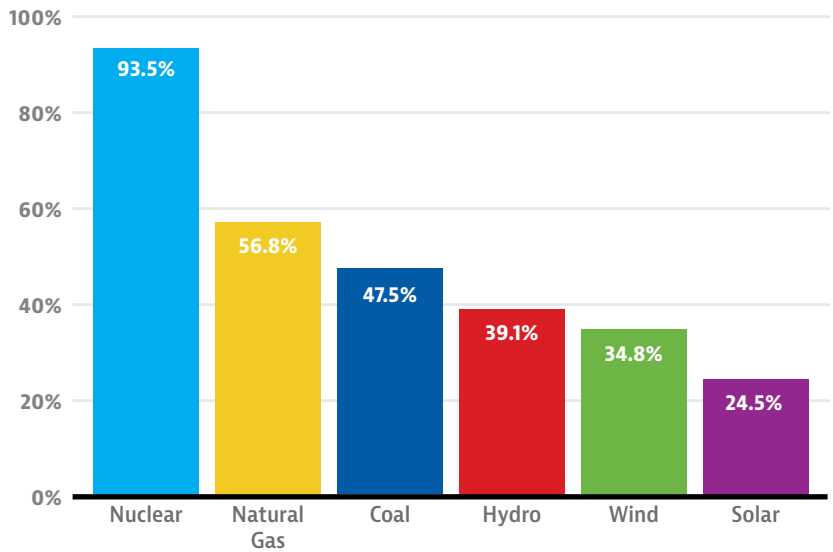
The cost of building 8,000 MW of offshore wind capacity in North Carolina is $55.7 billion in the Low-Cost scenario to $71.5 billion in the Base-Cost scenario through 2050. This would result in an average cost increase of $330 to $425 per year per North Carolina customer, respectively, peaking in the year 2040 at $641 and $823 per customer, respectively (Figure 2).

CAPACITY FACTOR

Capacity factor, as explained by the U.S. Department of Energy, is the measure of "how often a [power] plant is running at maximum power," and the statistic allows for the examination and comparison of "the reliability of various power plants." As the Energy Dept. explains, "A plant with a capacity factor of 100% means it's producing power all the time."[13]

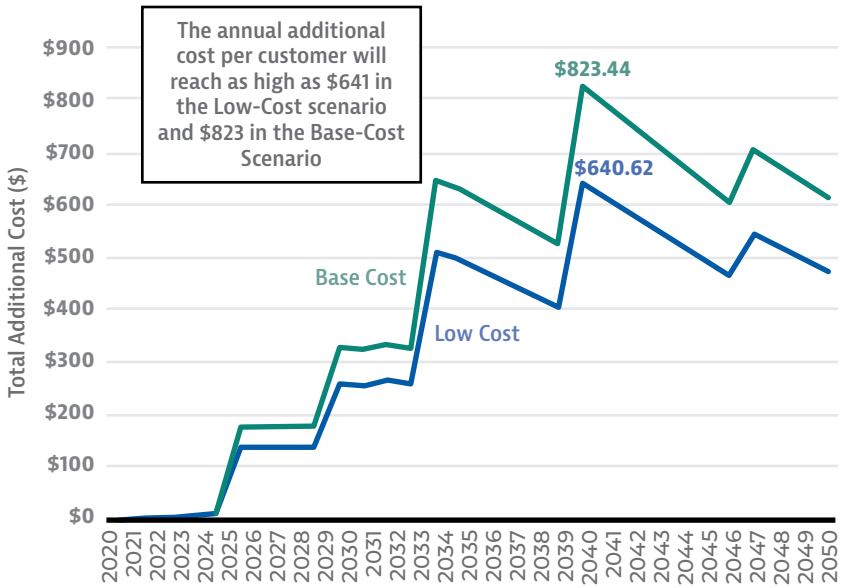
Figure 1 shows different capacity factors by source as determined by the EIA. Note that the EIA's capacity factor for wind (34.8 percent) is lower than the capacity factor assumption for offshore wind used here (43.3 percent).

Figure 1: Capacity Factors: How Often Different Power Sources Actually Run at Maximum Power, 2019



SOURCE: U.S. ENERGY INFORMATION ADMINISTRATION

Figure 2: Annual Additional Cost per Customer



SOURCE: AMERICAN EXPERIMENT

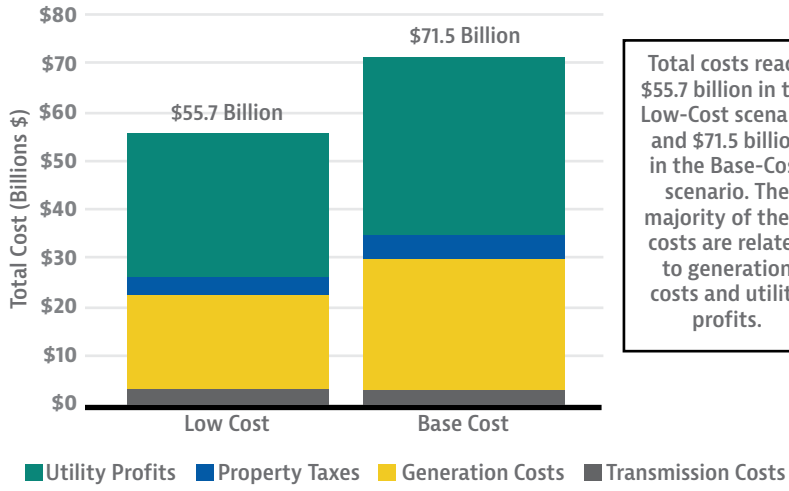
These costs are broken down by additional generation expenses, transmission expenses needed to incorporate offshore wind facilities, property tax expenses, and utility profits.

The Low-Cost scenario would cost an additional $19.4 billion in generation expenses, $3.8 billion in property tax expenses, $3.1 billion in transmission expenses, and $29.5 billion in utility returns through 2050. The Base-Cost scenario would cost an additional $27 billion in generation expenses, $4.7 billion in property tax expenses, $3.1 billion in transmission expenses, and $36.7 billion in utility returns through 2050. (Figure 3).

The amount of installed capacity on North Carolina's electricity grid would increase by 8,000 MW to 42,350 MW by 2040 (Figure 4), requiring $41 billion to $53 billion in capital expenditures in the Low-Cost and Base-Cost scenarios, respectively, to build and repower through 2050.

Under the Low-Cost scenario, electricity rates would increase as high as

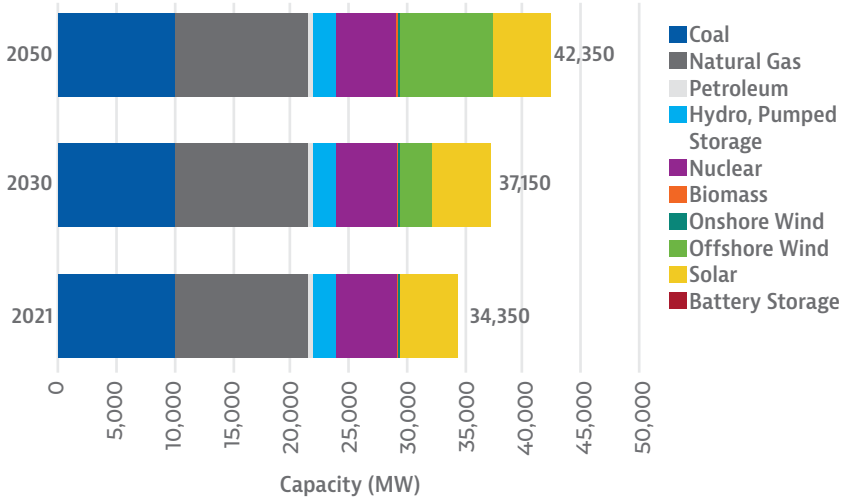
Figure 3: Total Cost Breakdown for Low- and Base-Cost Scenarios



Total costs reach $55.7 billion in the Low-Cost scenario and $71.5 billion in the Base-Cost scenario. The majority of these costs are related to generation costs and utility profits.

SOURCE: AMERICAN EXPERIMENT

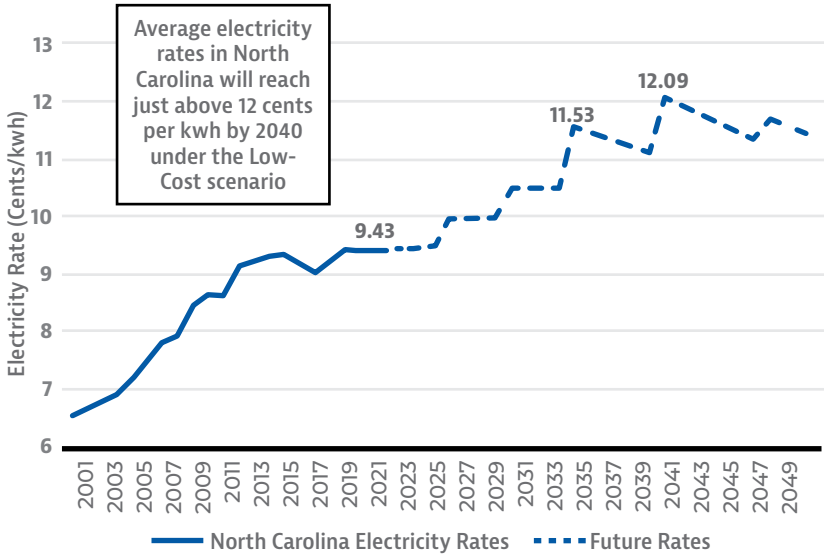
Figure 4: Installed Capacity Mix in North Carolina



North Carolina will add 8,000 MW of offshore wind capacity, which is the equivalent of 23 percent of the existing capacity on the grid.

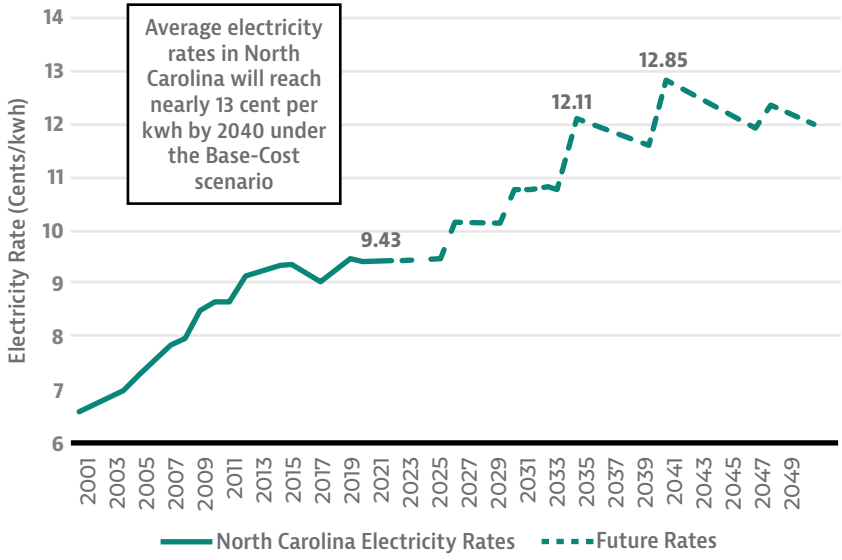
SOURCE: AMERICAN EXPERIMENT

Figure 5: Low-Cost Electricity Rates



SOURCE: AMERICAN EXPERIMENT

Figure 6: Base-Cost Electricity Rates



SOURCE: AMERICAN EXPERIMENT

28 percent compared to 2020 rates, reaching a peak of 12.09 cents/kwh in 2040 (Figure 5), while residential, commercial, and industrial rates peak at 14.59, 11.14, and 8.09 cents/kwh, respectively. In the Base-Cost scenario, electricity rates would increase by 36 percent to 12.85 cents/kwh in 2040 (Figure 6), with rate classes peaking at 15.51, 11.84, and 8.60 cents per kwh for residential, commercial, and industrial rates, respectively.

"This means that North Carolina residential customers will pay around $400 to $500 extra per year compared to current bills as a result of offshore wind additions."

The appendix to this report features detailed tables showcasing the projected annual changes in electricity rates and monthly electric bills for residential, commercial, and industrial electricity users, both historically and projected into the future for the Low-Cost and Base-Cost scenarios.

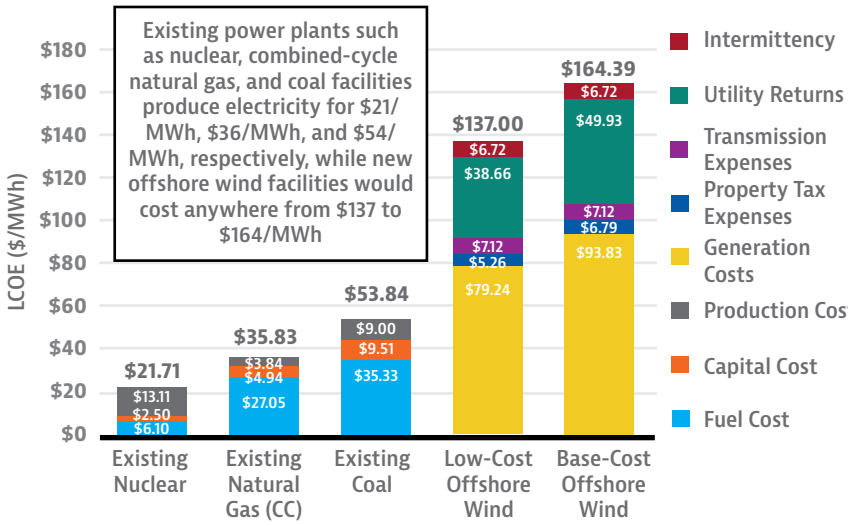
By 2040, residential bills increase to as high as $152 per month in the Low-Cost scenario and $161 per month in the Base-Cost scenario, an increase of $33 and $43 per month, respectively, from 2020 bills (Table A1). This means that North Carolina residential customers will pay around $400 to $500 extra per year compared to current bills as a result of offshore wind additions.

Commercial electric bills reach over $600 per month for both the Base-Cost and Low-Cost scenarios, peaking at $600 and $638 in 2040 (Table A2). This is an increase of $132 and $170 per month, or $1,600 to $2,000 extra every year compared to 2020 bills.

Industrial customers see bills increase as high as $17,732 and $18,847 per month in the Low-Cost and Base-Cost scenarios, respectively (Table A3). This is an increase of nearly $4,000 per month and over $5,000 per month, respectively, or $48,000 to $60,000 annually.

These cost increases are directly attributable to the buildout of offshore

Figure 7: Low-Cost Scenario LCOE: Existing Power Plants vs. New Offshore Wind



SOURCE: AMERICAN EXPERIMENT

wind, which is a much more expensive energy source than existing power plants already on the grid.

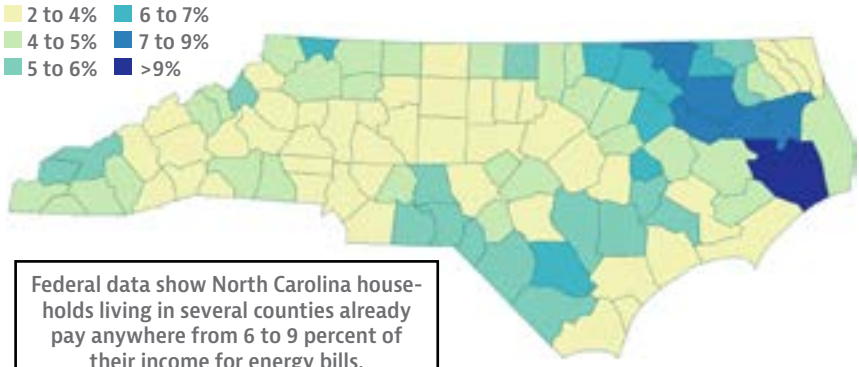
The Levelized Cost of Energy for Each Resource Type

The cost of offshore wind facilities is $137.00 per MWh (Low-Cost scenario) and $164.39 per MWh (Base-Cost scenario) after accounting for the often-hidden costs of property taxes, transmission expenses, utility returns, and intermittency.[18]

Data from the Federal Energy Regulatory Commission (FERC) show North Carolina's nuclear plants are some of the lowest-cost sources of electricity in the state, generating electricity for $21.71 per MWh. North Carolina's natural gas plants generated electricity for $35.83 per MWh, and coal plants in the state generated electricity for $53.84 per MWh, on average. (Figure 7).

The cost of intermittency was calculated by assessing the decrease in

Figure 8: Average Energy Burden (% Income)



SOURCE: LOW-INCOME ENERGY AFFORDABILITY DATA TOOL MAP EXPORT (HTTPS://LEAD.OPENEI.ORG)

thermal generation and the resulting increase in fixed costs per MWh for these energy sources. Fixed costs are required no matter how much electricity is generated and thus do not decrease with lower generation levels. Because thermal generators are forced to ramp down to make room for offshore wind generation, this model attributes the fixed costs that are no longer able to be recovered from thermal generators to the total generation of offshore wind facilities to come up with a levelized cost of intermittency value.

High Energy Costs Harm North Carolina Families and the Economy

Building 8,000 MW of offshore wind capacity will result in an additional cost per customer as high as $641 to $823 by 2040. Low-income households will be hurt most by rising electricity costs because they spend a higher percentage of their income on energy bills than other North Carolina households.

Data from the U.S. Department of Energy's Low-Income Energy Assistance Data (LEAD) program show a significant number of North Carolina residents already spend between 6 and 9 percent of their income on energy (Figure 8).[19]

By increasing energy costs on North Carolina consumers, offshore wind

facilities will increase the cost of essential services such as keeping food and medicine refrigerated, air conditioning, and home heating. As a result, incorporating offshore wind facilities onto North Carolina's electrical grid is incredibly regressive because those with the least will lose the most.

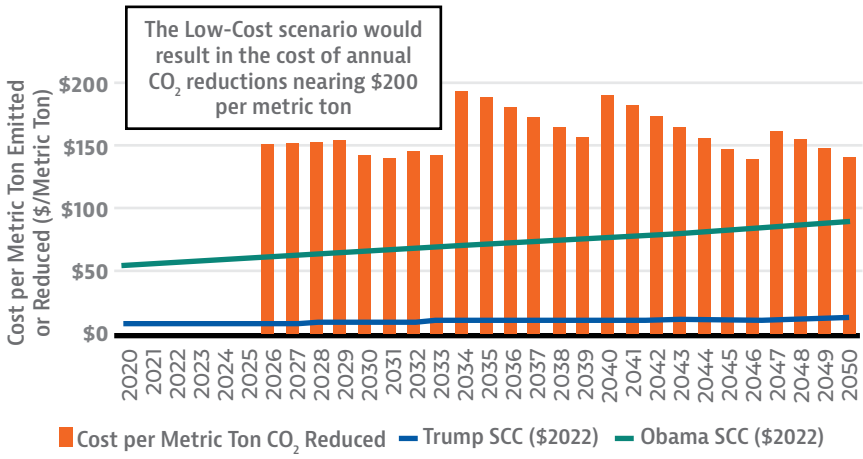
"By increasing energy costs on North Carolina consumers, offshore wind facilities will increase the cost of essential services such as keeping food and medicine refrigerated, air conditioning, and home heating."

Emissions Reductions

North Carolina would see total CO_2 emissions reductions estimated at 345 million metric tons compared to 2020 levels. This would be an average CO_2 emissions reduction of 11.9 million metric tons per year through 2050. The average cost of reducing CO_2 emissions would be $162 per metric ton reduced through 2050 in the Low-Cost scenario and $207 per metric ton reduced in the Base-Cost scenario. These costs would be so high, they would even outstrip the cost estimates under the questionable "Social Cost of Carbon" (SCC) approach of monetizing the costs of CO_2 emissions according to the differing SCC values estimated by both the Obama and Trump administrations.[20] In fact, the cost of CO_2 reductions resulting from building offshore wind facilities exceeds SCC estimates from both administrations every single year (Figures 9 and 10).

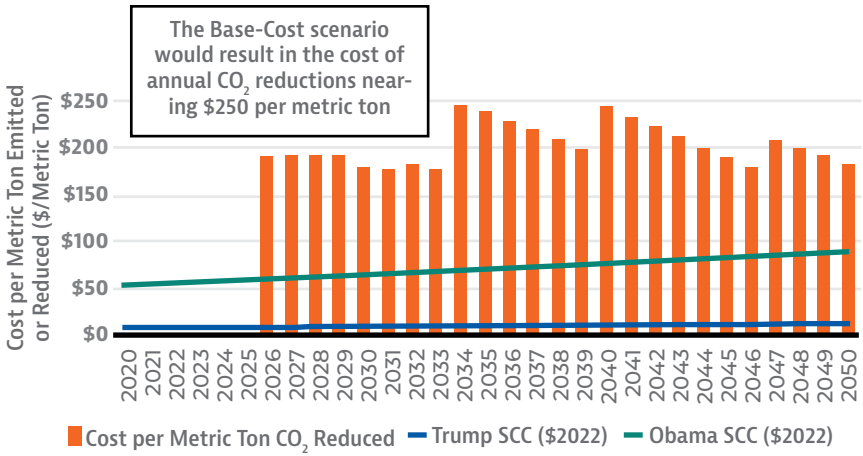
In 2034, the cost per metric ton of CO_2 reduced is $194 for the Low-Cost scenario and $246 for the Base-Cost scenario. Those are 178 percent and 254 percent more expensive than Obama's SCC ($70), respectively, and 1,835 percent and 2,364 percent more expensive than Trump's SCC ($10), respectively.

Figure 9: Low-Cost Scenario: Trump and Obama Social Cost of Carbon ($2022) vs. Cost of Reducing CO_2 Emissions ($/Metric Ton)



SOURCE: AMERICAN EXPERIMENT

Figure 10: Base-Cost Scenario: Trump and Obama Social Cost of Carbon ($2022) vs. Cost of Reducing CO_2 Emissions ($/Metric Ton)



SOURCE: AMERICAN EXPERIMENT

EMISSIONS AND CLIMATE IMPACT

Before embarking upon any governmental-directed reordering of productive resources, labor, and capital in North Carolina for the express purpose of reducing greenhouse gas emissions (GHGs) here on the expectation of "reducing climate change,"[21] it would be instructive to consider practical reality. How much *climate change reduction* can North Carolinians expect from such choices and costs forced upon them?

The State of North Carolina comprises 53,819 square miles on the surface of a planet encompassing 196.9 million square miles. In other words, North Carolina occupies an area that amounts to about 27 one-hundred-thousandths (0.00027) of the surface of the Earth. By implication, even if we ceased all productive activity and emissions in North Carolina, we could make no measurable impact on the planet's climate. All of North Carolina could disappear like the Lost Colony, and the global climate wouldn't change.

Concerning the Vineyard Wind offshore wind project proposed off the coast of Martha's Vineyard, Massachusetts, the Bureau of Ocean Energy

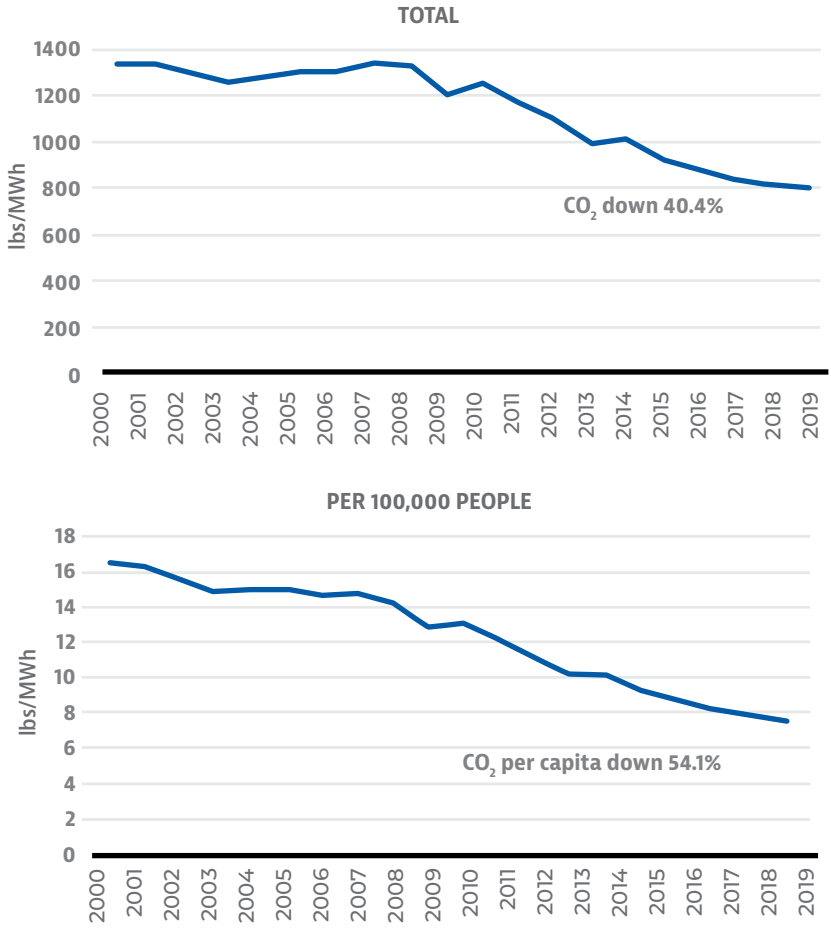
Management (BOEM) acknowledged that "GHG emissions spread out and mix within the troposphere," meaning that "the climatic impact of GHG emissions does not depend on the source location. Therefore, *regional climatic impacts are a function of global emissions*"[22] (emphasis added). BOEM's acknowledgment was to downplay expected emissions from the project and other offshore wind projects — "Development of offshore wind projects and the construction, implementation, operation, maintenance, and the eventual decommissioning activities would cause some GHG emissions increases primarily through emissions of CO_2."[23]

Nevertheless, BOEM noted, "Overall, it is anticipated that there would be *no collective impact on global warming as a result of offshore wind projects*" (emphasis added).[24]

Also, despite popular belief encouraged through political repetition and incurious (or paid partnership) reporting, it is *not* the case that CO_2 emissions in North Carolina have been getting worse. Far from it. Throughout the 21st century, CO_2 emissions from electricity generation in North Carolina have been falling dramatically (as has other GHGs). Just since 2000, CO_2 emissions from electricity generation in North Carolina had fallen 40.4% by 2019 (Figure 11). Since this decline coincided with rapid population growth, it means that CO_2 emissions per capita had fallen by 54.1%.[25]

Furthermore, it is also not the case that North Carolina's reductions in CO_2 emissions are being matched around the world. Rather, the opposite is in place. According to the BP *Statistical Review of World Energy*, between 2006 (when the index began tracking CO_2 emissions) and 2019,[26] the United States had eliminated far more CO_2 emissions than any other nation, reducing its CO_2 emissions by 1,064.5 million tons (Figure 12). Meanwhile, China's CO_2 emissions increased by 3,164.2 million tons, almost triple the amount cut by the U.S. By implication, North Carolina's gains in reducing emissions — a commensurate part of the U.S.'s overall emissions reductions — are being quickly wiped out by China's emissions increases.[27] Notably, China continues to build new, high-emissions coal-fired power plants, suggesting their rate of increase in CO_2 and other GHG emissions will not decline but even accelerate in the coming

Figure 11: Carbon Dioxide Emissions from Electricity Generation in North Carolina, 2000-19

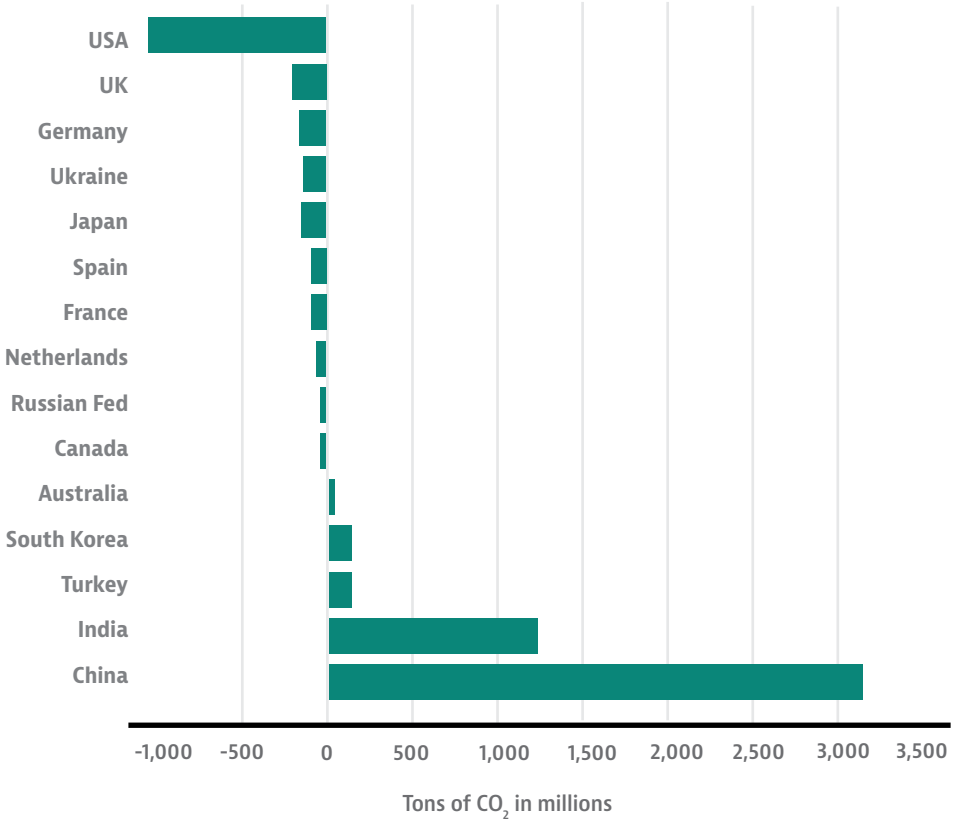


SOURCE: U.S. ENERGY INFORMATION ADMINISTRATION

years. A briefing from the Centre for Research on Energy and Clean Air in August 2021 reported that in just the first half of 2021, China had announced 43 new coal-fired power plants and 18 new blast furnace projects, which combined would emit an estimated 150 million tons of CO_2 per year.[28] Those are in addition to the 38.4 GW of new coal-fired electricity China added in 2020[29].

A sharp, steady fall in CO_2 emissions owing to market choices has been a

Figure 12: Reduction or Increase in CO_2 Emissions, Select Nations, 2006-19



SOURCE: BP STATISTICAL REVIEW OF WORLD ENERGY, 2017 AND 2020 EDITIONS

feature in North Carolina throughout this century.[30] Falling emissions are already occurring without any edicts by politicians and cannot be credited to executive orders. The reality is that any additional emissions reductions in North Carolina (i.e., beyond what would already happen) that could be achieved by *government orders* would be erased by Chinese emissions increases in very short order, to say nothing of increases in India, Turkey, and elsewhere. This report estimates that adding 8 GW of new offshore wind would result in a reduction of 11.9 million metric tons of CO_2 per year; at that rate it would take *nearly 27 years* just to offset the

"Offshore wind energy is one of the most expensive sources of 'clean' energy possible. It is also inefficient and intermittent."

additional CO_2 added by China in the year 2019 above its output the previous year.[31] Meanwhile, of course, China (and many other nations) will still be adding more CO_2.

Within the borders of North Carolina, concerning the expected reductions of CO_2 emissions from electricity generation by installing 8 GW of offshore wind, it will be imperative that the new offshore wind production not displace any nuclear generation. The simple, inescapable fact of the matter is, *there is no way to replace nuclear generation with energy generated from any other source without increasing emissions — or costs to consumers.*[32]

Absent the political push for offshore wind, would a dispassionate analysis find offshore wind to be the solution to energy-based CO_2 pollution in North Carolina?

The answer would have to be negative even before considering other aspects of offshore wind energy. Those include not only offshore wind's net impact on jobs and economic growth, but also offshore wind's many other impacts and open questions. Offshore wind energy is one of the most expensive sources of "clean" energy possible. It is also inefficient and intermittent. A focus on zero-emissions energy that favored lower costs, higher capacity factors, reliability, and dispatchability would invariably favor more nuclear generation. Focusing on lowering emissions and costs while retaining reliability and dispatchability would favor more natural gas generation.[33]

JOB CREATION AND ECONOMIC GROWTH

The other two major justifications by Cooper and Biden for ordering offshore wind energy development off the coast of North Carolina are economic: job creation and economic growth. As already demonstrated, government intervention for offshore wind energy development portends significantly higher costs to North Carolinians as electricity customers, from small families to large industrial users. It also will result in rearranging productive resources, capital, and labor here to other uses. Those facts represent steep economic tradeoffs, which are not immediately suggestive of overall large economic gains and could in fact signify large net economic losses.

All of the above should prompt policymakers to ask if North Carolina is sufficiently lacking in job creation and economic growth so as to justify such a hurried and demonstrably risky government intervention on behalf of a particular industry to the exclusion of others. How does North Carolina stand with respect to job creation and economic growth?

Years of North Carolina policymakers choosing to cut taxes and regulations, keep the state budget in line with inflation and population growth,

and add to the Savings Reserve (the state's emergency "rainy day" fund) brought about dramatic improvements in the state's employment and economic growth and also had the state better positioned than most other states for the economic upheaval of the Covid-19 pandemic and governmental responses to it. As tax and fiscal policy expert Joseph Coletti explained,

> From the bottom of the recession in 2009 through 2013, North Carolina's economy grew at half the rate of the nation as a whole (1.0 percent average annual real GDP growth in NC vs. 2.1 percent nationally). Spending restraint and tax reforms have brought the state (2.3 percent) closer to the national average (2.5 percent). From 2009 through 2013, private-sector employment grew an average 1.3 percent per year in North Carolina and nationally. From 2013 to 2019, however, North Carolina has outpaced the national average of 1.9 percent growth with 2.4 percent annual job growth.
>
> North Carolina also has attracted more residents from other states, ranking sixth on this measure in 2020.[34]

While there is always room for more growth, the simple fact is there is nothing so alarming in North Carolina's recent job creation and economic growth numbers to justify extraordinary government intervention on behalf of *any* particular industry, let alone offshore wind energy. North Carolina's policymakers have for over a decade now actively pursued time-tested *economic growth policies*, and North Carolinians have enjoyed accelerated economic growth as a result. Economic growth policies include such things as "across-the-board tax cuts for individuals and businesses, the elimination of the double taxation of saving and investment, and a reduction or amelioration of the regulatory burden on all businesses, small and large."[35] Those policies promote faster job creation and economic growth by removing government impediments to job creators and risk-taking entrepreneurs and also by expanding the purchasing power of individuals, households, and businesses. They stand in stark contrast to government "economic development" policies

"The fact that politicians, not private market participants, are driving this development is reason enough to doubt offshore wind is a true economic panacea."

featuring policy interventions and incentives favoring one industry or corporation over others.

North Carolina now regularly ranks at or near the top in economic and business climate rankings. Most recently, North Carolina ranked second in the nation in the American Legislative Exchange Council's state "Economic Outlook" rankings released April 2022.[36] The state has also ranked first overall in Forbes' "Best State for Business" rankings[37] and second in CNBC's "America's Top State for Business" rankings.[38] Furthermore, in outcomes consistent with pursuing economic growth policies, state revenue growth as a result of all this new economic activity has resulted in large budget surpluses annually since 2014-15.[39]

Nevertheless, if the thought is that North Carolina is lacking in sufficient job creation and economic growth, does offshore wind energy development provide the solution? Answering this question means going beyond the standard government/industry analysis focused solely on the facilities brought about by government actions and incentives as well as private investments. It requires consideration of the opportunity cost of the unseen alternate uses of those resources (productive resources, capital, and labor) as well as economic impacts from interconnecting 8 GW of intermittent offshore wind capacity to the grid for use by consumers who have no say over where their electricity derives from and how much their electricity costs. The fact that politicians, not private market participants, are driving this development is reason enough to doubt offshore wind is a true economic panacea.

A more relevant question is if offshore wind energy development would cost North Carolina jobs. Analysis of Cooper's wind proposal by David T.

Stevenson, director of the Caesar Rodney Institute's Center for Energy & Environment, estimated that building and operating 8 GW of offshore wind energy generation off the coast of North Carolina could — based on the necessary electricity price hikes and their downstream effects on the economy — "cost 45,000 to 67,000 jobs," even before accounting for "negative impacts on tourism and commercial fishing."[40]

Negative Economic Impacts From Large Electricity Price Hikes

This paper has already demonstrated significant electricity cost increases will be necessary to incorporate 8 GW of offshore wind generation onto the grid. Those cost hikes are estimated to be $152 to $161 per month for residential customers, $132 to $170 per month for commercial electricity customers, and nearly $4,000 to over $5,000 per month for industrial customers.

Given that electricity is a factor in the production of virtually every good and service provided across the economy, changes to electricity rates resound through the economy much the same way as do changes to tax rates. Higher rates depress economic growth and reduce people's purchasing power, while lower rates increase economic growth and expand purchasing power. Electricity is a basic need. Having to spend more money on a basic need means having less to spend on other needs and wants.

The disparate effects of this higher-priced electricity would fall especially on the poor. Because electricity is a basic human need, not a luxury item, energy poverty is a serious threat to health and incomes of the poor across America. The upper bound for home energy affordability set by the Home Energy Affordability Gap project is at six percent of household income.[41] As previously discussed, a significant number of North Carolina residents devote six to nine percent of household income to electricity currently; i.e., before their bills would reflect steep increases from incorporating highly expensive offshore wind production. Writers from *The Atlantic*[42] to *The Wall Street Journal*[43] have specifically cited North Carolina as a place where low-income families spend more than

"In 2021 the poorest families in North Carolina devoted as much as 29 percent of their income to energy costs – money they could therefore not use for food, clothing, rent or mortgage, medication or medical care, savings, or other important ways to help their families."

20 percent of their household income on energy costs. In 2021 the poorest families in North Carolina devoted as much as 29 percent of their income to energy costs[44] — money they could therefore not use for food, clothing, rent or mortgage, medication or medical care, savings, or other important ways to help their families. Causing electricity prices to rise even further would reduce people's purchasing power all the more, leaving the poor with comparably less to pay for life's other needs.

The problem expands beyond energy needs being somewhat constant despite incomes varying dramatically. Poor families tend to live in less energy-efficient housing, have older, less efficient appliances, and are less able to take advantage of programs to meet government goals of boosting renewable sources of energy (e.g., not only can poor families often not be able to take advantage of net metering and rooftop solar programs, but also they must shoulder the costs of such programs along with other non-participating ratepayers).[45] California, the state with the most aggressive approach to integrating renewable resources onto its grid, has the nation's highest poverty rate, and research finds rising electricity prices there to be a contributing and growing factor "disproportionately impact[ing] lower- and middle-income families who lack the disposable income to absorb the extra costs."[46]

Energy poverty is not an academic exercise; it can actually be dangerous. The burden of energy poverty is not stable across the four seasons; instead, it is at its worst during temperature extremes. So too are blackouts.

One in Five Households are Foregoing Food and Medicine to Pay for Energy

SOURCE: U.S. ENERGY INFORMATION ADMINISTRATION, SEPTEMBER 19, 2018

Families having to economize on heating and cooling bills during temperature extremes place themselves in greater danger (beyond the obvious); researchers cite "higher risk of respiratory problems, heart disease, arthritis, and rheumatism" as well as risks of carbon monoxide poisoning and other adverse outcomes from seeking alternative sources of relief.[47] The U.S. Energy Information Administration in 2018 found that "Nearly one-third of U.S. households (31%) reported facing a challenge in paying energy bills or sustaining adequate heating and cooling in their homes." Worse, the EIA found that "about one in five households reported reducing or forgoing necessities *such as food and medicine* to pay an energy bill" (emphasis added).[48] A retiree in North Carolina struggling to heat his 1,000-square-foot apartment put it this way to a local reporter about his daily choice: "Do I stay warm or eat?"[49]

A March 2019 Working Paper published by the National Bureau of Economic Research (NBER) found that higher heating bills in the winter increased exposure to cold and mortality risk and depressed spending

on items needed for good health, while "a lower heating price reduces winter mortality, driven mostly by cardiovascular and respiratory causes."[50] An October 2019 NBER Working Paper found that higher electricity prices in Japan following nuclear plant closures in the wake of the Fukushima Daiichi nuclear accident resulted in higher electricity prices that reduced consumption and "caused an increase in mortality during very cold temperatures" — and worse, that "the increase in mortality from higher electricity prices outnumbers the mortality from the accident itself."[51]

Along with adverse outcomes from higher electricity prices, incorporating offshore wind energy into the grid would increase unreliability into the system, bringing a higher risk of California-style blackouts — which again would be prone to occur not on pleasant days but during extreme weather events. (See sidebar on capacity factors above.) A key factor identified in the "Root Cause Analysis" of the blackouts from the California Independent System Operator, the California Public Utilities Commission, and the California Energy Commission was "2. In transitioning to 'clean' energy, the State's dispatchable generating capacity had 'not kept pace' with the state's needs."[52]

Expanding and deepening energy poverty for poor North Carolinians is a hefty tradeoff for politicians boosting one particular industry. North Carolina's law governing electricity utility service was crafted by policymakers with a fuller appreciation of the importance and life-giving properties of access to affordable, reliable electricity. Consider that by the mid-1930s only three percent of North Carolina farms were electrified, and many did not receive electricity until the 1950s.[53] In the Public Utilities law, state lawmakers recognized that "the rates, services and operations of public utilities … are affected with the public interest and that the availability of an adequate and reliable supply of electric power and natural gas to the people, economy and government of North Carolina is a matter of public policy."[54] With all that being the case, the law seeks to "promote adequate, reliable and economical utility service to all of the citizens and residents"[55] — and this standard of least-cost, reliable electricity at the flip of the switch has become people's intrinsic expectation.

Any disruption of this expectation will have negative implications for people and for the economy.

Impacts On The Coastal Economy: Tourism

Large wind facilities a few miles off the coast threatens disruption of two major drivers of the coastal economy: tourism and fishing. While government/industry reports downplay the potential of those impacts, the communities themselves view them with alarm. On May 21, 2021, the village council of Bald Head Island passed a resolution urging the U.S. Board of Ocean Energy Management (BOEM) to exclude from wind energy development locations within 24 nautical miles of the island, including especially areas in the proposed Wilmington East wind energy area (WEA) and also the Wilmington West WEA, which would be 15 and 10 nautical miles offshore respectively. The resolution also pledged solidarity with other communities that would be affected by wind energy development within their viewshed and stated commitment to challenge BOEM on any leases within this Visual Impact Exclusion Area.[56]

Bald Head Island councilors warned that "the natural coastal beauty of our viewshed is an essential driver of our economy," said that "wind turbines located within the Bald Head Island viewshed would transform our community's natural and historic vista of open ocean to a view of massive industrial machinery," and warned that "such a change would represent for us the most destructive commitment of ocean resources that we have ever heard proposed in North Carolina — one that could irreversibly damage the natural environment and resources that we cherish and that drive our economy." They stated that "we are deeply committed to and will fight for protection of our viewshed."[57] Several other affected beach communities passed similar resolutions, including Sunset Beach, Ocean Isle Beach, Caswell Beach, and Oak Island, followed also by the Brunswick County Commission on August 2, 2021.[58]

The resolutions were made with the understanding that the original Kitty Hawk WEA would have come within six nautical miles, but BOEM agreed to move the leasing area back to 24 nautical miles upon

objections from, among others, the National Parks Service, the Coast Guard, and the Town of Kitty Hawk.[59] BOEM had also granted a buffer of at least 24 nautical miles for the State of Virginia and 33.7 nautical miles for the protection of the Bodie Island Lighthouse, the same protection sought for Old Baldy, the Bald Head Island Lighthouse.[60]

Such concerns are not unique to offshore wind but also apply to offshore oil and natural gas rigs as well. Regarding the latter, Gov. Roy Cooper wrote to Pres. Donald Trump requesting that North Carolina's coast be added to his offshore energy moratorium. In that letter, Cooper noted:

> North Carolina's coastal tourism generates $3 billion annually and supports more than 30,000 jobs, as people from all over come to enjoy our beaches, restaurants, and recreational fishing. Commercial fishing brings in another $95 million to our economy each year. North Carolina's 300 miles of coastline, 2.3 million acres of estuarine waters, and over 10,000 miles of estuarine shoreline are important assets which contribute to a robust state and national economy, and we cannot afford to endanger them.[61]

In less than a year, however, Cooper appeared to have shed those concerns about coastal tourism and commercial fishing by dint of his ordering 8 GW of offshore wind energy development. Nevertheless, a 2016 survey from the Center for Environmental and Resource Economic Policy of North Carolina State University found that North Carolina beach tourists *are highly sensitive to viewshed disruption by wind turbines*. The 484 survey participants had all recently rented beach vacation homes in North Carolina in areas under consideration for offshore wind energy development. An *NC State News* release describes the survey design:

> In the survey, study participants were asked to consider renting the same vacation house they had just rented, but with one change: the view would include wind turbines off the coast.
>
> Participants were shown various sets of photographs. Two

> control photographs were of a view from the beach looking over the ocean – one taken at night, one during the day. The same photos were then altered to include up to 144 wind turbines at 5, 8, 12 or 18 miles offshore. Some participants were told they would get a discount on their rental price if wind turbines were present; some were told they would pay more; and some were told there would be no change in rental cost. Discounts went as high as 25 percent off the original rental price.[62]

"Spoil the view, and you'll send the tourists elsewhere."

The study found that a majority — 54 percent — "said they would not rent a vacation home if turbines were in view at all, no matter how large a discount was offered on the rental price." The rest were willing to make tradeoffs with their oceanic views for discounted rates. A minority (20 percent) was willing to accept a slight discount averaging about 5 percent, and only if turbines were eight nautical miles offshore. The remaining 26 percent wanted discounts if the turbines were 12 nautical miles offshore, but "the discounts they needed if turbines were closer than 12 miles were so high as to be completely unrealistic."[63] Turbine heights studied were over 500 feet tall.

Similarly, a 2015 BOEM study found that wind turbines of 577 feet tall would "dominate" the horizon within 15 nautical miles from shore.[64]

The survey results reinforce the plain understanding of beach tourism: people come for a view of unspoiled ocean, contemplation and enjoyment of the clear blue horizon, the eternal line where sea touches sky evincing the curvature of the earth and speaks serenity. Spoil the view, and you'll send the tourists elsewhere.

The other end of the state also features destinations that vacationers and tourists seek out for breathtaking views and contemplative beauty: the Blue Ridge Mountains and Great Smoky Mountains. When a ten-story

condominium was placed atop Little Sugar Mountain in 1982-83, not only spoiling the viewshed in the surrounding areas but also threatening a near future of construction dotting the surrounding mountaintops, the General Assembly responded quickly with the Mountain Ridge Protection Act of 1983[65] to prevent further ridgeline disfigurement and subsequent depression of tourism.

Another item with respect to over half of North Carolina beach vacationers choosing to go elsewhere if turbines are "in view at all": the turbines depicted in the N.C. State study were over 500 feet tall, and the turbines in the BOEM study were 577 feet tall. The turbines now under consideration in the Wilmington East leasing area (closest to Bald Head Island, within 15 nautical miles) and perhaps in a future Wilmington West leasing area (closest to several Brunswick County beaches, within 10 nautical miles) would be 850 feet tall, meaning their visibility and viewshed disruption would extend for several more nautical miles than studied. According to BOEM, turbines under consideration for Kitty Hawk would be 317.5 meters tall, which would be 1,042 feet tall[66] — 80 percent taller than turbines studied in 2015 that would "dominate" the horizon at 15 nautical miles. With respect to Wilmington East (and West), it is not unusual for developers to move to larger turbines when they become available.[67] By way of comparison, the tallest building in North Carolina is the Bank of America Corporate Center in Charlotte, which reaches 871 feet.[68]

Furthermore, the size of the Wilmington East WEA over which these large turbines would be arrayed is very large. At 172 square miles, it is over three times larger than the City of Wilmington (53 square miles).[69]

This problem of viewshed disruption poses potentially very large negative impacts on affected communities' tourism economies and property values.

Impacts On The Coastal Economy: Fishing

Fishing communities up and down the Atlantic Coast are alarmed by the profound and irreversible effects that offshore wind energy development

Figure 13: Wilmington East and Wilmington West Offshore Wind Energy Areas and Proximity to Shore

SOURCE: BOEM

would have on marine habitats and biodiversity, physical oceanography, and ultimately their livelihoods. A letter to BOEM on April 7, 2021, signed by 1,665 members of fishing communities in every coastal U.S. state called for transparency and full consideration of ocean ecosystems, better science, a more inclusive strategy, a clear process for permitting, a more circumspect approach than the "aggressive" development vowed by Pres. Biden, and an extensive list of mitigation measures. Signatories noted that offshore wind energy is "an ocean use that directly conflicts with fishing and imposes significant impacts to marine habitats, biodiversity, and physical oceanography."[70] The Biden administration seems in agreement with that assessment, as BOEM noted in its decision for the Vineyard Wind project that it would result in "major impacts" to

"commercial fishing and for-hire recreational fishing" and anticipated that commercial fishing would abandon those sites and lose income.[71]

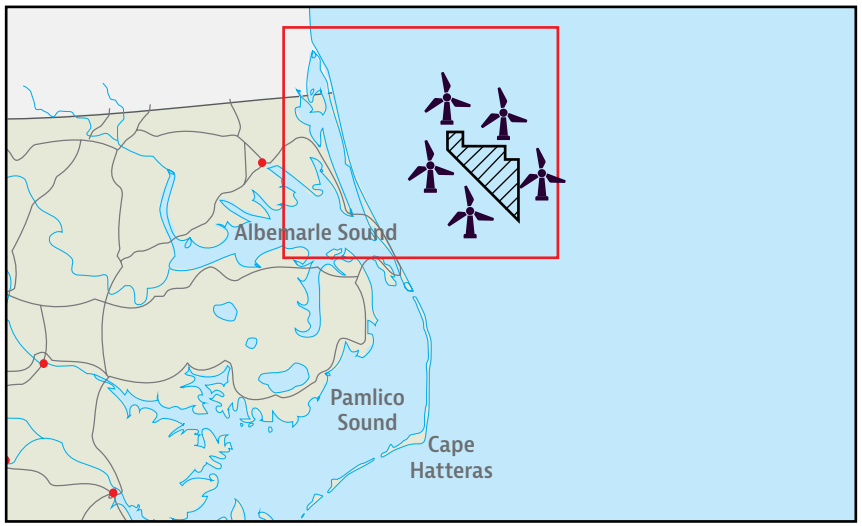
Many studies attest to negative effects on many different fish and mammal populations from offshore wind facilities, from construction to operation. They include population impacts[72] and habitat disruption[73] from site selection, construction, and operational noise. A related problem is that these unanticipated, detrimental population effects will go *unobserved*, while the disruptive presence of turbines will interfere with the ability to estimate commercial seafood populations in order to determine sustainable harvest levels.

Furthermore, the oceanic waters off the coast of North Carolina are home to certain highly unique features. For example, the mid-Atlantic Cold Pool features "seasonal stratification of cooler water close to the bottom, peaking in summer and turning over in fall and spring [which is] important to the survival of key, commercially important species including scallops and surf clams, and is a driver of primary production and nutrients for the ocean food web."[74] It faces significant yet critically unstudied effects from the Kitty Hawk wind project; nevertheless, BOEM is already moving to identify *two more wind energy areas* (so far) off the Outer Banks, which would impact the Cold Pool.[75]

Research from Rutgers University in February 2021 reviewing experiences with smaller offshore wind turbine arrays in Europe raised serious questions about potential impacts of projects like Kitty Hawk on the mid-Atlantic boreal fauna and the Cold Pool process. Acknowledging great uncertainty in modeling and forecasting, researchers raised several key questions, including what effects would turbines have on mixing in the water column, what impacts might they have on current velocity, what effects would loss of wind energy have on sea surfaces, what combined impacts would those factors have, and what all of those potential effects would mean for the Cold Pool and dependent ecology.[76]

It is difficult to understate the ecological and economic importance of the Cold Pool:

Figure 14: Kitty Hawk Offshore Wind Energy Area



SOURCE: BOEM

> The Cold Pool sustains a fauna whose range extends farther south than would be anticipated by its latitude and supports vast fisheries, including the most lucrative shellfish fisheries in the U.S. The region is highly productive, notably supporting the largest non-symbiotic clams on ocean shelves anywhere in the world and the second most lucrative single-species fishery, sea scallops, in the western Atlantic Ocean. The Cold Pool also regulates migratory behavior of fish that constitute the most important finfish fisheries in this region.[77]

North Carolina is also home to the collision of the Labrador Current (cold water flowing down from the north) and the Gulf Stream (warm water flowing up from the south), which happens around Cape Hatteras and which creates the ocean churn that caused the area to be known as the Graveyard of the Atlantic.[78] Then-Secretary of the North Carolina Department of Environment and Natural Resources Donald R. van der Vaart explained this confluence and therefore how it faces unique threat from offshore wind development in a Feb. 23, 2015, letter to BOEM, in which he requested among other things that Environmental Impact Statements

(EIS's) be prepared for the construction and operation of any wind energy facilities off North Carolina shores:

> [T]he convergence of the southward flowing cold water in the Labrador Current and the northward flowing warm waters of the Gulf Stream, in conjunction with the Western Boundary Undercurrent, causes an upwelling of nutrient-rich waters over unique bathymetric features and enhances the ocean's productivity off the North Carolina coast. Consequently, our state's coastal and ocean waters are filled with a particularly diverse and important mix of fish and other organisms at various stages of their life cycle, including a variety of endangered and threatened sea turtles, pelagic seabirds and marine mammals. Proceeding with lease sales prior to the preparation of an EIS puts these habitats, including hard-bottom and benthic, at risk, as purchasers could use their investment in the lease as pressure to allow subsequent construction and operation. Completing an EIS will ensure the preservation of sensitive habitats and resources prior to any investments in the leased area.[79]

A NORTH ATLANTIC RIGHT WHALE , ONE OF SEVERAL ENDANGERED AND PROTECTED SPECIES FOUND YEAR-ROUND IN THE WILMINGTON EAST WIND ENERGY AREA

The Wilmington East WEA contains several endangered and protected species year-round, including North Atlantic Right Whales, Fin Whales, Western North Atlantic Bottlenose Dolphins, Atlantic Spotted Dolphins, Risso's Dolphins, Long-Finned Pilot Whales, Short-Finned Pilot Whales, Loggerhead Turtles, Green Turtles, Kemp's Ridley Turtles, Leatherback Turtles, Hawksbill Sea Turtles, Giant Manta Ray Mantas, Oceanic Whitetip Sharks, and Atlantic Sturgeons. There are several other endangered and protected species that make seasonal visits or are occasionally seen in the area.[80]

Most recently, commercial and recreational fishing vessels as well as commercial shippers and the Coast Guard have been alerted to a serious problem of wind turbine generators disrupting marine vessel radar. A new study (prerelease as of this writing) has found that the standard, commonly used marine vessel radars for traversing commercial and recreational waterways, are severely affected by the presence of wind turbines. These "large structures predominantly constructed of steel" have "significant electromagnetic reflectivity and the capacity to interfere with radar systems in their vicinity." They cause "a substantial increase in strong, reflected energy cluttering the operator's display, leading to complications in navigation decision-making." But there is "no simple modification" that could allow marine vessel radar to operate in "the complex environments of a fully populated continental shelf wind farm."[81]

Worse than merely cluttered displays, however, the disrupted radar systems create the potential for deadly open-seas collisions. The turbines can "cast radar shadows, obfuscating smaller vessels exiting wind facilities in the vicinity of deep draft vessels in Traffic Separation Schemes." And that isn't the only way turbines disrupting radar systems endangers mariners: "Maritime search and rescue (SAR) assets rely on MVR [marine vessel radar] to search for smaller boats as their primary targets in the conduct of ordinary SAR operations. A loss of contact with smaller vessels due to various forms of MVR interference could complicate MTS [Maritime Transportation System] operations, and is therefore particularly consequential when conducting maritime surface SAR operations in and adjacent to an offshore wind farm."[82]

Comments to BOEM by Colonel Quaid H. Quadri, Jr., commander of the 169th Fighter Wing, South Carolina Air National Guard, argued against the Wilmington East WEA because of the danger of radar clutter and also the potential for tall turbines restricting supersonic flights and severely limiting air combat training:

> Air to air engagements require the use of radar systems. Studies conducted by the Air Force Research Lab in conjunction with the University of Texas and the Massachusetts Institute for Technology identified that wind turbines are a significant source of radar clutter. This clutter is capable of delaying and breaking radar locks and affects both Air Traffic Control (ATC) and Fire Control Radars alike. A 127,000 acre source of radar clutter in the airspace will hinder ATC's ability to safely control aircraft and degrade critical and uniquely available combat training.[83]

Also, given the proximity of the Wilmington East WEA to the Port of Wilmington, Col. Quadri warned, "Enabling a source of radar clutter in close proximity to a strategic port creates a significant vulnerability."[84]

OTHER IMPACTS AND QUESTIONS TO CONSIDER

There are many more impacts to offshore wind energy development to consider, as well as many other open questions that need further investigation. Despite the pressure to achieve political goals quickly, these issues nevertheless require measured consideration. Here are a few of them.

Threats To Seabirds, Gulls, and Endangered Migratory Birds

Turbines from offshore wind facilities threaten avian species. Onshore wind energy facilities are already notorious for slaughter of birds and bats, and the same dynamic is expected for offshore wind. One worrisome difference is that, while it is possible to survey and estimate how many birds, bats, endangered eagles, and other avian species are "taken" by onshore turbine blades, there is no way to count the carcasses of dead birds dropped in the ocean.

Turbines off the coast of North Carolina may pose a far-reaching threat to avian species, since they will not only impact local seabirds but also

migratory birds. For example, in 2017 a coalition of bird and wildlife conservation groups wrote to officials at BOEM, the National Marine Fisheries Service, and the U.S. Fish and Wildlife Service urging that mitigation strategies, wildlife surveys, EIS's, and other measures be put in place to protect the endangered Roseate Terns, which migrate "the entire length of the eastern seaboard," including the waters off North Carolina, and "also forage in coastal waters, sometimes venturing many miles offshore to feed their developing chicks."[85] North Carolina is also home to the endangered Piping Plovers; according to Audubon NC, "North Carolina is the only state where Piping Plovers are found as both breeding and wintering birds – meaning they inhabit the coast year-round!"[86]

The Unique Problem Of Hurricanes

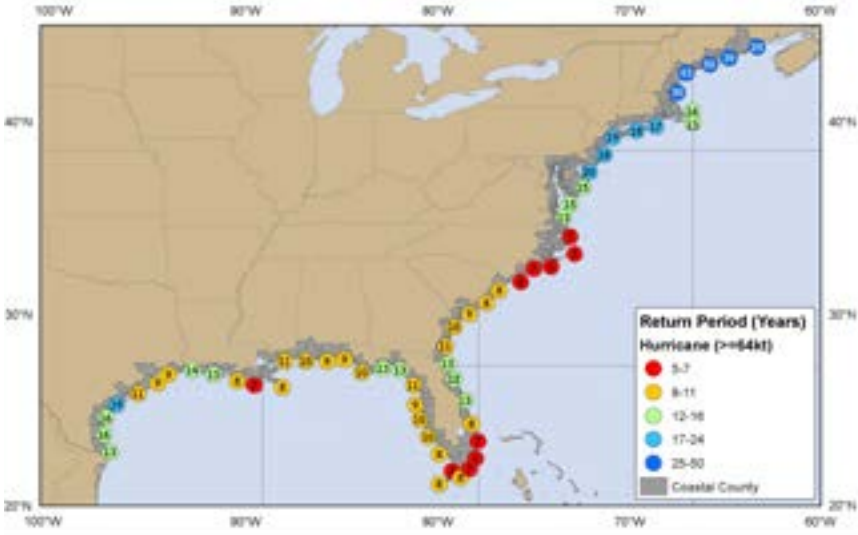
Turbines are especially vulnerable to hurricane gusts, and the waters off North Carolina are particularly vulnerable to hurricanes. Research has estimated that nearly half the turbines in a wind farm placed in the most vulnerable areas would face destruction from hurricanes within a 20-year period.[87] Turbines are especially vulnerable to wind gusts generated by major hurricanes (considered Category 3 or higher).[88] The National Hurricane Center uses a metric of "return period" of hurricanes, which is a measure of how frequently a site is visited by hurricanes within 50 nautical miles. Damaging gusts can extend many miles from a storm's center. The shores of North Carolina are frequently revisited by hurricanes — with return periods of hurricanes at 5–7 years, and of major hurricanes at 16–25 years, the greatest frequencies along the Atlantic Coast rivaled only by the southern tip of Florida.[89]

Figure 15: Hurricane Paths Within 65 Nautical Miles of Cape Hatteras, North Carolina

SOURCE: NOAA

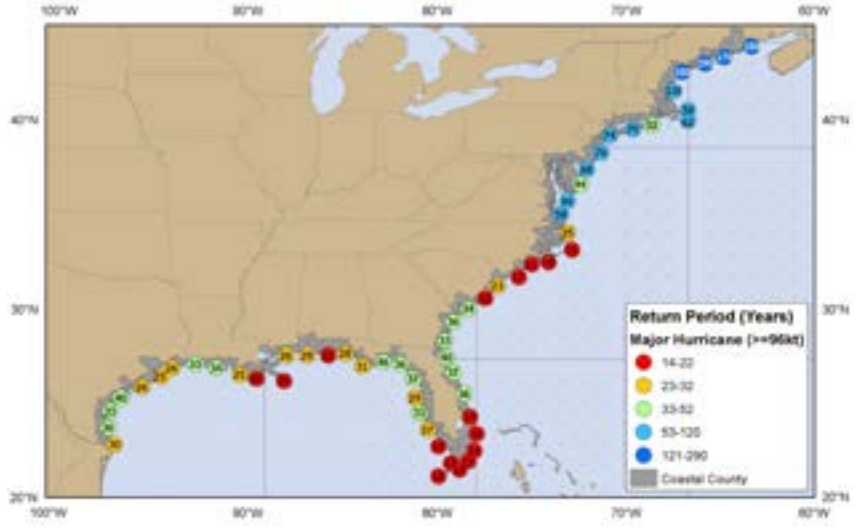
HURRICANES ARE EXTREMELY COMMON TO THE COASTS OF NORTH CAROLINA

Figure 17: Estimated Return Period in Years for Hurricanes Passing Within 50 Nautical Miles of Various Locations on the U.S. Coast



SOURCE: NOAA

Figure 17: Estimated Return Period in Years for Major Hurricanes Passing Within 50 Nautical Miles of Various Locations on the U.S. Coast



SOURCE: NOAA

"Forever Waste" From Retired And Damaged Turbine Blades

At present, based on the existing fleet of onshore wind energy facilities, retired or damaged turbine blades are a significant and growing environmental waste problem. In brief, the blades are unrecyclable and unrepurposable "forever waste," they require specialized equipment to cut them into pieces that must be hauled away by tractor-trailers (one truck per blade), and unless they are burned in kilns, they are causing current landfill space to become exhausted already even as the bulk of U.S. blade retirements has yet to occur.[90] Blade retirements therefore require increased trucking emissions as well as pose serious problems needing to convert land for landfill use or else contribute even more GHG emissions through kilning.

Adding 8 GW of offshore wind production will obviously require large arrays of turbines and with them, the near-future, sizable increase to this already significant waste problem. Additional factors may make offshore wind's contribution to this problem even more acute, especially the use of larger turbines with even longer blades. A single 21 MW turbine 1,042 feet tall sweeps an area of 686.6 thousand square feet, approximately

UNRECYCLABLE AND UNREPURPOSEABLE, DAMAGED TURBINE BLADES ARE A SIGNIFICANT AND GROWING ENVIRONMENTAL WASTE PROBLEM

the size of 14 football fields.[91] Turbine blade waste could be exacerbated by the possibility of more frequent replacements necessitated by blade or rotor damages, as has been witnessed at other offshore wind facilities, and also by hurricane damage. It will contribute to the need for converting even more land in North Carolina and the U.S. to landfills for wind turbine blade disposal.

Lessons And Questions From Other Offshore Wind Operations

Experience from the nation's first offshore wind farm, the Block Island Wind Farm off Rhode Island, is highly suggestive of offshore wind facilities leading to unforeseen emissions from backup generation. For several months in 2021, and not for the first time, Block Island's wind turbines were shut down.[92] The cause for the shutdown was that four of the five turbines had already developed "stress lines."

Beyond expensive, long-term shutdowns, stress lines or leaks in turbines can cause oil and lubrication to leak into the ocean. Similar problems with rotors and blades can endanger any vessels in the area. They also threaten commercial fishing near other offshore wind arrays, as witnessed earlier this spring when a rotor and three blades broke and fell off a turbine operated by Ørsted A/S off the shore of Denmark. In response, as reported by Bloomberg, Ørsted officials requested authorities set up "no-sail zones" forbidding all maritime traffic around not only that facility, but also "another Danish wind park, a handful of sites off the coast of the U.K. and a wind farm in German waters" where the same turbine machines were in use.[93]

Another cautionary lesson Block Island offers North Carolina policymakers is its ongoing problem of undersea cables being exposed. From the beginning the Block Island facility has been plagued by problems with undersea cables continually being exposed owing to the current.[94] Undersea cables emit an electromagnetic field (EMF) that affects the behavior, migration, movement, and even vital signs of several different underwater species, including sharks, eels, skates and rays, fish, and shellfish. As with many aspects surrounding offshore wind energy

development, research into these effects is still scant.[95] Nevertheless, exposure of the cables exacerbates their EMF. Furthermore, electricity consumers are charged with the cost of the reconstruction efforts via passthrough surcharges on their bills.[96]

Regardless of politicians' enthusiasm for offshore wind projects, the projects can attract strident opposition in the courts from affected communities, ratepayers, interest groups, conservationists, and even environmental advocates. For example, the Vineyard Wind project currently faces five lawsuits.[97] As discussed above, affected North Carolina communities have already signaled willingness to seek redress with the courts if BOEM does not honor their request for visual buffer zones — at least 24 nautical miles as already established by BOEM's approval of leases for the State of Virginia and for the Kitty Hawk wind leasing area, and 33.7 nautical miles for the protection of Old Baldy, the Bald Head Island Lighthouse, as established by BOEM's 33.7 nautical mile buffer for the Bodie Island Lighthouse.

A pilot project off the coast of Virginia could yield important information for North Carolina policymakers with respect to the feasibility, costs, benefits, and related effects of offshore wind developments. The Coastal Virginia Offshore Wind (CVOW) pilot project was completed in September 2020, a $300 million, two-turbine, 12 megawatt project 27 nautical miles offshore under a BOEM research lease designated to the public electricity utility Dominion Energy.[98] The pilot project is in anticipation of a massive, 180-turbine offshore wind site, but it has already attracted serious criticism over costs and other issues from public officials and advocates for electricity consumers.[99] As Dominion attested to BOEM, however, the intent of the CVOW pilot project is to be a research project gathering information about offshore wind facilities in the U.S., including turbine installation and operation, power output, hurricane resilience, operating and maintenance costs, supply chain issues, effects of close placement of turbines, and environmental effects.[100]

Summary and Recommendations

The governor, the president, other politicians, offshore wind energy corporations, lobbyists, and advocacy groups seek to bring 8 GW of offshore wind capacity off the coast of North Carolina. That figure is arbitrarily set by gubernatorial order. Adding the equivalent of 23 percent of North Carolina's existing capacity, they promise, will reduce "climate change pollution" and bring new jobs and economic growth.[101] But these promises come with little to no examination of their likely impacts on electricity consumers, families, small businesses, large industrial firms, commercial fishing, coastal tourism, fish and marine life, and birds and other airborne creatures, let alone consideration of other questions, including how massive turbine arrays will do amid North Carolina's frequent hurricanes.

This report shows that building 8 GW of offshore wind capacity will make North Carolina's electricity grid much more expensive and will impose an extra cost on the state's existing thermal generators by requiring them to increase ramping and lower their output to make room for

new renewable generators. The cost would range from $55.7 billion in the Low-Cost scenario to $71.5 billion in the Base-Cost scenario through 2050 and would result in an average cost increase of $330 to $425 per year per North Carolina residential customer, peaking in the year 2040 at $641 and $823 per customer.

Absent from discussion altogether — despite such significant and rushed government intervention — is whether it is necessary at all. Is offshore wind energy the way for North Carolina to cut CO_2 emissions, create jobs, and grow the economy? No, no, and no. CO_2 emissions have already been falling dramatically in North Carolina all century, thanks to market-based decisions, and North Carolina has witnessed excellent economic growth and job creation over the last decade thanks to economic growth policies based in lowering taxes, reducing the burden of regulations, keeping state budgetary growth within sensible limits, and saving for emergencies such as hurricanes and pandemics.

The proposition before North Carolina policymakers is essentially this: to jack up electricity rates on everyone, create subsequent price increases on everything because of the pervasive effect of electricity rate hikes, cause people to spend an exorbitant amount of money throughout the coming years paying for these facilities, inflict some unknown amount of harm to coastal communities' fishing and tourism, disrupt sensitive underwater habitats, kill an uncountable number of birds, disrupt vessel navigation as well as search and rescue operations, introduce more intermittency and unreliability on electrical grids, and all to put the most expensive form of electricity generation with enormous towers and unrecyclable wind blades into the nation's most hurricane-prone waters and say it's to reduce North Carolina's climate emissions, create jobs, and grow the economy — ongoing achievements North Carolinians have already been enjoying without it.

For all those reasons and more, North Carolinians need their elected officials to give this issue sober consideration. Watch and wait. The General Assembly should call for a study to give full consideration of the issues raised here, and the governor should support this good-faith effort.

Continue to collect information and data on the experiences with Block Island and the CVOW pilot project, which is explicitly a research project but has been operative only for a year and a half. Pay attention to coastal communities' concerns. Give researchers time to undertake more comprehensive studies of potentially affected marine ecologies, habitats, and creatures, as well as gulls, seabirds, and migratory birds. Make careful study of the potential impact of hurricanes, given their particular prominence off the coast of North Carolina, unlike any other offshore wind energy area.

Take into consideration the tradeoffs between energy-based emissions and energy costs as well as the tradeoffs between energy costs and people's quality of life, and see if there are more optimal ways to balance those considerations. Remember the main stakeholder in electricity matters is the consumer, not any particular provider or source.

Finally, the legislature, the Public Staff of the Utilities Commission,[102] and the courts should be prepared to defend the consumer protections built into H.B. 951. Only by strict adherence to the law's text can people be protected from runaway electricity costs. That means unflinching attention to the "least-cost mix" standard of generation sources so as not to overload the grid with expensive, unreliable, intermittent sources, especially offshore wind. It also means placing a high weight on protecting electricity consumers from being "unreasonably harmed" and "unreasonably" subject to "rate shock" (with a very sensitive definition of "unreasonably") and to "reduc[ing] low-income energy burdens." A proper study could help inform the legislature on how offshore wind facilities' construction, production, operation, and maintenance would affect these matters[103] that clearly are "affected with the public interest."[104]

For all those reasons and more, North Carolinians need their elected officials to give this issue sober consideration.

Study, Watch, And Wait

The General Assembly should call for a study to give full consideration of the issues raised here, and the governor should support this good-faith effort. Continue to collect information and data on the experiences with Block Island and the CVOW pilot project, which is explicitly a research project but has been operative only for a year and a half. Pay attention to coastal communities' concerns. Give researchers time to undertake more comprehensive studies of potentially affected marine ecologies, habitats, and creatures, as well as gulls, seabirds, and migratory birds. Make careful study of the potential impact of hurricanes, given their particular prominence off the coast of North Carolina, unlike any other offshore wind energy area.

Fully Consider The Tradeoffs Involved

Take into consideration the tradeoffs between energy-based emissions and energy costs as well as the tradeoffs between energy costs and people's quality of life. See if there are more optimal ways to balance those considerations. Remember the main stakeholder in electricity matters is the consumer, not any particular provider or source.

Vigorously Protect Electricity Consumers

Finally, the legislature, the Public Staff of the Utilities Commission,[102] and the courts should be prepared to defend the consumer protections built into H.B. 951. Only by strict adherence to the law's text can people be protected from runaway electricity costs. That means unflinching attention to the "least-cost mix" standard of generation sources so as not to overload the grid with expensive, unreliable, intermittent sources, especially offshore wind. It also means placing a high weight on protecting electricity consumers from being "unreasonably harmed" and "unreasonably" subject to "rate shock" (with a very sensitive definition of

"unreasonably") and to "reduc[ing] low-income energy burdens." A proper study could help inform the legislature on how offshore wind facilities' construction, production, operation, and maintenance would affect these matters[103] that clearly are "affected with the public interest."[104]

Arbitrary political goals must always take a back seat to doing what is best for the people.

Appendix: Annual changes in electricity rates and monthly electric bills by rate class

Table A1: Annual changes in electricity rates and monthly electric bills — residential

	Residential Rate Class			
	Low Cost		Base Cost	
Year	Rate (Cents/kwh)	Bill (Monthly)	Rate (Cents/kwh)	Bill (Monthly)
2001	8.12	$85.59	8.12	$85.59
2002	8.19	$90.93	8.19	$90.93
2003	8.32	$90.55	8.32	$90.55
2004	8.45	$94.71	8.45	$94.71
2005	8.65	$99.20	8.65	$99.20
2006	9.12	$100.13	9.12	$100.13
2007	9.40	$107.42	9.4	$107.42
2008	9.52	$106.64	9.52	$106.64
2009	9.99	$112.26	9.99	$112.26
2010	10.12	$125.24	10.12	$125.24
2011	10.26	$118.13	10.26	$118.13
2012	10.91	$117.49	10.91	$117.49
2013	10.97	$120.48	10.97	$120.48
2014	11.10	$126.06	11.1	$126.06
2015	11.28	$125.50	11.28	$125.50
2016	11.03	$121.47	11.03	$121.47
2017	10.94	$114.03	10.94	$114.03
2018	11.09	$125.15	11.09	$125.15
2019	11.42	$123.27	11.42	$123.27
2020	11.38	$118.45	11.38	$118.45
2021	11.38	$118.45	11.38	$118.45
2022	11.40	$118.63	11.40	$118.63
2023	11.39	$118.54	11.39	$118.54
2024	11.42	$118.86	11.42	$118.86
2025	11.45	$119.16	11.45	$119.16
2026	12.07	$125.61	12.26	$127.60
2027	12.07	$125.68	12.26	$127.61
2028	12.08	$125.74	12.26	$127.61
2029	12.09	$125.79	12.26	$127.60
2030	12.68	$131.98	13.04	$135.72
2031	12.66	$131.80	13.01	$135.42
2032	12.70	$132.24	13.05	$135.86
2033	12.68	$132.02	13.02	$135.51
2034	13.92	$144.89	14.61	$152.11
2035	13.86	$144.23	14.53	$151.19
2036	13.75	$143.13	14.40	$149.84
2037	13.65	$142.03	14.27	$148.49
2038	13.54	$140.94	14.14	$147.13
2039	13.44	$139.84	14.01	$145.78
2040	14.59	$151.89	15.51	$161.44
2041	14.45	$150.37	15.33	$159.54

2041	14.45	$150.37	15.33	$159.54
2042	14.30	$148.85	15.15	$157.64
2043	14.16	$147.33	14.96	$155.73
2044	14.01	$145.81	14.78	$153.83
2045	13.86	$144.29	14.60	$151.93
2046	13.72	$142.77	14.41	$150.03
2047	14.10	$146.75	14.91	$155.14
2048	13.98	$145.55	14.76	$153.63
2049	13.87	$144.36	14.62	$152.12
2050	13.75	$143.16	14.47	$150.61

Table A2: Annual changes in electricity rates and monthly electric bills — commercial.

	Commercial Rate Class			
	Low Cost		Base Cost	
Year	Rate (Cents/kwh)	Bill (Monthly)	Rate (Cents/kwh)	Bill (Monthly)
2001	6.42	$382.22	6.42	$382.22
2002	6.51	$392.25	6.51	$392.25
2003	6.65	$401.02	6.65	$401.02
2004	6.70	$402.62	6.7	$402.62
2005	6.86	$413.97	6.86	$413.97
2006	7.17	$428.29	7.17	$428.29
2007	7.43	$452.84	7.43	$452.84
2008	7.55	$450.64	7.55	$450.64
2009	7.98	$472.60	7.98	$472.60
2010	8.16	$505.64	8.16	$505.64
2011	8.13	$488.14	8.13	$488.14
2012	8.66	$514.48	8.66	$514.48
2013	8.76	$520.10	8.76	$520.10
2014	8.75	$528.21	8.75	$528.21
2015	8.73	$527.54	8.73	$527.54
2016	8.62	$519.08	8.62	$519.08
2017	8.44	$494.63	8.44	$494.63
2018	8.58	$509.61	8.58	$509.61
2019	8.81	$511.65	8.81	$511.65
2020	8.69	$468.06	8.69	$468.06
2021	8.69	$468.06	8.69	$468.06
2022	8.70	$468.81	8.70	$468.81
2023	8.70	$468.45	8.70	$468.45
2024	8.72	$469.69	8.72	$469.69
2025	8.74	$470.90	8.74	$470.90
2026	9.22	$496.36	9.36	$504.24
2027	9.22	$496.64	9.36	$504.28
2028	9.23	$496.89	9.36	$504.28
2029	9.23	$497.09	9.36	$504.24
2030	9.68	$521.56	9.96	$536.34
2031	9.67	$520.84	9.94	$535.13
2032	9.70	$522.56	9.97	$536.89

2033	9.69	$521.70	9.94	$535.51
2034	10.63	$572.55	11.16	$601.10
2035	10.58	$569.94	11.09	$597.48
2036	10.50	$565.61	10.99	$592.12
2037	10.42	$561.27	10.89	$586.77
2038	10.34	$556.94	10.79	$581.42
2039	10.26	$552.60	10.70	$576.07
2040	11.14	$600.24	11.84	$637.96
2041	11.03	$594.23	11.70	$630.44
2042	10.92	$588.22	11.57	$622.93
2043	10.81	$582.21	11.43	$615.41
2044	10.70	$576.20	11.29	$607.90
2045	10.59	$570.19	11.15	$600.38
2046	10.47	$564.18	11.01	$592.87
2047	10.77	$579.92	11.38	$613.07
2048	10.68	$575.18	11.27	$607.10
2049	10.59	$570.45	11.16	$601.12
2050	10.50	$565.72	11.05	$595.15

Table A3: Annual changes in electricity rates and monthly

	Industrial Rate Class			
	Low Cost		Base Cost	
Year	Rate (Cents/kwh)	Bill (Monthly)	Rate (Cents/kwh)	Bill (Monthly)
2001	4.61	$10,419.24	4.61	$10,419.24
2002	4.7	$10,554.68	4.7	$10,554.68
2003	4.79	$10,653.70	4.79	$10,653.70
2004	4.88	$11,042.67	4.88	$11,042.67
2005	5.04	$11,518.35	5.04	$11,518.35
2006	5.23	$11,736.24	5.23	$11,736.24
2007	5.47	$12,290.03	5.47	$12,290.03
2008	5.54	$11,690.11	5.54	$11,690.11
2009	5.99	$11,014.44	5.99	$11,014.44
2010	6.17	$12,282.80	6.17	$12,282.80
2011	6.01	$12,535.99	6.01	$12,535.99
2012	6.42	$13,837.32	6.42	$13,837.32
2013	6.45	$14,055.99	6.45	$14,055.99
2014	6.5	$14,103.71	6.5	$14,103.71
2015	6.51	$14,612.88	6.51	$14,612.88
2016	6.31	$14,300.28	6.31	$14,300.28
2017	6.2	$14,089.83	6.2	$14,089.83
2018	6.33	$14,393.02	6.33	$14,393.02
2019	6.3	$14,568.21	6.3	$14,568.21
2020	6.31	$13,827.47	6.31	$13,827.47
2021	6.31	$13,827.47	6.31	$13,827.47
2022	6.32	$13,849.39	6.32	$13,849.39
2023	6.32	$13,838.78	6.32	$13,838.78
2024	6.33	$13,875.52	6.33	$13,875.52

2025	6.35	$13,911.14	6.35	$13,911.14
2026	6.69	$14,663.34	6.80	$14,896.24
2027	6.70	$14,671.70	6.80	$14,897.32
2028	6.70	$14,678.95	6.80	$14,897.28
2029	6.70	$14,685.07	6.80	$14,896.12
2030	7.03	$15,407.77	7.23	$15,844.44
2031	7.02	$15,386.64	7.21	$15,808.74
2032	7.04	$15,437.27	7.24	$15,860.77
2033	7.03	$15,412.09	7.22	$15,820.02
2034	7.72	$16,914.27	8.10	$17,757.70
2035	7.68	$16,837.08	8.05	$17,650.49
2036	7.62	$16,709.03	7.98	$17,492.42
2037	7.57	$16,580.98	7.91	$17,334.35
2038	7.51	$16,452.94	7.84	$17,176.29
2039	7.45	$16,324.90	7.77	$17,018.23
2040	8.09	$17,732.15	8.60	$18,846.52
2041	8.01	$17,554.50	8.50	$18,624.40
2042	7.93	$17,376.97	8.40	$18,402.39
2043	7.85	$17,199.44	8.30	$18,180.39
2044	7.77	$17,021.92	8.20	$17,958.39
2045	7.69	$16,844.40	8.09	$17,736.40
2046	7.61	$16,666.89	7.99	$17,514.42
2047	7.82	$17,131.77	8.26	$18,111.23
2048	7.75	$16,991.97	8.18	$17,934.73
2049	7.69	$16,852.17	8.10	$17,758.24
2050	7.63	$16,712.38	8.02	$17,581.76

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Our History

The John Locke Foundation was created in 1990 as an independent, nonprofit think tank that would work "for truth, for freedom, for the future of North Carolina." The Foundation is named for John Locke (1632-1704), an English philosopher whose writings inspired Thomas Jefferson and the other Founders. The John Locke Foundation is a 501(c)(3) research institute and is funded by thousands of individuals, foundations and corporations. The Foundation does not accept government funds or contributions to influence its work or the outcomes of its research.

Our Vision

The John Locke Foundation envisions a North Carolina of responsible citizens, strong families, and successful communities committed to individual liberty and limited, constitutional government.

Our Mission

The John Locke Foundation employs research, journalism, and outreach programs to transform government through competition, innovation, personal freedom, and personal responsibility. Locke seeks a better balance between the public sector and private institutions of family, faith, community, and enterprise.

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