A M E R I C A N J O B S P R O J E C T



The South Carolina Jobs Project

A Guide to Creating Jobs in Offshore Wind

SEPTEMBER 2018

AMERICAN JOBS PROJECT

A Letter from the

American Jobs Project

It is no secret that America's middle class is in crisis; of the millions of jobs lost during the recession, most were good-paying, middle-class jobs. Unfortunately, many of the jobs created during the recovery have been in low-skill, low-paying occupations. It is true that the United States is unlikely to attract the traditional manufacturing jobs of the past, but our research shows that with innovative policies and a smart focus on industrial sectors, states can become global hubs of innovation and create new jobs in advanced industries that capitalize on each state's strengths.

Our analysis starts with identifying the biggest market opportunity of our era. The world has embarked on a historic energy transformation, and the growing demand for advanced energy and its enabling technology draws on "the mother of all markets" for U.S. businesses to build and sell those solutions. Strategically minded businesspeople are taking advantage of this accelerating market and seeing outsized returns. In 2016, the private sector reported $1.4 trillion in global advanced energy revenues, which is equal to that of the global apparel industry and nearly twice as much as the global airline industry. And jobs? At least 10.3 million people were employed in the global advanced energy industry in 2017, and market growth could support over 13 million additional jobs by 2030. The question for the United States is: Where will those new jobs be created?

At least 10.3 million people were employed in the global advanced energy industry in 2017, and market growth could support 24 million jobs by 2030.

We believe that our states are the answer to this question. If countries across the globe are seeking solutions for growing energy needs, how can U.S. businesses take advantage of this demand and build products locally that can be exported to the world? And how can we equip Americans with the skills those businesses need?

The American Jobs Project gives policymakers tools to spur economic growth and create good-paying jobs in their states. Our analyses chart pathways designed to accelerate and expand a state's advanced energy economy. We propose innovative solutions built on extensive research and tailored to each state. These solutions are written with a focus on streamlining bureaucracy and are seasoned with the principles of competition, local control, and fewer regulations.

The American Jobs Project empowers state and local leaders to build prosperous and equitable advanced energy economies that will transform our nation's energy future. If these recommendations are adopted, hard-working Americans will be among the first to benefit.

About Us

American Jobs Project

The American Jobs Project is a nonprofit, nonpartisan, think-and-do tank focused on creating good-paying jobs in advanced energy and manufacturing through a bottom-up, data-driven, 360° economic development approach. Our experts tailor best practice strategies for bolstering advanced energy and manufacturing, identify assets across the value chain, estimate an industry's job-supporting potential, and support stakeholder-led initiatives by communicating ideas and analyses. Through engagement with a broad cross-section of stakeholders, we develop a shared vision of effective strategies to leverage the unique competitive advantages offered by each state and generate positive economic impacts.

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Burroughs and Chapin Center for Marine and Wetland Studies, Coastal Carolina University

The Burroughs and Chapin Center for Marine and Wetland Studies is broadly engaged in research, engagement, and policy initiatives related to renewable energy in South Carolina, primarily around wind power. Staff undertake observation and modeling campaigns refining wind resource potential, projection of wind and wave forcings to be planned for from tropical storm systems, geophysical mapping of sea floor conditions, and service on state and regional task forces and technical committees on wind energy and other related environmental and regulatory issues.

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BVG Associates

BVG Associates is an independent consultancy with a global outlook, specializing in the technology, industrialization, and economics of wind and marine energy generation systems. They are driven by a desire to make a real difference in the global renewable energy industry, delivering insight that comes from over 140 years of staff experience. Their team has the best objective knowledge of the market and supply chain for offshore wind, wave, and tidal energy. Their significant client base spans government, enabling bodies, investors, developers, turbine manufacturers, and other companies across the supply chain.

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Table of Contents

A LETTER FROM THE AMERICAN JOBS PROJECT 3
ABOUT US 4
American Jobs Project 4
Burroughs and Chapin Center for Marine and Wetland Studies, Coastal Carolina University 4
BVG Associates 4
ACKNOWLEDGMENTS 6
EXECUTIVE SUMMARY 7-11
Summary of Recommendations 9-11
INTRODUCTION 12-15
South Carolina's Need for Good-Paying Jobs 14
The Benefits of Cluster-Based Development 15
SOUTH CAROLINA'S ECONOMIC OPPORTUNITY IN OFFSHORE WIND 16-21
Why Offshore Wind in South Carolina? 18-21
STATE ASSETS TO SUPPORT OFFSHORE WIND CLUSTER DEVELOPMENT 22-28
POLICY RECOMMENDATIONS 29-51
Innovation Ecosystem 31-34
Policy 1: Foster the Commercialization Culture at Universities 31-32
Policy 2: Facilitate Mentorships for Entrepreneurs Statewide 33
Policy 3: Establish a Venture Catalyst Program to Strengthen Rural Entrepreneurship 34
Access to Capital 35-39
Policy 4: Extend and Expand the Angel Tax Credit 35
Policy 5: Increase Funding for the SC Launch Program 36
Policy 6: Establish an Offshore Wind Business Development Fund for Small Businesses 37
Policy 7: Encourage Program-Related Investments in Offshore Wind Businesses 38-39
Workforce Development 40-43
Policy 8: Create a Simulated Workplace Program for Job Readiness Skills 40
Policy 9: Address the STEM Skills Gap to Boost Manufacturing Employment 41
Policy 10: Establish Offshore Wind Certificate Programs at Technical Colleges 42
Policy 11: Increase Student Engagement in Offshore Wind Research Activities 43
Value Chain 44-48
Policy 12: Assess the Offshore Wind Readiness of State Ports 44
Policy 13: Bolster Foreign Direct Investment in the Offshore Wind Industry 45-46
Policy 14: Establish a Regional Offshore Wind Memorandum of Understanding 47-48
Local Market 49-51
Policy 15: Highlight the Tourist Attraction Potential of Offshore Wind 49-50
Policy 16: Incorporate Utility Performance-Based Regulation 51
CALL TO ACTION 52
APPENDIX: Economic Impacts, Jobs Estimates, and Modeling Methodology 53-54

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EXECUTIVE SUMMARY

Offshore wind manufacturing and innovation in South Carolina is a significant economic opportunity for job growth, having the potential to support an annual average of 847 jobs through 2035. South Carolina can capitalize on this opportunity by bolstering the innovation ecosystem, access to capital, workforce development, value chain, and local market.

EXECUTIVE SUMMARY

South Carolina has an urgent need for good-paying jobs and accessible skills pathways to expand its workforce capacity and economic prosperity. An aging workforce and a large population of eligible workers disconnected from education and employment opportunities have contributed to a low labor force participation rate. Low wages and mismatched skills for job prospects are among the reasons South Carolinians are increasingly discouraged by the labor market. To address these obstacles, the state could advance strategies that leverage competitive advantages in high-growth industries and equip South Carolinians with critical workforce-ready skills.

Extensive research and over thirty interviews with stakeholders and experts in South Carolina have identified offshore wind as a promising job creator and economic driver. Offshore wind turbines harness the power of strong ocean winds by generating energy from faster, more consistent wind speeds and can be leveraged to meet the vast energy needs of coastal states. In fact, upcoming offshore wind projects across the Atlantic Coast signal an opportunity for South Carolina to supply local products and support technological innovation. Given South Carolina's offshore wind research infrastructure and expertise, high offshore wind manufacturing potential, and robust logistics industry, the state is positioned to benefit from long-term market growth in this region.

Through the offshore wind industry, South Carolina can leverage its numerous strengths to take advantage of expanding opportunities, such as:

- **Capitalizing on growing demand and falling costs.** By 2030, the global offshore wind industry is projected to grow 16 percent annually and costs are forecasted to be as low as 6 cents per kWh.
- **Leveraging cutting-edge research.** South Carolina is home to a globally competitive drivetrain testing facility, which has attracted partnerships with GE and MHI Vestas. The state also has significant expertise in offshore meteorology and oceanography.
- **Mobilizing existing manufacturing and industry assets.** South Carolina is home to fifteen active wind manufacturing facilities and many companies that could expand their in-state operations to serve the offshore wind market, such as subsea cable manufacturer Prysmian Group, Siemens, and Timken. The state's strengths in advanced composites, shipbuilding, and logistics also support offshore wind activities.
- **Harnessing robust infrastructure assets.** South Carolina's ports can handle the manufacturing and staging of offshore wind turbines, and the state's transmission system can handle the interconnection of large offshore wind capacity.
- **Supporting good-paying jobs.** With forward-thinking solutions, South Carolina's offshore wind industry could support 847 jobs annually through 2035.

To realize these opportunities, state and local leaders can pursue strategies that create a strong foundation for industry growth in offshore wind and help South Carolina businesses grow, innovate, and outcompete regional, national, and global competitors. In today's competitive, globalized economy, businesses are more likely to thrive in cities and states that offer a rich innovation ecosystem, provide fertile ground for capital investment, boast a highly skilled workforce, maintain a robust value chain, and offer clear policy signals. By having a close network of partners and suppliers, South Carolina companies can reap the benefits of increased productivity and operational efficiency, amplifying local job creation and economic growth.

Capitalizing on this opportunity offers real benefits for the state economy and South Carolinians. Offshore wind could support an average of 847 jobs annually through 2035 from the development, installation, and operation of offshore wind farms in South Carolina as well as component manufacturing for local and regional projects. This industry offers a diverse array of good-paying jobs that cater to various education and experience levels, including computer-controlled machine tool operators, electrical engineering technicians, and industrial production managers. Policymakers can support these jobs by taking advantage of increasing global demand and overcoming barriers to industry growth.

Summary of Recommendations

The analysis presented in this report culminates in recommendations for South Carolina leaders based on stakeholder interviews and best practice research. Each recommendation identifies strategies to address barriers or untapped opportunities in the state's offshore wind industry across five foundational building blocks: innovation ecosystem, access to capital, workforce development, value chain, and local market. Although they draw on model policies and programs from elsewhere, South Carolina could also advance innovative solutions that become case studies for other states. While the recommendations are intended to be complementary and would be more powerful if adopted as a package, each can also be viewed as a stand-alone option. South Carolina policymakers and stakeholders can use this guide for collaboration and prioritization of actions given the opportunities and challenges that lie ahead in the growing offshore wind industry.



Innovation Ecosystem

Policy 1: Foster the Commercialization Culture at Universities
South Carolina universities have the opportunity to help homegrown innovations play a larger role in the global economy by embracing a culture that fosters entrepreneurship among faculty, students, alumni, and the community. University leaders could leverage favorable commercialization policies and programs such as recognizing technology transfer activities in tenure and promotion reviews, instituting startup support programs, and facilitating startup-industry exchanges.

Policy 2: Facilitate Mentorships for Entrepreneurs Statewide
In addition to organic networking and knowledge-sharing opportunities, regional efforts to build robust entrepreneur-mentoring programs can help develop entrepreneurs as individuals and bring their ideas to fruition. South Carolina universities, incubators, accelerators, or economic development organizations could replicate the highly successful MIT Venture Mentoring Service model to manage regional volunteer mentor networks and curate mentor-mentee matches.

Policy 3: Establish a Venture Catalyst Program to Strengthen Rural Entrepreneurship
Through stronger entrepreneurial services, rural communities could better develop advanced technology ideas to meet community needs, tap into high-growth markets, and drive local economic development. Drawing on Oregon's Venture Catalyst program, South Carolina could deploy a seasoned entrepreneur or investor in each rural area to provide business development expertise, connect residents with resources, and address critical gaps in the local innovation ecosystem.



Access to Capital

Policy 4: Extend and Expand the Angel Tax Credit
South Carolina's Angel Tax Credit de-risks and incentivizes equity investments in high-growth industries and has had a significant impact on startup growth and job creation since its inception. The South Carolina General Assembly could extend the lifespan of the incentive past the end of 2019 and consider amending the annual credit caps to more closely align with investors' level of interest in local startups and encourage larger investments.

Policy 5: Increase Funding for the SC Launch Program
The South Carolina Research Authority's SC Launch program offers diverse early-stage funding opportunities to advanced technology startups and fills critical gaps in the state's innovation ecosystem. To continue to support local entrepreneurship and achieve outsized economic impacts, South Carolina could raise the cap on business contributions to the Industry Partnership Fund, which currently limits the program's annual budget to over $6 million and is often exceeded within minutes.

Policy 6: Establish an Offshore Wind Business Development Fund for Small Businesses
Small and growing firms face steep barriers to entry to the offshore wind market that may include high administrative costs for bidding on contracts and capital expenditures for retooling operations. The South Carolina General Assembly and Department of Commerce could fund a competitive grant program to cover operating and capital expenses for local small businesses interested in supplying the offshore wind industry.

Policy 7: Encourage Program-Related Investments in Offshore Wind Businesses
As opposed to traditional nonprofit grants, philanthropic foundations are increasingly making program-related investments (PRIs) that advance their charitable mission while generating a financial return. To leverage PRIs as an alternative funding pathway for startups, the Governor's Office or Department of Commerce could appoint a foundation liaison who builds relationships with foundations and brokers PRIs in support of in-state businesses, innovation, and jobs.



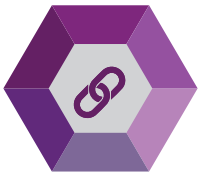
Workforce Development

Policy 8: Create a Simulated Workplace Program for Job Readiness Skills
A significant challenge for South Carolina employers is the workforce's soft skills gap; they struggle to find potential workers with a good work ethic, critical-thinking skills, writing ability, and effective communication. South Carolina schools could implement simulated workplaces in classrooms to help students develop these job readiness skills and acclimate them to professional expectations prior to joining the labor force.

Policy 9: Address the STEM Skills Gap to Boost Manufacturing Employment
Despite the importance of advanced manufacturing in South Carolina's economy, the state's low labor force participation rate and shortage of people with STEM backgrounds results in a limited workforce to support business growth. South Carolina's technical colleges could help disenfranchised workers get over the remedial hump and build the STEM workforce by expanding integrated basic education and skills (I-BEST) programs for specific in-demand career pathways.

Policy 10: Establish Offshore Wind Certificate Programs at Technical Colleges
Offshore wind projects are a particularly challenging work environment and demand specialized knowledge and skills, which makes dedicated workforce training programs critical to industry success. As South Carolina's offshore wind value chain and project pipeline develops, the state's technical colleges could establish certificate programs that teach students wind power fundamentals and wind turbine maintenance skills.

Policy 11: Increase Student Engagement in Offshore Wind Research Activities
South Carolina has extensive offshore wind innovation assets to drive technology development and build research expertise across its workforce. The South Carolina General Assembly could expand the SmartState program to enable state matching funds for educational outreach programs and sponsored graduate-level student engagement, which aligns with the program's mission to stimulate research, commercialization, and economic growth.



Value Chain

Policy 12: Assess the Offshore Wind Readiness of State Ports
Ports are critical for reducing offshore wind project costs and centralizing industry resources, such as manufacturing warehouses, testing facilities, and training centers. In collaboration with the South Carolina Ports Authority, the state could assess existing port infrastructure and recommend planning and investments to support current and future offshore wind industry needs.

Policy 13: Bolster Foreign Direct Investment in the Offshore Wind Industry
Foreign direct investment (FDI) could help catalyze South Carolina's offshore wind industry growth by filling critical gaps in the in-state value chain and bringing new jobs and capital into the state economy. State leaders could attract specific anchor companies and their suppliers as well as strengthen relationships with key countries and offshore wind cluster networks.

Policy 14: Establish a Regional Offshore Wind Memorandum of Understanding
Regional partnerships are key to overcoming offshore wind's complicated supply chain and logistics needs. The Governor's Office and State Energy Office could organize a memorandum of understanding (MOU) on the regional offshore wind industry with North Carolina and Georgia with the goals of lowering capital costs, boosting investor confidence, and distributing economic benefits throughout the region.



Local Market

Policy 15: Highlight the Tourist Attraction Potential of Offshore Wind
A common but largely misplaced concern of offshore wind farms is that they may harm the tourism industry, a significant economic driver in the state. In preparation for future offshore wind deployment, South Carolina communities could adopt best practice models for allaying public fears and stimulating tourism activity, such as strong community engagement requirements throughout project development as well as informational exhibits and guided boat tours after construction.

Policy 16: Incorporate Utility Performance-Based Regulation
South Carolina's failed nuclear project and high electricity consumption levels has put a spotlight on the state's current utility model, which incentivizes large capital investments without strong measures for social and economic benefits such as project reliability and energy efficiency. South Carolina could explore implementing some level of performance-based regulation (PBR), which can alternatively compensate utilities for achieving outcomes that are important to customers, regulators, and utilities.

INTRODUCTION

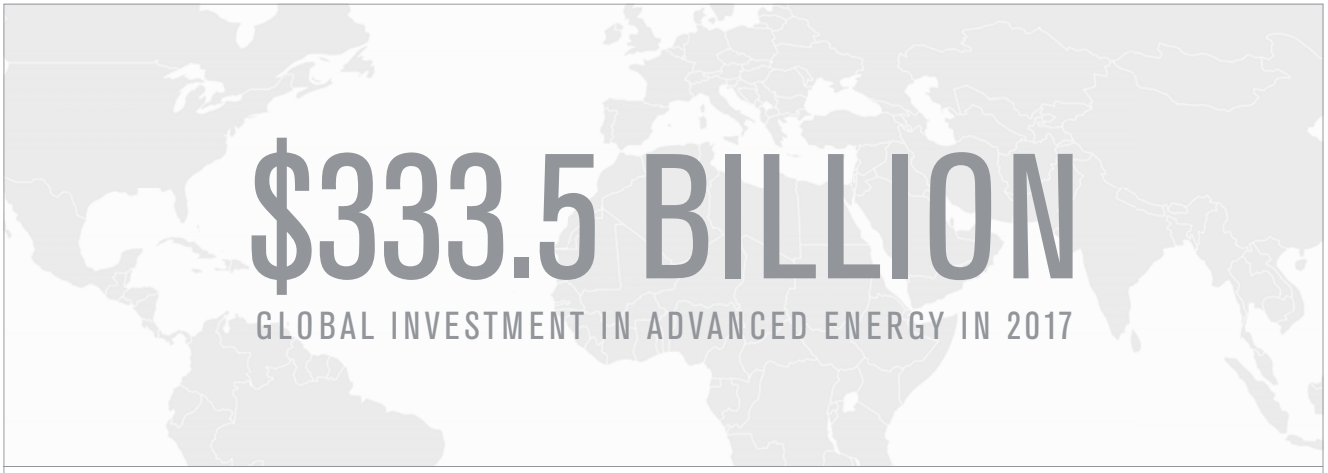
South Carolina can tap into the growing global advanced energy market to foster and support good-paying jobs for South Carolinians. Through the strategic cluster-based development of the offshore wind industry, South Carolina could support an annual average of 847 jobs through 2035.

INTRODUCTION

The American Jobs Project aims to spur job creation in the advanced energy industry by identifying state-level economic opportunities and crafting tailored solutions for in-state growth. This national initiative takes advantage of the accelerating demand for advanced energy and leverages states' competitive advantages to build robust economic clusters. The American Jobs Project believes that manufacturing is a cornerstone of the U.S. economy—providing workers with good wages and causing a multiplier effect on local revenue and employment—and resolves to support industry jobs that are resistant to offshoring and automation. State and local leaders who seek to capitalize on state resources to create good-paying jobs can use this report as a foundation for action.

By fostering growth in the offshore wind industry, South Carolina could reasonably support an annual average of 847 jobs from 2018 through 2035.

Extensive research and more than thirty interviews with stakeholders and experts in South Carolina have identified offshore wind manufacturing and innovation as showing particular promise in the state. South Carolina is well positioned to benefit from the rising demand for offshore wind technology given its globally competitive drivetrain research facility, robust ports, and network of manufacturers able to serve the offshore wind industry. Opportunities to leverage these strengths to further serve growing regional, national, and global markets offer substantial benefits for both the state economy and South Carolina residents. Strategic state-level coordination and collaboration could elevate in-state companies in the marketplace and facilitate middle-income job growth. By fostering growth in the offshore wind industry, South Carolina could reasonably support an annual average of 847 jobs from 2018 through 2035.



Advanced Energy Market Opportunity: Advanced energy includes all sources, technologies, products, and services that help meet the need for affordable, secure, and clean energy. Demand for advanced energy has soared in recent years and is poised for continued growth. In 2017, investment in the advanced energy industry was $333.5 billion worldwide, over five times that of 2004. By 2040, investments are expected to total $7.4 trillion. The advanced energy market is a clear opportunity for increased revenue and job growth.

South Carolina's Need for Good-Paying Jobs

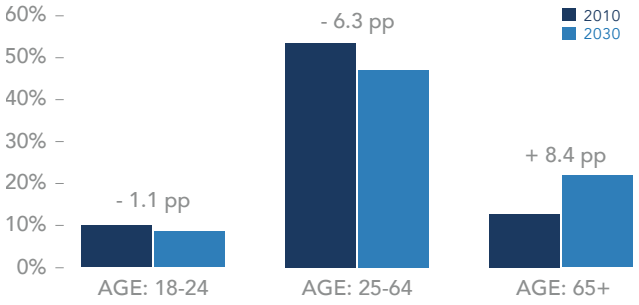
Like other states, South Carolina has seen its traditional industries suffer under the effects of the 2008 recession, which resulted in the disappearance of thousands of good-paying manufacturing jobs. While some economic indicators show that the state has made great strides towards recovery since the recession, other indicators suggest that recovery is still a long way off. South Carolina has the forty-fifth lowest labor force participation rate in the country. In 2017, only 58.6 percent of eligible workers participated in the workforce, which was significantly lower than the national average of 62.8 percent. This downward trend has continued since 1993 when approximately 66.8 percent of the population in South Carolina was either employed or actively looking for employment.

The decline in labor force participation is partially attributed to a rapidly aging population. South Carolina ranked fourteenth in a list of U.S. states by highest percentage of population over sixty-five years old. In 2016 alone, over half of those migrating to the state were over the age of fifty. This trend will have a substantial impact on South Carolina's workforce. Between 2010 and 2030, the overall population share of South Carolinians between ages of eighteen and twenty-four is expected to moderately decrease while the share of South Carolinians ages sixty-five and up is projected to increase by approximately 8.4 percentage points.

Additionally, many eligible workers are disconnected from education and employment opportunities. The Palmetto State has a skills mismatch that limits job prospects for residents. While 57 percent of jobs require middle-skill education and training, only 46 percent of the workforce meets those requirements. At the high- and low-skill levels, however, there is a shortage of available jobs for qualified workers. South Carolina's low wages also discourage potential workers and limit access to training programs. Furthermore, about 12.7 percent of young adults in South Carolina are neither working nor in school. These workforce barriers have contributed to a rising poverty rate: More than 15 percent of South Carolinians live in poverty, which is notably higher than the national poverty rate of 12.7 percent.

Growing and diversifying the state's manufacturing base could facilitate a strong labor market with good-paying job opportunities in the local economy. In South Carolina, manufacturing jobs pay an average of $51,153 per year, which is higher than the average annual salary in the state. To facilitate these outcomes, the state will need an economic development strategy that equips South Carolinians with critical workforce-ready skills while attracting out-of-state talent and improving the standard of living. State leaders have the opportunity to build a robust offshore wind industry anchored by local businesses and homegrown innovations, catalyzing future economic growth.

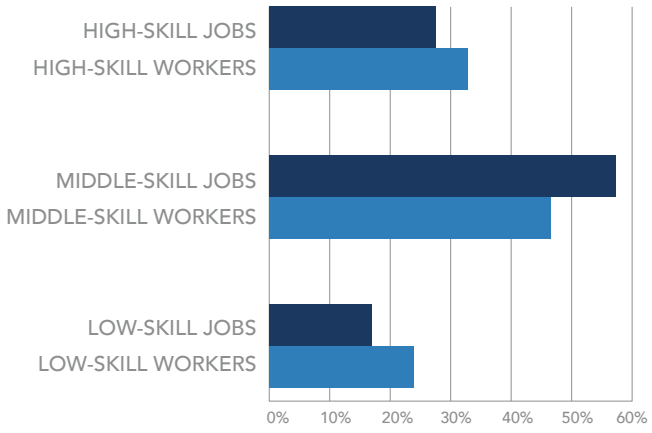
SOUTH CAROLINA'S AGING POPULATION



Source: South Carolina Revenue and Fiscal Affairs Office

LABOR FORCE SKILLS MISMATCH

Jobs and Workers by Skill Level, 2015

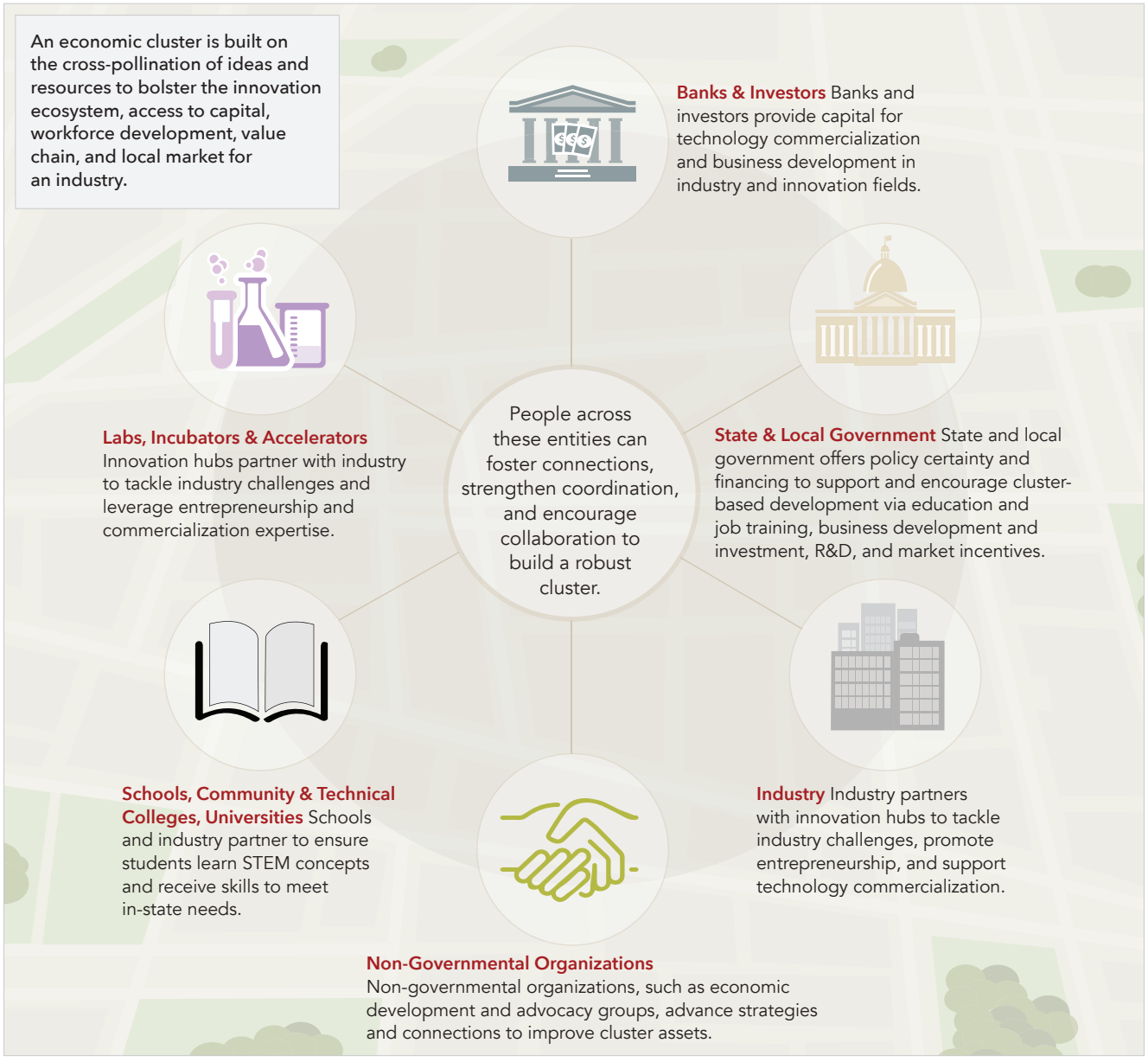


Source: National Skills Coalition

The Benefits of Cluster-Based Development

Economic clusters are regionally situated groups of interconnected companies and institutions organized around a particular industry. In today's competitive globalized economy, businesses are more likely to thrive in cities and states that cultivate the foundational building blocks of cluster development: a rich innovation ecosystem, fertile ground for capital investment, a highly skilled workforce, a robust value chain, and clear policy signals. In South Carolina, multiple studies have identified cluster-based development as key to increasing the state's economic competitiveness. This strategy has especially seen success with South Carolina's automotive cluster, recruiting new businesses to the value chain and embedding them in the state's advanced research infrastructure. Geographic proximity and repeated exchanges of information help foster an environment of coordination and cooperation among companies and institutions, leveraging a trained workforce and each actor's unique expertise. By having a close network of suppliers and partners, companies can reap the benefits of increased productivity and operational efficiency, amplifying local job creation and economic growth.

HOW DOES AN ECONOMIC CLUSTER WORK?



SOUTH CAROLINA'S ECONOMIC OPPORTUNITY IN OFFSHORE WIND

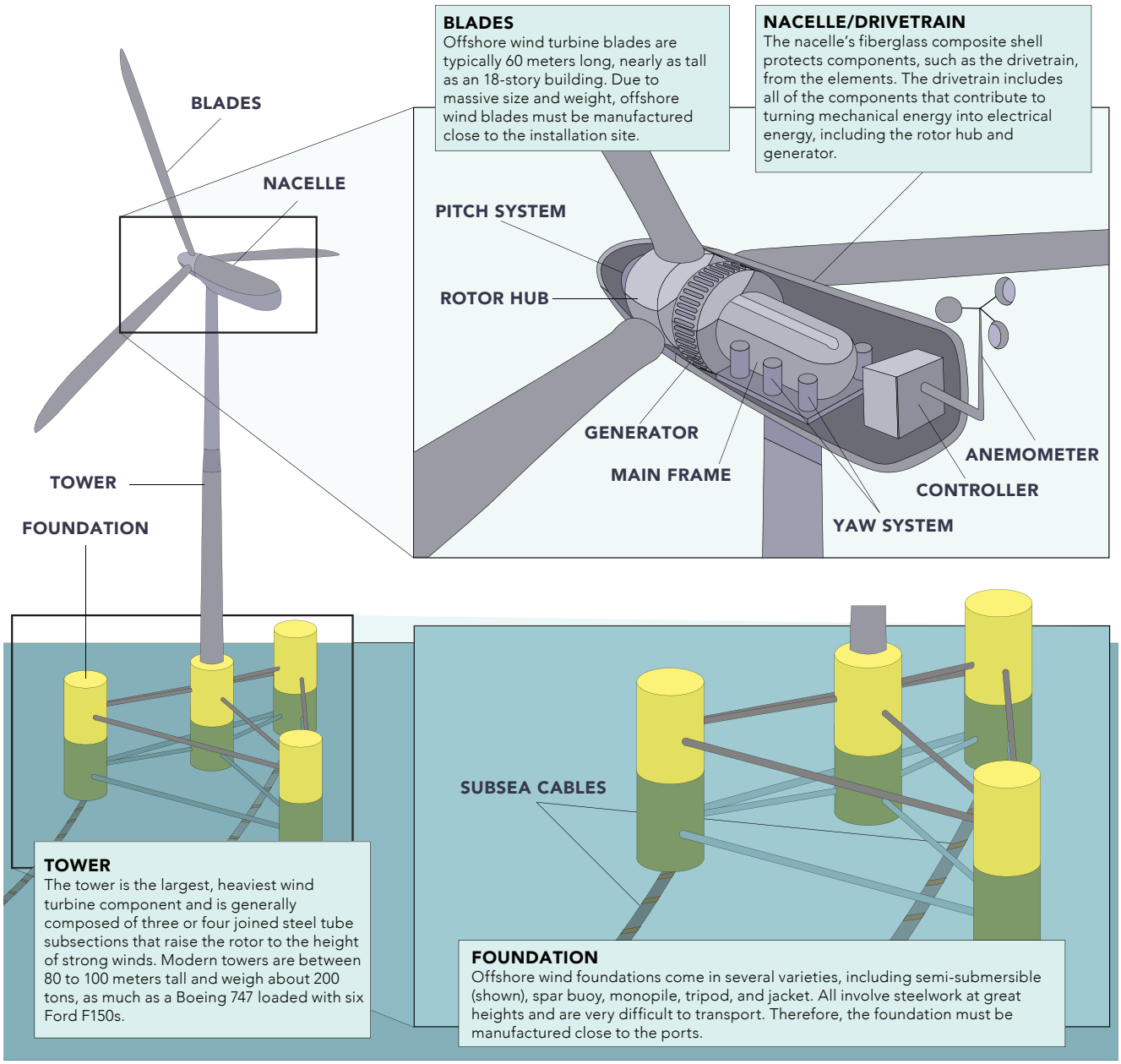
South Carolina is well positioned to capitalize on rising market demand for offshore wind given the state's globally competitive drivetrain research facility, robust ports and transmission system, and network of manufacturers able to serve the offshore wind industry.

SOUTH CAROLINA'S ECONOMIC OPPORTUNITY IN OFFSHORE WIND

Offshore wind turbines harness the energy of strong ocean winds. As an emerging industry in the United States, offshore wind generates energy from fast, consistent wind speeds and can be leveraged to meet the vast energy needs of coastal states. Offshore wind technology is also evolving rapidly to include larger turbines and floating foundations, expanding wind generation potential. South Carolina can carve out a role in this industry by harnessing its strengths in offshore wind manufacturing and innovation to catalyze economic growth and job creation.



Anatomy of an Offshore Wind Turbine



Why Offshore Wind in South Carolina?

Opportunity to Capitalize on Growing Demand and Falling Costs for Offshore Wind

Global demand for offshore wind continues to rise. In 2017, installations increased 95 percent over the prior year, with an additional 4.3 GW installed worldwide. Between 2017 and 2030, the global offshore wind industry is projected to grow 16 percent each year. Not only is demand rising for offshore wind, but costs are falling: The levelized cost of energy (LCOE) of offshore wind dropped 17.6 percent from 2010 to 2016. The LCOE for offshore wind is expected to

further decrease by 68 percent from 2010 to 2020. In the long term, costs are forecasted to decline from 13 cents per kWh in 2015 to 6 cents per kWh in 2030.

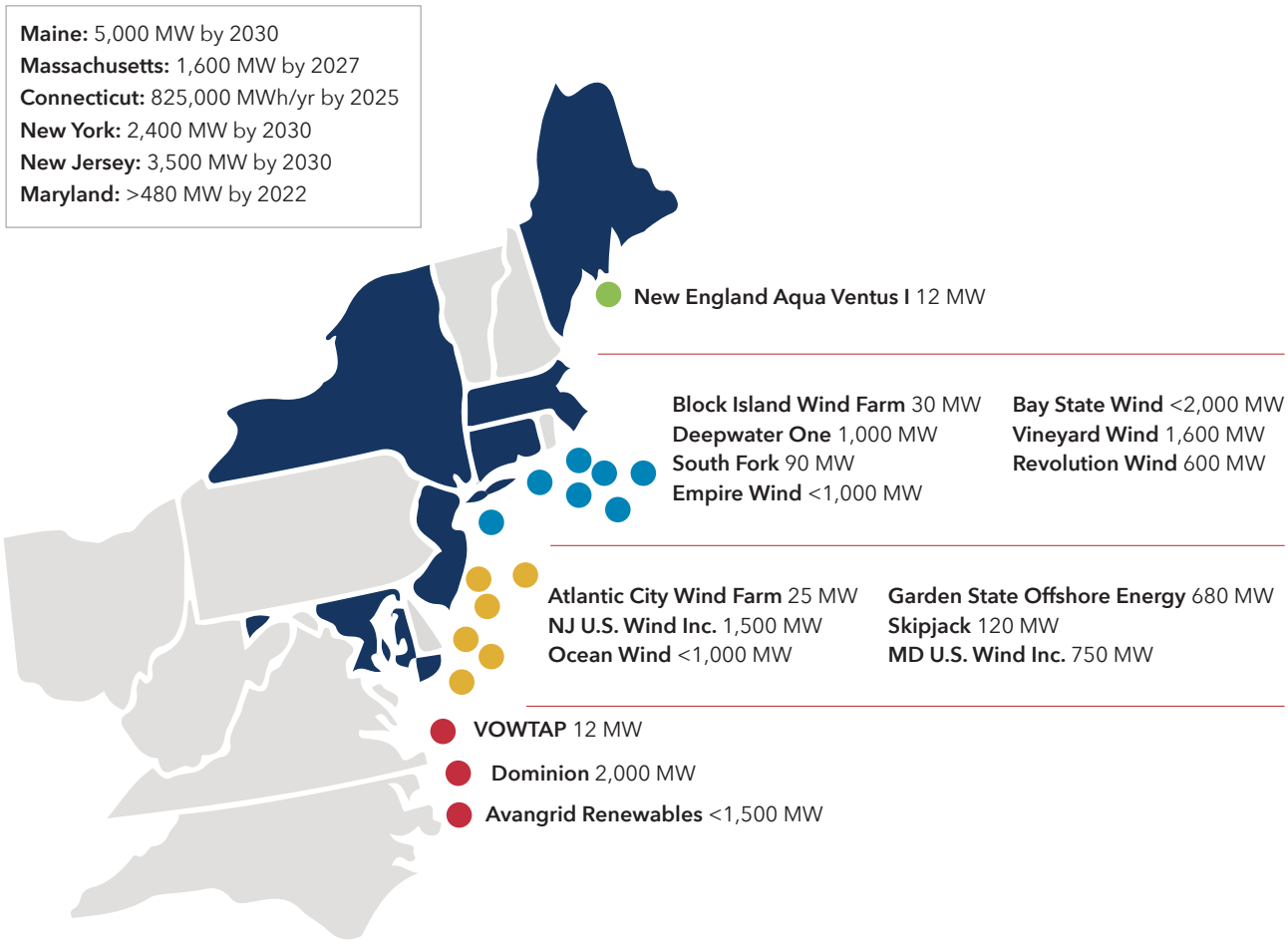
In the United States, there are more than twenty planned offshore wind projects with an estimated 24 GW of capacity. Buildout in the Atlantic Coast could top 8 GW by 2030. These states have indicated reliable levels of regional demand to warrant value chain development: Massachusetts alone plans to procure 1.6 GW of offshore capacity and New York is exploring up to 1 GW of offshore production in partnership with Statoil, with a goal of reaching 2.4 GW of offshore deployment by 2030. The offshore industry in the Southeast is also beginning to take off, with Avangrid Renewables winning North Carolina's offshore lease in March 2017. Because most manufacturing will have to take place on the coast due to the size of components and transportation needs, states like South Carolina are positioned to capitalize on market opportunities created by regional offshore wind development.

South Carolina's Offshore Wind Generation Potential: South Carolina has the sixth-highest net technical energy resource potential in the United States. Offshore wind power could meet more than fifty times the state's electricity needs, with about 130 GW of offshore wind resources at a ninety-meter hub height.

Opportunity to Leverage Cutting-Edge Research

South Carolina's research sets the stage for the state to be a global leader in the field, while also preparing it for local deployment. Clemson University's massive, ship-accessible drivetrain testing facility located in

OFFSHORE WIND STATE GOALS AND PLANNED PROJECTS





North Charleston was built in 2013 and funded in part by a $45 million U.S. Department of Energy grant. The testbed received $53 million in matching funds and is operated in partnership with SCE&G. The largest of its kind in the United States and one of the biggest in the world, the Clemson lab has the ability to test wind turbines up to 15 MW. Moreover, the testbed can assess nacelles, blade force simulations, and is also capable of simulating U.S. and European grid frequencies. MHI Vestas entered a $35 million agreement with Clemson in October 2017 to test its most powerful offshore wind turbine. Given the trend toward increasingly large turbines, like GE's proposed 12 MW Halaide-X, South Carolina is uniquely positioned to capture industry R&D investment.

South Carolina's research strengths are not limited to testbeds. Numerous studies have been performed by universities, local utilities, state officials, and the federal government to assess South Carolina's potential to deploy offshore wind. Santee Cooper and Coastal Carolina University have gathered wind data via buoys and SODAR (sonic detection and ranging) as well as designed interactive and integrated ocean-atmosphere-wave model systems for applications including wind resource and storm simulations. Corporate innovation, largely by GE, and local entrepreneurship also rank the Greenville region as having the highest number of wind energy patents in the United States. Through strategic engagement with the Partnership for Offshore Wind Energy Research (POWER-US), South Carolina can build focused programs that leverage existing assets, fill research gaps, and emphasize student engagement.

Opportunity to Mobilize Existing Manufacturing and Industry Assets

The Palmetto State is home to many companies that can profit from the offshore wind industry, including fifteen active wind manufacturing facilities. South Carolina-based manufacturers Nexans and Prysmian Group are ideally suited to export high-voltage subsea cables for regional projects, filling a critical gap in the U.S. offshore wind value chain. In fact, Nexans will complete expansion of its Goose Creek plant to enable subsea cable manufacturing in 2020. Iljin could also target the offshore wind market with its wind turbine bearings. Major manufacturing companies such as Siemens and Timken could also leverage their expertise in the global offshore wind industry and expand their in-state operations to include offshore wind products. The state also offers an abundance of steel and other raw materials as well as low costs for manufacturing operations, distribution warehousing, and offshore wind construction. Three South Carolina locations ranked in the top five in an assessment of cost-competitiveness when compared to twenty strategic logistics locations in the United States.

Moreover, South Carolina has a competitive edge in offshore wind due to synergy with existing industries including automotive instrumentation, advanced composites, shipbuilding, and logistics. Instrumentation deployed in the automotive industry overlap with data collection and modeling needs for energy production, ocean and atmospheric observation, and storm forecasting to assess offshore

wind. Advanced composites made by firms including Toray, Chromarat, and PPG could help manufacturers meet the need for lighter, more durable offshore wind components. Large-scale ship-rebuilding facilities in South Carolina could build specialized installation vessels needed for the offshore wind industry. The state's strong logistics industry could lend its expertise to the complicated permitting, installation, operations, and maintenance needs of offshore wind.

Opportunity to Harness Robust Infrastructure Assets

South Carolina's infrastructure can meet the physical demands of the offshore wind industry. The Port of Charleston is a deep-water port that could be used for manufacturing or staging of offshore wind. Its cargo service is able to support large wind turbine components, while barge access to industrial sites near the Port of Charleston enables moving components to port. Other ports in South Carolina with shallower water depths and lower live load capacities, such as the Port of Georgetown, could host operations and maintenance vessels and other activities. Not only can South Carolina's ports handle the manufacturing and staging of offshore wind turbines, but the state's electrical grid is robust enough to support power from offshore wind. Grid studies conclude that South Carolina's grid could handle 1,080 MW of offshore wind by 2020 with only moderate investments.

Opportunity to Support Good-Paying Jobs

Offshore wind manufacturing and innovation could bolster South Carolina's economy while offering a diverse array of employment opportunities that cater to different education and experience levels. With forward-thinking solutions, the offshore wind industry could support an annual average of 847 South Carolina jobs through 2035. (*See Appendix for jobs modeling methodology.*) These jobs are based on the development, installation, and operation of offshore wind farms in South Carolina as well as component manufacturing for local and regional projects.

JOB OPPORTUNITIES IN OFFSHORE WIND



Electrical & Electronics Engineering Technicians
Assist engineers with design and development.

TYPICAL ENTRY-LEVEL REQUIREMENTS:
Associate Degree

Wage: $27.62



Computer-Controlled Machine Tool Operators
Operate computer-controlled machinery to tool metal or plastic parts.

TYPICAL ENTRY-LEVEL REQUIREMENTS:
High-school diploma or equivalent with technical and on-the-job training

Wage: $20.24



Industrial Production Managers
Oversee the daily manufacturing operations.

TYPICAL ENTRY-LEVEL REQUIREMENTS:
Bachelor's Degree

Wage: $53.62



Mechanical Engineers
Design and develop mechanical equipment.

TYPICAL ENTRY-LEVEL REQUIREMENTS:
Bachelor's Degree

Wage: $39.88



Construction Laborers
Perform physical labor on construction site.

TYPICAL ENTRY-LEVEL REQUIREMENTS:
On-the-job training

Wage: $13.59

STATE ASSETS TO SUPPORT OFFSHORE WIND CLUSTER DEVELOPMENT

There are five foundational building blocks for clusters: innovation ecosystem, access to capital, workforce development, value chain, and local market. South Carolina has many assets that can be aligned with cluster-based development, including its drivetrain research facility, potential offshore wind manufacturing network, business-friendly climate, startup support programs, and workforce training incentives.

STATE ASSETS TO SUPPORT OFFSHORE WIND CLUSTER DEVELOPMENT

South Carolina can capitalize on its strengths in offshore wind by strategically building an economic cluster. Clusters require several foundational building blocks coordinated for growth: an innovation ecosystem that cultivates new ideas, access to capital for new and expanding businesses, education and training for a skilled workforce, a comprehensive value chain, and a local market for South Carolina-made goods. When reinforced by clear market signals and policy certainty, these assets translate into major opportunities for business growth and job creation in the target industry, laying the groundwork to catalyze economic opportunity for hundreds of South Carolinians.

The following visual guides break down the key assets for a robust cluster. This section will use these guides to illustrate the state's strengths in each foundational building block and showcase significant resources for South Carolina's offshore wind industry.



Innovation Ecosystem: Innovation is essential for business and industry competitiveness, and a strong knowledge hub can be a beacon for talent and investment. The innovation ecosystem supports fundamental research across universities and labs, fosters an entrepreneurial culture that seeks to advance and disrupt industries, and brings ideas to market.



Access to Capital: Access to investors or competitively priced non-dilutive capital can be the difference between success and failure for a new or expanding business. It is also important for consistent access to capital across development from the seed and early/growth stages to the late stage. An active investment environment can attract more entrepreneurs and investors to the state.



Workforce Development: Trained and skilled workers are fundamental to industry success, and strategic workforce development can support talent recruitment and retention. Workforce development requires collaboration across schools, businesses, and government offices to integrate STEM education, foster industry-ready skills via apprenticeships and career-integrated curriculum, enable stackable credentials that offer multiple entries and exits, and provide resources that match skills to available jobs.



Value Chain: An industry value chain is composed of an array of companies engaged in the manufacturing, sale, marketing, and distribution of technologies. It also includes organizations that represent business interests across platforms. This base provides a solid foundation from which to attract more companies and customers.



Local Market: Creating a local market for products sends a market signal to businesses that encourages investment in new facilities and employees. High local demand can attract a local company base that could then expand to regional, national, and global markets. Clear utility and business regulatory environments coupled with resources for project development and end-user adoption can create a strong local market.

SOUTH CAROLINA'S INNOVATION ECOSYSTEM ASSETS

Working Together to Bring Ideas to Market

Key components of an innovation ecosystem are technical, financial, and capacity-building resources that support entrepreneurship, research and development, and commercialization. South Carolina has a growing entrepreneurial culture supported by its research universities and industry partners. South Carolinians can utilize these assets to foster technological innovation and launch startups in the offshore wind industry.



Research & Development

- **Clemson University's SCE&G Energy Innovation Center:** A research and testing facility for next-generation wind turbine drivetrains and grid integration, with current partnerships with MHI Vestas Offshore Wind and General Electric.
- **South Carolina Sea Grant Consortium:** A collaborative network of academics, scientists, government officials, and concerned citizens developing strategies for South Carolina's coast.
- **SmartState Program:** A program that leverages state lottery funds to establish Centers of Economic Excellence, which have sparked over 580 inventions and more than 10,000 new jobs.
- **McNAIR Center Composites Research**
- **Clemson Composites Center**

Entrepreneurship

- **Clemson University's Spiro Institute for Entrepreneurial Leadership**
- **USC's Faber Entrepreneurship Center**
- **USC/Columbia Technology University Incubator (Columbia Region)**
- **The Harbor Entrepreneur Center (Charleston Region)**
- **NEXT (Upstate Region)**
- **Department of Commerce Office of Innovation's Startup Fuel Challenge Grants**

Commercialization

- **South Carolina Research Authority:** A nonprofit that offers direct services to advanced materials/manufacturing, information technology, and life sciences startups and fosters connections across startups, academic institutions, and industry.

SOUTH CAROLINA'S ACCESS TO CAPITAL ASSETS

Investing in New and Growing Businesses

Key components of access to capital are diverse and robust funding for seed-stage, early/growth-stage, and late-stage businesses. South Carolina offers a slate of capital resources, but the state could scale up private investment and follow-on funding to support the robust growth of offshore wind-related businesses.



SC Launch: Startup businesses in advanced materials/manufacturing, information technology, and life sciences can tap into over $6 million in early-stage funding, provided by business contributions to the Industry Partnership Fund. Potential support includes equity investment, SBIR/STTR matching, acceleration grants, and demonstration project funding.

Technology Maturation Fund Program: Clemson faculty can apply for commercialization grants from the Clemson University Research Foundation, which may range from $10,000 to $50,000.

Loan Participation Program: Small businesses can access flexible short- and long-term lending options.

Angel Groups: VentureSouth represents a network of angel groups across the Southeast, including the Upstate Carolina Angel Network and Capital Angels. Charleston Angel Partners is also an established funder in the region.

Venture Capital Firms: Alerion Ventures and Capital A Partners are among a few venture capital firms with a presence in South Carolina and investments in in-state businesses.

Angel Investor Tax Credit: Angel investors can claim a 35% tax credit on qualified investments. This incentive expires at the end of 2019.

R&D Tax Credit: Taxpayers can claim a tax credit equal to 5% of qualified research expenses and limited to 50% of their annual tax liability.

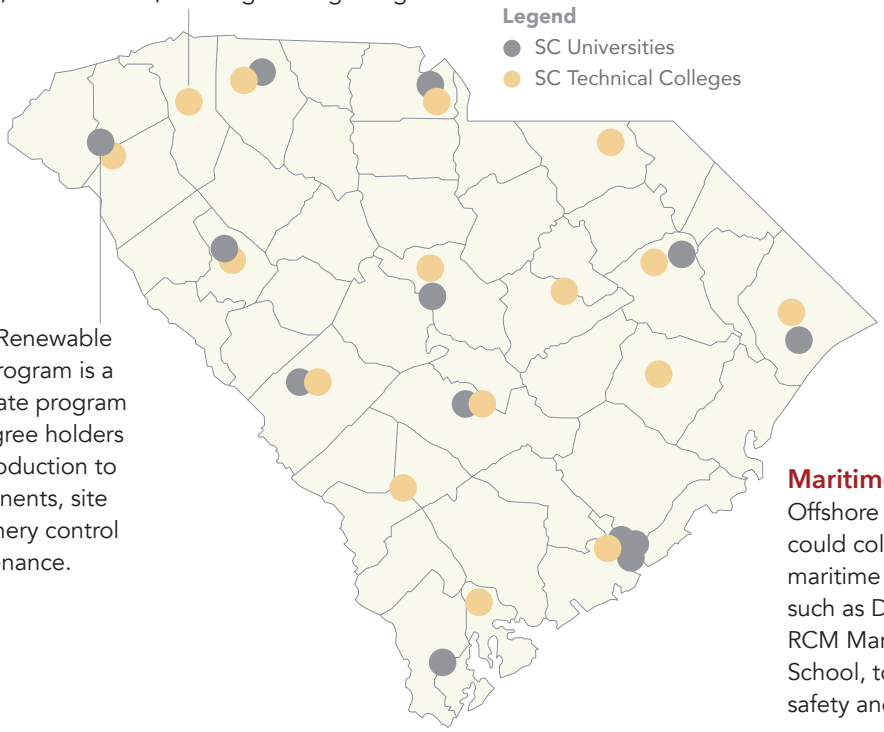
SOUTH CAROLINA'S WORKFORCE DEVELOPMENT ASSETS

Building a Skilled Industry-Ready Workforce

Key components of workforce development are STEM education, work-integrated learning, flexible career pathways, apprenticeships, skill-matching resources, and interagency cooperation. South Carolina only has one wind training program in the state, but offshore wind businesses can leverage the state's higher education network, skilled technical workforce, and favorable training incentives to prepare South Carolinians for these jobs.

Advanced Manufacturing Training

Greenville Technical College Center for Manufacturing Innovation is one of many technical college programs offering degrees, certificates, corporate training, and continuing education opportunities in advanced machining, mechatronics, and engineering design.



Wind Training

Clemson University Renewable Energy Certificate Program is a three-course certificate program available to B.S. degree holders that includes an introduction to wind turbine components, site assessments, machinery control systems, and maintenance.

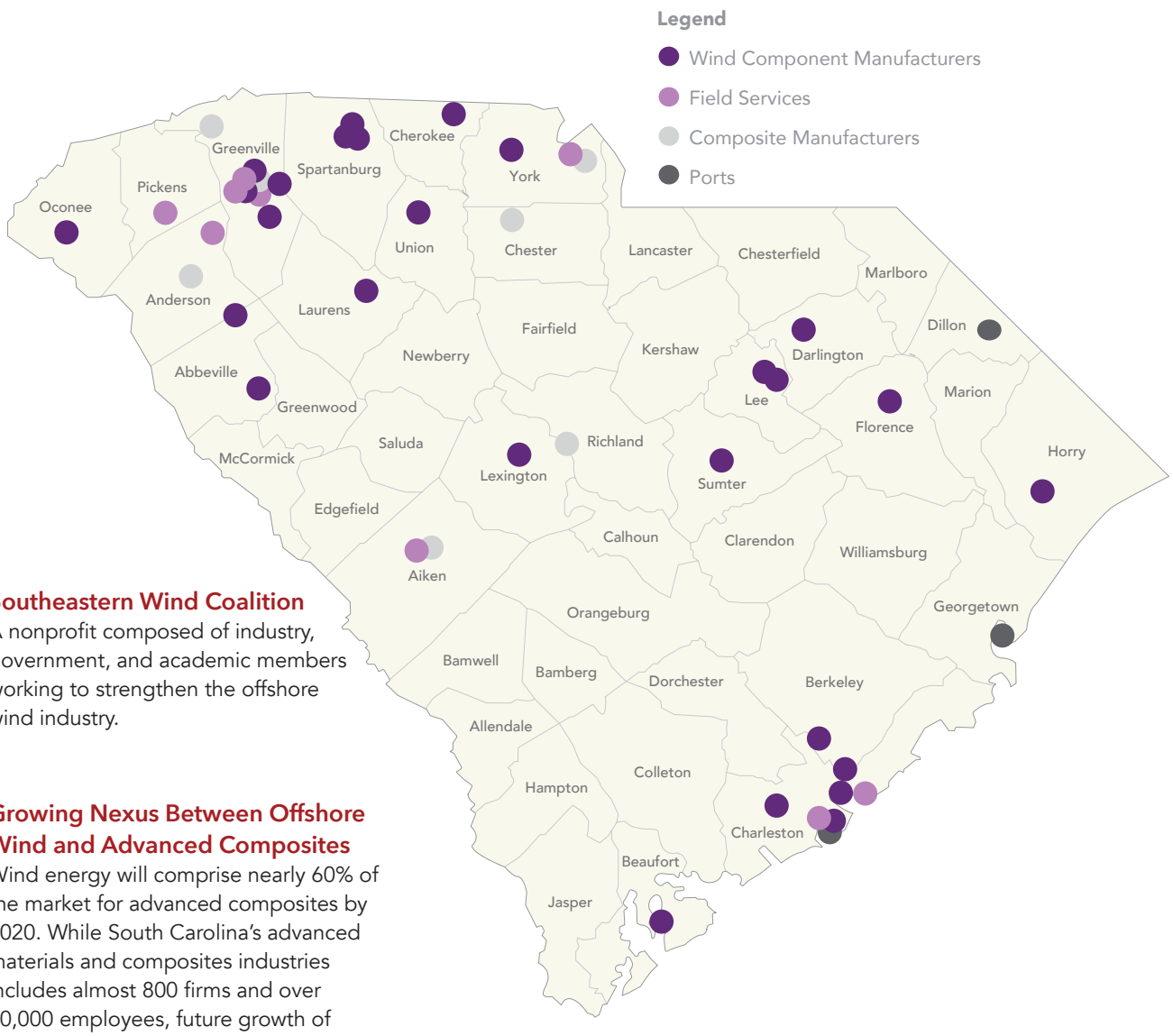
Maritime Training

Offshore wind developers could collaborate with maritime training programs, such as Downeast Maritime, RCM Maritime, and Sea School, to train workers on safety and rescue procedures.

WORKFORCE SNAPSHOT	PROGRAM SNAPSHOT
• South Carolina has a high concentration of skilled technical workers in manufacturing, scientific and engineering fields. • Only 42 percent of working-age South Carolinians have a post-secondary credential.	• readySC provides low-cost training and recruitment services for new and growing businesses and has served about 289,000 workers since its inception. • Apprenticeship Carolina offers a $1,000 tax credit per apprentice per year to employers to help offset planning and administration costs. Over the past ten years, the number of programs has increased tenfold and now supports about 14,400 apprentices and an average of 120 more each month, totalling over 26,800 served. • Enterprise Zone Retraining Program reimburses manufacturing and processing companies up to $1,000 per employee for the training and education of full-time first line workers and supervisors.

SOUTH CAROLINA'S VALUE CHAIN ASSETS
Expanding In-State Industry Capabilities

Key components of an industry value chain are businesses that anchor manufacturing, supply, installation, operations and maintenance, project development, construction, and resource extraction as well as resources that support business attraction, retention, and advocacy. Although there are no U.S. suppliers of the high-voltage subsea cables that are needed for coastal transmission, South Carolina boasts several manufacturers, research institutions, and large ports that could support offshore wind production.



Southeastern Wind Coalition

A nonprofit composed of industry, government, and academic members working to strengthen the offshore wind industry.

Growing Nexus Between Offshore Wind and Advanced Composites

Wind energy will comprise nearly 60% of the market for advanced composites by 2020. While South Carolina's advanced materials and composites industries includes almost 800 firms and over 30,000 employees, future growth of state's offshore wind industry will rely on innovations in composites manufacturing such as carbon fibers, carbon nanotubes, and graphene. These coatings help increase durability, protecting wind turbines from corrosion and wear.

SOUTH CAROLINA'S LOCAL MARKET ASSETS

Encouraging Investment in South Carolina-Made Goods

Key components of a local market are end-user and project development resources, a favorable energy regulatory environment, and a business-friendly climate. South Carolina is among the best states for manufacturing thanks to a favorable tax environment and business incentives. Policies and programs that encourage offshore wind development could help attract these manufacturers and value chain companies to the state.



BUSINESS-FRIENDLY CLIMATE

Renewable Energy Systems and Components Tax Credit: New or expanding renewable energy manufacturers can claim a corporate income tax credit equal to 10% of their investment in production facilities and equipment and up to $500,000 for one year. This incentive expires at the end of 2019.

Low Offshore Wind Construction Costs: A 2010 EIA study found that South Carolina had among the lowest project costs in the country.

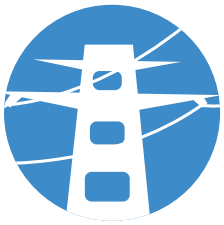
Port Volume Increase Credit: Companies that leverage state port facilities and increase their cargo volume by 5% from base-year totals are eligible for a tax credit. The incentive is capped at $8 million per year for all recipients.

Investment Tax Credit: New or expanding manufacturers can claim a one-time credit against corporate income tax for up to 2.5% of their investment in new production equipment.

Job Development Credit: Expanding businesses that create at least 10 new full-time jobs can receive up to $3,250 per new employee per year.

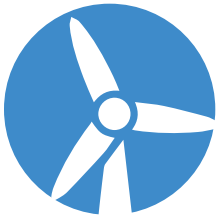
Sales Tax Exemption for Manufacturing Machinery

Economic Development Set-Aside Program for Business-Related Infrastructure Improvements



ENERGY REGULATORY ENVIRONMENT

Distributed Energy Resource Program: Utilities may recover costs that enable them to derive 2% of their electricity supply from renewables, including wind, by 2021. However, they are nearing this limit two years early, largely with solar investments.



END-USER & PROJECT DEVELOPMENT RESOURCES

Commercial Leasing: In 2015, the U.S. Bureau of Ocean Energy Management (BOEM) published a Call for Information and Nomination to gauge interest in wind development off the coast of South Carolina.

POLICY RECOMMENDATIONS

To grow the offshore wind industry, state and local leaders can address barriers and capitalize on opportunities across foundational building blocks, such as expanding entrepreneurial resources, increasing available capital for businesses, bolstering job readiness and technical skills development, mapping strategic value chain assets, and encouraging local offshore wind projects. These forward-thinking policies, programs, and ideas are intended to serve as stepping stones to discussion and collaboration.

POLICY RECOMMENDATIONS

To help create hundreds of jobs and strengthen the state's manufacturing industry, South Carolina's leaders can capitalize on the state's competitive strengths and demonstrate their commitment to the offshore wind industry by enacting smart, forward-thinking policies and implementing non-legislative solutions. In particular, state and local leaders can pursue strategies that address barriers and missed opportunities across foundational building blocks, as noted by the icons. These broad strategies include fostering technology development and commercialization, increasing business access to financial resources, improving workforce training, and growing the in-state value chain. South Carolina can also build a local market for offshore wind products as an opportunity for industry growth. Robust demand near manufacturing facilities can help create synergies that drive innovation, train and retain talent, and attract out-of-state investors.

Whether taken as a whole or as piecemeal solutions, the following recommendations could attract private investment, stimulate the state's economy, and create good-paying jobs for South Carolinians. Although they draw on model policies and programs from elsewhere, state and local leaders can also advance novel solutions that become case studies for other states.



Innovation Ecosystem: Fosters an entrepreneurial spirit and builds "connective tissue" in the offshore wind research and entrepreneurial community.



Access to Capital: Stimulates investment activity and diversifies available capital for offshore wind businesses.



Workforce Development: Strengthens educational pathways for job readiness skills development and technical training for the offshore wind industry.



Value Chain: Maps strategic assets for offshore wind development and leverages them for business recruitment and regional collaboration.



Local Market: Creates a favorable environment for offshore wind development at the community and regulatory levels.

Policy 1: Foster the Commercialization Culture at Universities

OPPORTUNITY

Universities with a strong focus on entrepreneurship and commercialization experience numerous benefits, including improved industry relations and funding opportunities, increased regional economic development, and positive publicity for recruitment and retention of faculty and students. While universities continue to serve as research hubs for emerging technologies, they have historically encouraged faculty members to publish more than explore commercializing research. Furthermore, university resources may stop short of the walls of the institution, limiting entrepreneurial connections with the broader community and support for startups once they spin out from the university. In the Milken Institute's 2017 report on top universities in technology transfer, Clemson University ranked 57th and USC ranked 122th, with both scoring low on licenses issued and startups formed. South Carolina's universities have an opportunity to enable homegrown innovations to play a larger role in the global economy by embracing a culture that rewards advanced technology development and commercialization. As South Carolina invests more in offshore wind, a stronger university commercialization culture could foster entrepreneurial ideas that boost the state's industry competitiveness.

SOLUTION

South Carolina universities could adopt policies and programs that support entrepreneurship among faculty, students, alumni, and the community. To specifically target faculty entrepreneurs, universities could acknowledge faculty members for authoring patents or accelerating university innovation by expressly including technology transfer activities in the criteria considered for promotion and tenure (*see call-out box*). A complementary policy could be to allow one- to two-year entrepreneurial leaves of absence for faculty, during which fringe benefits are still available and accruable, as implemented at the University of Minnesota (*see case study*). South Carolina universities could also create startup support programs to help faculty and students take their ideas to market, not just assist with the patent application process. Program services could include connecting faculty members and graduate students with seasoned entrepreneurs and commercialization boot camps, as seen at the University of Utah (*see case study*).

South Carolina universities could also expand their impact by building entrepreneurial connections with the broader community. Specifically, university offices and programs that provide direct support to entrepreneurs could establish pre-negotiated relationships with local service companies frequently used by spinouts, a strategy that has seen success at the University of California, Los Angeles (*see case study*). This effort could ensure a safe and streamlined on-ramp for startups as well as build stronger ties across the entrepreneurial ecosystem.

While South Carolina excels at spurring corporate-sponsored research, as seen with the Clemson University International Center for Automotive Research and USC's McNair Center for Aerospace Innovation and Research, the state's universities could also proactively facilitate startup-industry exchanges. For example, universities could pitch industry challenges to entrepreneurs based at university-affiliated incubators and accelerators, in addition to students and researchers who are typically engaged. They could also play a more active role at connecting local businesses with startups that may have technologies of interest to them, expanding the opportunity for partnerships, mentorships, and investments. By cultivating strategic connections, South Carolina universities could attract more corporate innovation arms to the state, retain local startups, and support regional economic development.

Any or all of these activities could stimulate commercialization, capitalize on regional industry opportunities, and further embed South Carolina universities in the entrepreneurial ecosystem. These efforts could be led by the Clemson Office of the Provost and USC Office of Economic Engagement with support from the Clemson University Research Foundation, USC/Columbia Technology Incubator, and South Carolina Research Authority.

Key Players: Clemson Office of the Provost, USC Office of Economic Engagement, Clemson University Research Foundation, USC/Columbia Technology Incubator, South Carolina Research Authority



Case Study: University of Minnesota

The University of Minnesota's entrepreneurial leave of absence policy allows faculty members up to eighteen months of unpaid leave to explore commercializing university intellectual property without compromising their benefits. While faculty members pursue startup projects, they continue to maintain health benefits, accrue vacation time, and earn other fringe benefits. In addition to the Venture Center, the policy is among a slate of resources that University of Minnesota advanced to maximize the impact of internal research and strengthen connections to the local business community. This effort has fostered a robust startup ecosystem that includes over 120 spin-offs since 2006, with 78 percent still active. The University of Minnesota ranked fourteenth on the Milken Institute list of top commercialization universities.

Case Study: University of Utah

In 2007, the University of Utah launched the Entrepreneurial Faculty Scholars (EFS) program to create a broad network of support for faculty members commercializing their research. The network of 155 seasoned faculty entrepreneurs university-wide help faculty members take their ideas to market. Alongside EFS, the seven-week Lean Cohort accelerator program helps faculty navigate commercialization. As a result of the strong culture of innovation, the University of Utah produced $211.8 million in licensing income and supported sixty-nine startups between 2012 and 2015. The University of Utah ranked first on the 2017 Milken Institute Innovation Index.

Case Study: University of California, Los Angeles (UCLA)

UCLA has created a dedicated program for university community members looking to commercialize, which has resulted in multiple startups. The "Startup in a Box" program aims to launch startups using university intellectual property. The program offers pre-negotiated partnerships with local law, accounting, commercial real estate, marketing, web, human resources, insurance, and financial firms. Due in part to this initiative, UCLA ranked first for the number of startups in the 2017 Milken Institute report. As of fiscal year 2016, UCLA has $65.9 million in revenue from licensing and 1,075 active U.S. patents.

Sample Language for Incorporating Entrepreneurial Activities in Tenure and Promotion Review

- **Virginia Polytechnic Institute and State University (Virginia Tech)**
  - "Economic contributions and entrepreneurship: **1.** Start-up businesses (including competitive grants and contracts such as SBIR awards and other notable business achievements), **2.** Commercialization of discoveries, **3.** Other... Intellectual properties: **1.** Software, **2.** Patents, **3.** Disclosures (pre-patent)"
- **The Ohio State University**
  - "… creative works pertinent to the candidate's professional focus:...Inventions and patents, including disclosures, options, and commercial licenses"
- **The University of Arizona**
  - "...integrative and applied forms of scholarship that involve cross-cutting collaborations with business and community partners, including translational research, commercialization activities, and patents"

Policy 2: Facilitate Mentorships for Entrepreneurs Statewide

OPPORTUNITY

Mentorships leverage seasoned entrepreneurs' past experience and current expertise to develop entrepreneurs as individuals and help bring their ideas to fruition. They are an especially valuable and economic strategy for growing the innovation ecosystem: As entrepreneurs gain experience, they can help to pay it forward for others in the field and cultivate a strong innovative spirit. South Carolina has a few entrepreneur-mentoring programs across innovation resources, such as The Harbor Entrepreneur Center, Charleston Digital Corridor, NEXT, and USC/Columbia Technology Incubator. As South Carolina continues to foster organic networking and knowledge-sharing opportunities in the innovation ecosystem, regional efforts to build robust entrepreneur-mentoring programs across the state can help strengthen the entrepreneurial culture and encourage offshore wind innovations.

SOLUTION

More South Carolina communities could replicate the highly successful MIT Venture Mentoring Service (*see case study*), which is the basis of over fifty entrepreneur-mentoring programs internationally, including NEXT's program in Greenville. The program's success is due in large part to an extensive mentor vetting process and a team mentoring approach, which builds accountability and offers entrepreneurs a diverse array of support. Universities, incubators, accelerators, or economic development organizations could adopt this program model to manage a volunteer mentor network and curate mentor-mentee matches. They could also seek grant funding from the Department of Commerce Office of Innovation. An emphasis on regional collaboration could prevent duplicated efforts within regions and tap into local alumni, retiree, and industry networks. Through a distributed mentorship network, entrepreneurs throughout the state could have a front door to people with relevant expertise and connections.

Key Players: Universities, Incubators, Accelerators, Economic Development Organizations, Entrepreneurial Community, Department of Commerce Office of Innovation, South Carolina Research Authority

Case Study: MIT Venture Mentoring Service (VMS)

VMS was established in 2000 by MIT-affiliated serial entrepreneurs with the goal of leveraging university assets to support entrepreneurial ventures. It is a free and confidential entrepreneur-mentoring program exclusively available for MIT community members at any startup stage, from concept development to business operations. VMS employs an extensive screening process to build a highly qualified and committed mentor network that adheres to strict guidelines for confidentiality, financial involvement, and business ethics. The program also prioritizes a team mentoring approach that matches three to four mentors with an individual to build accountability and amplify support. Over 165 mentors have contributed 12,000 volunteer hours to mentoring, program management, and outreach. They have mentored more than 2,500 participants across 1,450 ventures and facilitated over $1.4 billion in funding for VMS ventures. Because of interest from other institutions, VMS created an Outreach Training Program to share best practices and help others replicate and scale the model, resulting in over fifty VMS-trained programs worldwide.

Policy 3: Establish a Venture Catalyst Program to Strengthen Rural Entrepreneurship

BARRIER

Rural South Carolina has been largely left out of economic recovery, with many communities still impacted by unemployment, poverty, and dwindling businesses. While business attraction and targeted recruitment efforts are important for carving a pathway to growth, South Carolina could also build the rural entrepreneurial ecosystem to meet community needs and support economic development. Previous initiatives have delivered entrepreneurial education and support for agribusiness innovations, but the state could also expand rural entrepreneurs' capacity to take other advanced technology ideas to market. Through greater entrepreneurial services and resources, rural communities could better tap into current and projected high-growth markets such as advanced manufacturing and offshore wind.

SOLUTION

South Carolina could pilot a Venture Catalyst program to spur rural entrepreneurship and strengthen the entrepreneurial ecosystem in rural communities. Based on an Oregon model, the Venture Catalyst program deploys seasoned entrepreneurs and investors across regions to serve as coaches, connectors, and strategists (*see case study*). Venture Catalysts operate at three key levels: providing local entrepreneurs business development expertise and connections to training, services, and investors; addressing critical gaps in the entrepreneurial ecosystem, such as pre-accelerator boot camps and angel investment conferences; and coordinating resources across stakeholder groups. The state could broker financial support from philanthropic foundations and leverage resources at the South Carolina Research Authority and Clemson Cooperative Extension. By embedding these resources in South Carolina communities and focusing on entrepreneurial education and capacity-building, South Carolina could bolster local entrepreneurship and create robust pathways for economic development.

> "The return on investment for this initiative has been remarkable wherever the model has been deployed, resulting in not only more successful companies and jobs, but also in the development of critical entrepreneurial infrastructure. In Central Oregon alone, the Venture Catalyst position at EDCO has been key in the growth of the Bend Venture Conference and local PubTalks, as well as the establishment of the region's first accelerator, a regional angel fund, and mentor database, to name a few." – *Oregon Entrepreneurs Network*

Key Players: Economic Development Organizations, Entrepreneurial Community, Department of Commerce Office of Innovation, South Carolina Research Authority, Philanthropic Foundations, Clemson Cooperative Extension

Case Study: Oregon's Venture Catalyst Program

In 2009, the Oregon Entrepreneurs Network (OEN) established the first Venture Catalyst in partnership with Economic Development for Central Oregon (EDCO). Since then, OEN and local partners have supported two more Venture Catalysts in Southern Oregon and the South Willamette Valley. This position is jointly funded by OEN, municipal governments, private foundations, and local community groups. Since 2016, the three Venture Catalysts have supported 500 companies, which account for 346 new jobs and $55 million in revenue. South Willamette Valley's Venture Catalyst, specifically tasked with supporting rural entrepreneurs, has also helped startups obtain over $15 million of investment capital and create 293 jobs since 2014. The program's success likely stems from its focus on education and capacity-building and Venture Catalysts' understanding of local companies. In early 2018, OEN and the Oregon Community Foundation announced plans to expand the program to eleven more counties. The Ford Family Foundation also led investment in a Venture Catalyst for the state's mid-coast region.

Policy 4: Extend and Expand the Angel Tax Credit

OPPORTUNITY

While South Carolina is home to world-class offshore wind R&D, access to capital is critical for local entrepreneurs bringing their technologies to market in the globalized and capital-intensive offshore wind industry. High-growth startups are a significant source of job creation, and South Carolina could facilitate this growth by implementing risk-mitigation incentives and attracting early-stage capital. Angel investors play a particularly important role in this activity, accounting for 90 percent of outside equity raised by startups nationally. In South Carolina, angel groups are increasingly joining together for larger strategic investments to fill the state's startup funding gap.

Historically, South Carolina has promoted early-stage capital for emerging firms in high-growth industries through the Angel Tax Credit. Established by the High Growth Small Business Job Creation Act in 2013, the incentive offers South Carolina angel investors a tax credit of up to 35 percent of an investment made in a qualified in-state business. Out-of-state investors can also claim the credit if they have a tax liability in South Carolina. Qualified businesses must have at most five years of operation, twenty-five employees, a gross income of $2 million, and operations primarily in manufacturing, processing, warehousing, software development, and/or R&D. The state caps total available credits at $5 million per year, with an annual maximum of $100,000 for each investor. In the first year of the incentive, registered startups increased twofold and were more broadly distributed across the state. They attracted more than double the amount of qualified investments over the year, totaling $8.1 million in 2014. Investors also hit the annual credit cap in 2015. Since its inception, the Angel Tax Credit has helped create 527 full-time, 181 part-time, and 118 temporary jobs. Despite showing promising results, the incentive sunsets at the end of 2019.

SOLUTION

In order to cultivate homegrown firms in the offshore wind value chain and other growing industries, the South Carolina General Assembly could strengthen investments by bolstering the Angel Tax Credit. At a minimum, legislators could extend the lifespan of the incentive and consider amending the annual credit caps. In-state investment activity has previously exceeded the total available credits in a year, signaling that the level of interest in South Carolina startups is not being sufficiently met. Eliminating or raising the annual $5 million ceiling could enable more investments and attract new investors. Furthermore, legislators could raise the individual credit cap of $100,000 to encourage larger investments, which could particularly benefit capital-intensive industries such as offshore wind. An expanded incentive could lower the risk profile of investments, leading investors to look towards more high-risk, potentially high-yielding ventures and to commit more capital than they otherwise would have.

Key Players: State Legislature, Angel Investors, Entrepreneurial Community



Policy 5: Increase Funding for the SC Launch Program

OPPORTUNITY

The SC Launch program fills a critical gap in the state's early-stage investment environment, helping startups at a crucial point of development. This program from the South Carolina Research Authority supports advanced technology startups and the entrepreneurial ecosystem with over $6 million each year, mostly provided by business contributions to the Industry Partnership Fund. Through SC Launch, South Carolina startups can tap into an array of support, including equity investments, matching funds for federal Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) grants, acceleration grants, demonstration project funding, and academic startup assistance. The program could benefit the offshore wind industry through direct support for related startups and greater commercialization resources for university-based innovation. Over the last decade, $25 million invested in more than 300 local startups has garnered $600 million in follow-on funding and over 2,000 direct and indirect jobs. By increasing available funding, South Carolina could expand the program's outsized economic impacts.

SOLUTION

South Carolina could increase funding for the SC Launch program by raising the cap on business contributions to the Industry Partnership Fund. Currently, investors can receive a dollar-for-dollar state tax credit from their contribution, with total annual credits capped at $6 million. Each year, investors exceed this cap within minutes. A higher cap could accommodate high demand for the tax credit and allow more people to sponsor the local innovation ecosystem. With additional funding, the SC Launch program could support more South Carolina startups through new programs and larger investments, especially to move offshore wind innovations from lab to market.

Key Players: State Legislature, South Carolina Research Authority, Businesses



Policy 6: Establish an Offshore Wind Business Development Fund for Small Businesses

OPPORTUNITY

Although the offshore wind value chain is driven by large multinational corporations, suppliers and participants can be smaller firms specializing in a niche product or service. South Carolina businesses are particularly positioned to embed themselves into the offshore wind value chain given their capabilities and facilities dedicated to wind component manufacturing, advanced composites, shipbuilding, and logistics. Because of the state's strategic location, these businesses could supply the emerging regional offshore wind market as well as support local projects down the line. However, small and growing firms face steep barriers to entry that may include high administrative costs for bidding on contracts and capital expenditures for retooling operations. South Carolina could leverage funding to help local businesses overcome these barriers and enter the offshore wind value chain.

SOLUTION

The South Carolina General Assembly and Department of Commerce could fund a grant program for local small businesses interested in supplying the offshore wind industry, as modeled in Maryland (*see case study*). Managed by the State Energy Office, these grants could cover operating and capital expenses, such as business travel to solicit contracts and partnerships with offshore wind developers as well as equipment and facility upgrades to retool manufacturing operations. The program could also require a cost share from grantees for specific activities and tie funding to local job creation and increased business activity. South Carolina's small businesses have expertise in areas that lend themselves to the growing offshore wind industry, and state support could expand access to this economic opportunity.

Key Players: State Legislature, Department of Commerce, State Energy Office, Small Businesses



Case Study: Maryland's Offshore Wind Business Development Grant Program

The Offshore Wind Business Development Grant Program provides financial assistance to Maryland companies, especially minority-owned businesses, seeking to enter the offshore wind industry. The program was established by the Maryland Offshore Wind Energy Act of 2013 and is managed by the Maryland Energy Administration (MEA). The program targets two key areas of business development: For market entry, funds can offset bidding costs and associated administrative expenses, and for retooling, funds can cover equipment and facility upgrades needed for offshore wind-related exports. In 2018, MEA awarded $700,000 in grant funding to businesses specializing in welding and fabrication as well as development and construction. This infusion of capital is helping catalyze offshore wind development among the 1,300 businesses located around the Port of Baltimore.

Policy 7: Encourage Program-Related Investments in Offshore Wind Businesses

OPPORTUNITY

Although South Carolina ranks thirteenth in the nation for new startup activity, entrepreneurs regularly encounter barriers ranging from creditworthiness to eligibility when trying to access the necessary capital to start or grow their business. In a single quarter in 2016, over 2,600 businesses closed while 2,700 businesses were created, ultimately depressing employment growth. Because emerging firms in the offshore wind industry face additional barriers such as high administrative costs and capital expenditures, South Carolina could facilitate alternative funding pathways for these companies to jumpstart and sustain operations.

Large national foundations have substantial resources to invest across the country. As opposed to the traditional grant to nonprofit entities, foundations are increasingly making program-related investments (PRIs) in for-profit businesses, nonprofit organizations, and investment funds that advance their charitable mission while generating a financial return. Major philanthropic organizations such as the Rockefeller Foundation, MacArthur Foundation, and F.B. Heron Foundation now incorporate formal PRI programs into their broader strategies. Because PRIs are on mission and returns are not a primary goal, the IRS can treat them similarly to grants, which does not jeopardize foundations' tax status.

SOLUTION

South Carolina could appoint a foundation liaison who builds relationships with foundations and brokers PRIs in local offshore wind businesses. The Governor's Office or Department of Commerce could reach out to leading foundations in the state and enlist their help in appointing a liaison and contributing a portion of the liaison's salary. To reduce investor concerns, the liaison could screen applicant businesses to ensure that potential funding recipients are viable and align with funders' philanthropic missions. The state could also leverage PRIs for advanced energy-focused incubators and accelerators, education and workforce training programs, and other targeted cluster growth opportunities. By increasing PRIs, the liaison could help reduce barriers to capital and create jobs at minimal cost to the state.

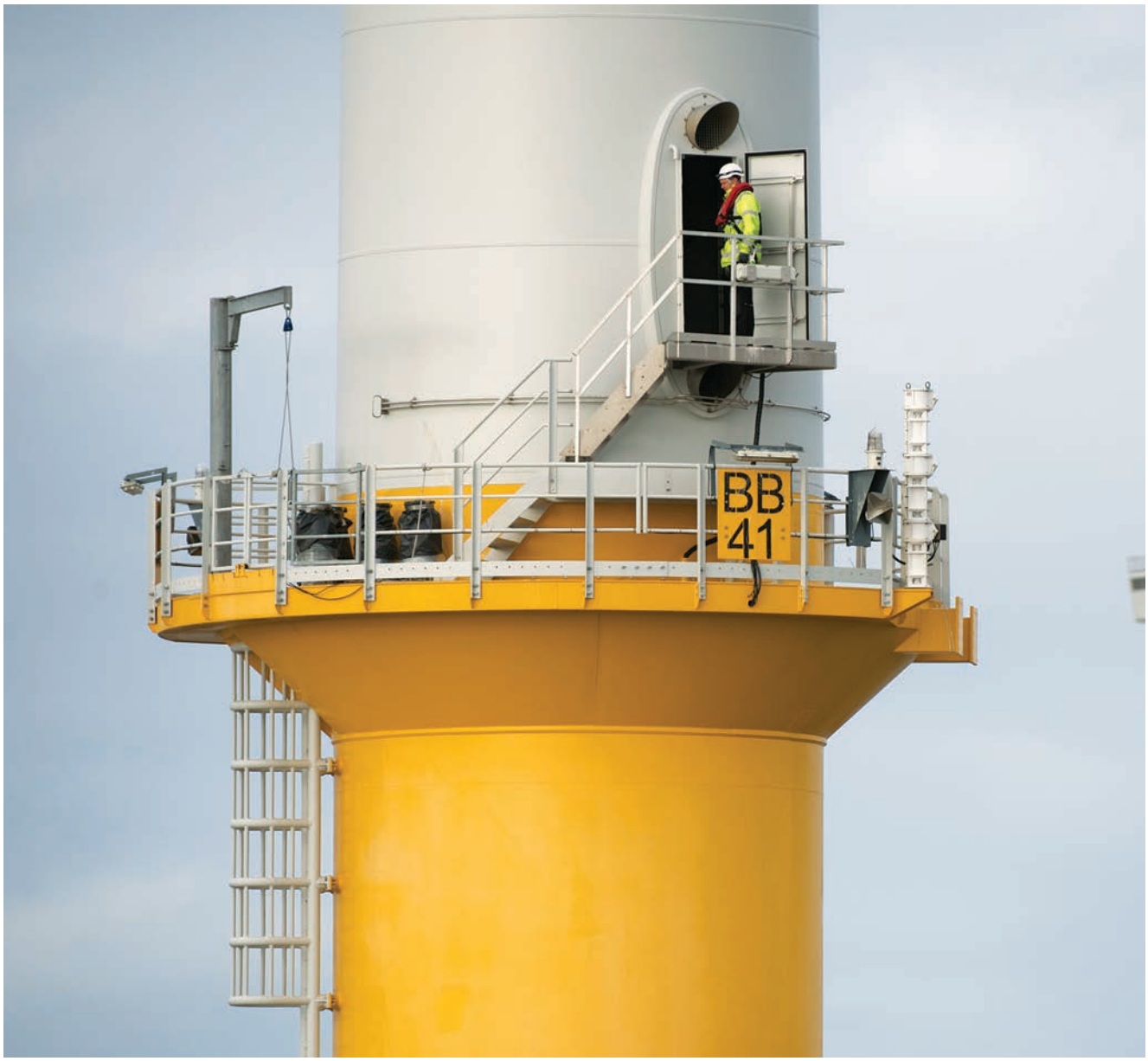
Foundation liaisons have been successful at both the city and state government levels: This role was first leveraged by the Michigan Governor's Office and then implemented by the City of Newark based on the model's success (*see case studies*). Nationally, PRIME Coalition's efforts to solicit PRIs specifically for advanced energy companies have also made an impact and demonstrate foundations' interest in this industry (*see case study*).

In addition to engaging large national foundations, the liaison could build strong connections with local and regional foundations. In 2014, South Carolina's 507 charitable foundations contributed more than $165 million. North Carolina also has over 3,100 foundations, including the Mary Reynolds Babcock Foundation, which has pledged $10 million towards its PRI program to promote economic opportunity in the South. The foundation liaison could ultimately help South Carolina and the grantmaking community leverage one another's investments and efforts, working together to support in-state business, innovation, and jobs in emerging fields like offshore wind.

Key Players: Governor's Office, Department of Commerce, Philanthropic Community

Case Study: Michigan Governor's Office of Foundation Liaison

As the first of its kind in the nation, the Michigan Governor's Office of Foundation Liaison (OFL) builds funding partnerships and strategic collaborations between the state government and the philanthropic community to support programs that improve the education and health of all Michigan residents. Foundations are actively engaged throughout OFL activities. The Foundation Liaison and OFL staff come to the state on loan from participating foundations, while contributing funders and nonprofits partly comprise the OFL Advisory Committee. Since 2003, OFL has brokered investments from seventeen foundations, totaling more than $150 million.



Case Study: Newark Philanthropic Liaison

Based on the success of Michigan's OFL, the Council of New Jersey Grantmakers and the City of Newark established the city's first foundation liaison in 2007. In close partnership with the Mayor's Office, the Office of the Newark Philanthropic Liaison garners and leverages support for public projects from the grantmaking community. From 2007 to 2016, the office brokered over $50 million in philanthropic investments for initiatives such as expanding summer youth employment and improving community literacy.

Case Study: PRIME Coalition

Launched in mid-2015, PRIME Coalition encourages more foundations to prioritize PRIs by connecting them with budding companies. PRIME is a charity that facilitates investments by working with both philanthropic organizations and early-stage, for-profit clean energy companies. PRIME reduces the barriers that make PRIs difficult for foundations by providing industry expertise and connections to best-in-class companies. Although PRIME has started small, it has already facilitated investment in seven companies and is currently working on funding an additional four firms.

Policy 8: Create a Simulated Workplace Program for Job Readiness Skills

BARRIER

South Carolina's workforce faces a soft skills gap. According to a 2015 Department of Employment and Workforce study, employers noted that job candidates' soft skills had room for improvement. In a 2016 South Carolina Business and Industry Survey, business executives listed finding workers with a good work ethic, communications skills, and problem-solving and critical thinking skills among the challenges that "keep them up at night." Individual interviewees suggested that it is especially challenging to find workers who can write competently and professionally as well as maintain a positive attitude for a full-time schedule. These soft skills are critical for success in almost any workplace as identified by the Profile of the South Carolina Graduate, and this certainly applies to the varied work environments of the offshore wind value chain.

SOLUTION

Simulated workplaces modeled on West Virginia's successful program could help develop students' soft skills in South Carolina (*see case study*). Simulated workplaces transform a technical high school classroom into a company by adopting features that mimic a professional workplace. This means larger responsibilities and more accountability: Students have to apply and pass an interview to enroll in a class, clock in when they arrive, submit quarterly reports, and participate in random drug tests. They may also be asked to lead team meetings and undergo business inspections. A pool of vacation days (in addition to school holidays) and the ability to play music in the workplace and take breaks throughout the day offer students some adult freedoms as well. Instructors still teach hard skills, but this non-traditional classroom experience helps instill soft skills that high schools may skim over. Program managers can engage with local employers to tailor learning environments to industry expectations.

Simulated workplaces can bring about a cultural change in classrooms, setting high standards for professional behavior and making students more accountable for their own learning. At the same time, by experiencing a workplace environment as students, young people can recover from mistakes without the consequences they would face as adults. By acclimating them to potential expectations at an early age, simulated work environments could give students a head start on professional success. South Carolina could use this educational innovation to better meet employers' needs.

Key Players: High Schools, Career and Technical Education Centers, Businesses, Department of Education



Case Study: Simulated Workplaces in West Virginia

The West Virginia Department of Education established the first simulated workplaces in 2013 to address local business leaders' need for workers with both technical and professional skills, ranging from punctuality to safety. Funding from the state's workforce development board and employer engagement mobilized by the West Virginia Chamber of Commerce helped drive the program's initial success. Students play the role of employees to transform the classroom into a business environment for technical training, and all simulated workplaces adhere to twelve guidelines designed in partnership with business experts to mimic the needs of West Virginia employers. The model has since been scaled up to support roughly 24,000 students in over 1,200 classrooms each year. Simulated workplaces have a significant impact on student achievement: 37 percent of high school seniors completed a technical degree program in 2016, more than double the rate in 2010, and 98.4 percent of participants graduate drug-free. Ninety-six percent of students and an overwhelming amount of employers approve of the program and its outcomes.

Policy 9: Address the STEM Skills Gap to Boost Manufacturing Employment

BARRIER

Despite the importance of advanced manufacturing to the state's economic roadmap, South Carolina's workforce has a shortage of people with STEM backgrounds. The state awards associate and bachelor's degrees in STEM fields at a lower rate than the national average. South Carolina also ranked forty-third in the 2016 Milken Institute's State Technology and Science Index and has consistently ranked in the bottom five for human capital investment, an indicator that assesses the STEM skill level of states' workforce. In fact, surveys show that a majority of South Carolina manufacturers cannot find people to fill their skilled jobs. This shortfall is a warning sign to any firm considering locating in South Carolina and inhibits growth of the state's manufacturing sector.

South Carolina's strong business growth creates ample demand for workers; meanwhile, the state's low labor force participation rate indicates that there are unusually large numbers of working-age adults who are not working or looking for work. As outlined in the Profile of the South Carolina Graduate, STEM training and readiness programs could be the difference maker in resolving this mismatch, putting more people to work while ensuring South Carolina's continued economic dynamism. However, retraining workers who have been out of the workforce for a long time is a major challenge, often requiring remedial education in basic literacy and math competency. In addition, South Carolina has the third-highest rate of illiteracy in the nation, and employers report a shortage of workers with competent literacy and communications skills. This forms a barrier to success in community college programs, which require students to complete developmental courses before enrolling in a field of study.

SOLUTION

South Carolina could help its disenfranchised workers get over the remedial hump and build the STEM workforce it needs by expanding integrated basic education and skills (I-BEST) programs, such as the one currently offered at Tri-County Technical College. I-BEST programs address the basic skills barrier to workforce training by helping students develop basic math and literacy competency alongside professional and technical training tied to a specific in-demand career pathway. I-BEST courses are taught by two instructors: Professional technical curriculum is taught by an experienced professional, while basic skills instruction is led by an expert in programs such as Adult Basic Education (ABE), English as a Second Language (ESL), and General Education Development (GED). Originated in Washington State (*see case study*), I-BEST programs have been successfully implemented across the country, providing a number of models that South Carolina could look to.

South Carolina could use I-BEST programs to engage unemployed, underemployed, and disenfranchised workers and get them on the fast track to filling the state's high number of job openings. To tailor the program to South Carolina's labor environment, curricula could focus on skills needed for advanced manufacturing occupations. As the offshore wind industry develops, the program could expand to include training programs specifically dedicated to the needs of offshore wind value chain.

Key Players: Technical Colleges, State Board for Technical and Comprehensive Education, Businesses

Case Study: Washington State's I-BEST Program

In 2004, Washington's technical and community college system implemented the first Integrated Basic Education and Skills Training Program (I-BEST). The program helps remedial students develop the basic skills they need to make it through college and into living-wage jobs. Currently, Washington is home to over 150 I-BEST programs which are located at thirty-four technical and community colleges and financed through state-funded Opportunity Grants for amounts up to $1,000 per academic year. Washington's I-BEST programs have enabled a more productive learning environment for students while also delivering positive employment outcomes after college. In fact, students who complete the program demonstrate net employment increases of 12.3 percent and earn an average of $1.61 more per hour than similar students who did not receive skills training.

Policy 10: Establish Offshore Wind Certificate Programs at Technical Colleges

BARRIER

Offshore wind projects are a particularly challenging work environment and demand specialized knowledge and skills. Operations and maintenance workers must perform their jobs over deep water and often at great heights, requiring a particularly high level of precision, attention to detail, and fearlessness. Workers elsewhere in the offshore wind value chain must be able to understand and work with strict quality standards. This mix of challenges makes having workforce training programs dedicated to offshore wind critical to industry success. In Europe, where offshore wind deployment has already taken hold, industry leaders have emphasized the critical importance of qualified technical institutions providing training based on international standards. While South Carolina offers training in many of the diverse skills critical to the offshore wind workforce, such as welding, power engineering, and marine survival, it lacks the industry-specific training necessary for offshore wind jobs. Clemson University offers the only wind-related certificate program in the state. Without training programs tailored to the industry's unique challenges, South Carolina's offshore wind businesses will have difficulty finding the right workforce.

SOLUTION

As South Carolina's offshore wind value chain and project pipeline develops, the state's technical colleges could support potential industry growth by establishing offshore wind certificate programs, especially near coastal areas. Such technical training programs could teach students the electrical, electronic, and mechanical concepts that are fundamental to the wind industry, while emphasizing training in wind turbine maintenance and electrical power production. By establishing wind energy programs in close proximity to the coast, South Carolina could help ensure the offshore wind industry has the skilled workforce necessary for success. Technical colleges that are located inland could coordinate with other colleges and universities to support interested students who may not be able to relocate for specialized wind programs. South Carolina's workforce leaders could consider partnering with the German-based BZEE, which offers a model for offshore wind training that has been expanded to twenty-nine locations across multiple countries. BZEE has training modules on the service and maintenance of offshore wind farms, as well as a number of other certificates covering topics such as logistics and rotor blade servicing (*see case study*).

Since the offshore wind industry in South Carolina is in its early stages, the state could take a step-by-step approach to building its workforce. Before turbines go in the water, the state could expand access to programs with relevance to offshore wind, particularly those related to working in a marine environment, such as maritime logistics and marine survival. Graduates from these programs could fill jobs in economically growing coastal regions such as Charleston. In this early phase, the state could also expand access to wind energy certificate and degree programs that are not specific to offshore deployments.

Key Players: Technical Colleges, State Board for Technical and Comprehensive Education, Businesses

Case Study: Germany's BZEE Wind Training Academy

The Education Centre for Renewable Energies (BZEE) was established due to the lack of trained personnel in the growing offshore wind industry and the need for industry-wide technical and safety standards. BZEE's objective is to provide flexible, personalized training programs that comply with international standards. Since its inception in 2004, BZEE has trained approximately 3,500 wind turbine technicians and issued 18,000 certificates. BZEE is known as an industry model because of its comprehensive training, focus on learning outcomes, and high proportion of hands-on practical training. Students can earn a variety of certificates such as the Service Technician for Wind Turbine Certificate, which is completed over a six-month period with more than forty modules, a six-week internship, and practical and written exams. Modular courses allow for industry professionals to sharpen their skill sets and are structured around topics such as health and safety, wind turbine electronics, rotor blades, and operations management.

Policy 11: Increase Student Engagement in Offshore Wind Research Activities

OPPORTUNITY

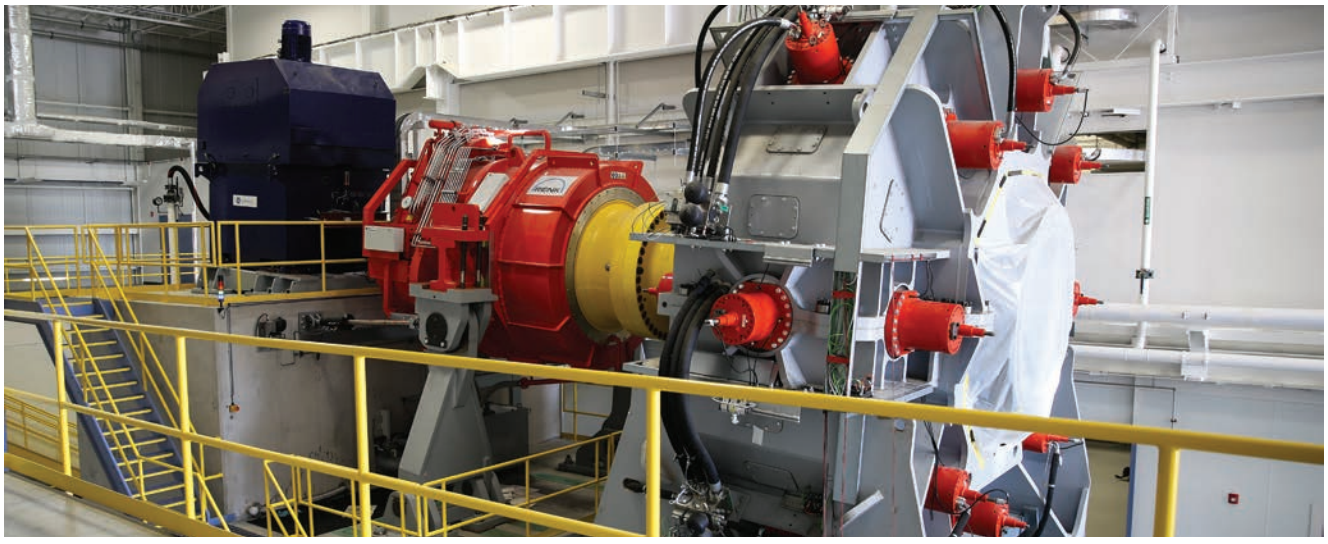
South Carolina has extensive technical research capabilities to support offshore wind innovation and workforce development. Attracting the likes of GE and MHI Vestas, Clemson's drivetrain research facility has a 7.5 MW test rig and a 15 MW test rig, which is the largest of its kind in the United States and one of the biggest in the world. The facility also has a grid simulator that can test the compatibility of wind turbine generators with different grid frequencies. Additionally, Coastal Carolina University offers expertise in geophysical mapping of the ocean floor and measuring wave, current, and wind conditions off the coast. These assets showcase the state's ability to drive technology development and prepare South Carolinians for jobs in the offshore wind industry. South Carolina could further leverage its assets by increasing student engagement in offshore wind research activities.

SOLUTION

South Carolina could expand the SmartState program to help university research centers sponsor greater student engagement, such as participating in new research projects and helping users operate equipment. Established by the South Carolina General Assembly in 2002, the SmartState program leverages lottery revenue to raise capital from the private sector to stimulate research, commercialization, and economic growth. Funds can support endowed professorships at the state's research universities as well as research infrastructure, technical staff, and graduate programs that comprise centers of economic excellence that they serve. To date, the program has resulted in more than $2.8 billion dollars in non-state investment, supported nearly 14,000 jobs, and in-state knowledge hubs for the automotive engineering, biomedical research, and energy industries. South Carolina could amplify these impacts by cultivating graduate-level students at its universities in addition to embedding experts in the state's innovation ecosystem.

By increasing the number of students involved in the state's research activities and innovative facilities, South Carolina could fortify hands-on learning opportunities and build research expertise across its workforce, which aligns with the program's mission. The South Carolina General Assembly could amend the SmartState program's enabling legislation to allow more research universities to utilize state matching funds for educational outreach programs and sponsored student engagement, such as research fellowships and internships. A strong complementary focus on developing students as researchers could attract more outside investment, facilitate new research opportunities, and foster the next-generation of leaders in South Carolina.

Key Players: State Legislature, Universities, Businesses



Policy 12: Assess the Offshore Wind Readiness of State Ports

OPPORTUNITY

As seen in Europe's offshore wind industry, ports are critical for reducing project costs and centralizing industry resources such as manufacturing warehouses, testing facilities, and training centers. U.S. ports will likewise be the nucleus of offshore wind activity, and local investment will catalyze economic growth. In fact, upgrades to a single U.S. port for offshore wind readiness could generate 6,000 full-time jobs and add $449 million to the state's gross domestic product. In South Carolina, the Port of Charleston is already able to support the transportation of massive drivetrains and associated equipment to Clemson's wind turbine test beds, as a deep-water port with a crane barge that can lift over 500 tons. Local manufacturers in the Charleston region can also easily transport components from facility to port given barge access. Upgraded port infrastructure could enable South Carolina firms to support offshore wind projects all along the Atlantic coast. A full assessment of South Carolina's ports could evaluate their capacity to support current and future industry needs.

SOLUTION

In collaboration with the South Carolina Ports Authority, the state could assess existing port infrastructure and recommend planning and investments to support offshore wind across three primary areas: component manufacturing, construction staging, and project operations and maintenance. South Carolina could look to similar analyses by the U.S. Department of Energy, Maryland Energy Administration, Massachusetts Clean Energy Center, and Virginia Department of Mines, Minerals, and Energy.

Considerations for offshore wind readiness include navigation channel depth, berth length, quayside bearing capacity, dry dock area, and crane lift requirements. Coordinated development among South Carolina's ports could ensure that ports provide supplementary roles and upgrades are optimized to support each port's role in the offshore value chain. For example, the Port of Charleston could handle large components while the Port of Georgetown could deploy operations and maintenance services. South Carolina could also assess how it could leverage North Carolina's Port of Wilmington and Georgia's Port of Savannah as part of a regional memorandum of understanding for offshore wind development (*see Policy 14*). Investments in port staging facilities and offices would also encourage manufacturers to co-locate in close proximity to the port, as supported by a 2013 European offshore wind industry survey. In Denmark, the Port of Esbjerg's clustering of over 270 offshore wind firms yielded a significant return on investment (*see case study*). Through an assessment and coordinated follow-on investments, South Carolina could similarly boost profits at the ports and support more local jobs.

Key Players: Department of Commerce, South Carolina Council on Competitiveness, South Carolina Ports Authority



Case Study: Denmark's Port of Esbjerg

Denmark's Port of Esbjerg is a high-performing offshore wind cluster that is home to over 270 firms. These firms span the entire offshore wind value chain and employ 8,000 people. The Port was established in 1868 and is managed by an autonomous port authority, which directs port investments and planning. In preparation for hosting large-scale projects and supporting a growing industry, the Port's Board of Directors invested $183 million in facilities over a ten-year period, which created space for pre-assembly, servicing, and export of wind turbines. Such investments contributed to Esbjerg's European leadership in offshore wind logistics and continued preference by global leaders such as Siemens. The Port of Esbjerg witnessed continued economic growth after upgrades and had its highest profits on record from 2012 to 2014. In 2013, wind turbine transport increased by 44 percent and ship calls increased by 21 percent. The Port supports forty-five projects totaling over 15 GW and 67 percent of total offshore capacity in Europe.

Policy 13: Bolster Foreign Direct Investment in the Offshore Wind Industry

OPPORTUNITY

South Carolina ranks among the top states for foreign direct investment (FDI) in manufacturing based on job creation, capital investment, and number of projects. BMW, Michelin, Bosch, and GE are among the global industry leaders that have a strong presence in South Carolina. While the state is known for its robust FDI pipeline for the automotive cluster, its foreign companies represent a diverse array of industries. To bolster economic development efforts such as FDI, the Governor allocated an additional $12 million to the Department of Commerce in the 2018-19 Executive Budget. With offshore wind projects along the Atlantic Coast expected to total 8 GW by 2030, South Carolina could leverage these funds to attract foreign companies wanting to supply this growing market. Many of the largest offshore wind companies are located in Europe and South Carolina's close proximity to the regional buildout and favorable manufacturing climate make it an attractive location for expansion. FDI could help catalyze industry growth by filling critical gaps in the in-state value chain and bringing new jobs and capital into the state economy.

SOLUTION

To jumpstart South Carolina's nascent offshore wind industry, state leaders could leverage FDI to promote the role of anchor companies, or well-connected organizations that can help bring suppliers or other businesses into the state. For example, South Carolina could attract large-scale turbine blade manufacturers such as LM Wind Power in Denmark and nacelle manufacturers such as Alstom Power in France. South Carolina could also work with anchor companies already based in the state to attract their partner businesses and expand production. For example, subsea cable manufacturer Prysmian Group and wind turbine component manufacturers GE, Siemens, and Timken are engaged in the global offshore wind industry; although they are represented in the state, they do not have in-state manufacturing operations dedicated to offshore wind. In the United Kingdom, Siemens' offshore wind manufacturing FDI revitalized the local economy and generated significant economic benefits (*see case study*). South Carolina could employ this strategy to create new jobs and fortify the industry.

South Carolina could also strengthen its global presence by establishing formal ties with countries that have a strong offshore wind industry. The Department of Commerce has only one office in Europe; it could leverage this Germany-based office or expand its global network to engage with other European countries, such as the United Kingdom, Denmark, and the Netherlands. State leaders could also connect with cluster networks like the European Clusters for Offshore Wind Servicing (ECOWindS) and Wind Europe. As seen with the Massachusetts–Israel Innovation Partnership, these connections can begin as research collaborations and grow into more robust FDI and trade relationships (*see case study*). As part of this business-oriented marketing strategy, South Carolina could also highlight its manufacturing climate, logistics hubs, and innovation resources as strategic assets for international companies wanting to serve the regional offshore wind market.

Key Players: Department of Commerce, Governor's Office, Universities



Case Study: Siemens' Investment in Hull

In March 2014, German industrial conglomerate Siemens announced a £160 million investment in an offshore wind manufacturing facility on Hull's Alexandra Dock, with a complementary investment of £150 million by Associated British Ports (ABP) to support infrastructure development. This investment revitalized an economically distressed community suffering from high unemployment. It has created over 1,000 jobs at the facility, 1,200 indirect jobs from supply chain growth, and 920 apprenticeships. A focus on local upskilling and recruitment has also ensured that the Hull workforce can support most of Siemens' operations. Direct employment may contribute £71.3 million to Hull's gross value added, or total economic output. Every £1 invested in the project is projected to add an additional 47 percent in disposable income to the local economy.

The investment was part of Siemens' global strategy to tap into reliable markets that could support full capacity production. Siemens initially expressed interest in the United Kingdom in 2010 after the government made offshore wind policy commitments and began leasing activities. The conglomerate's site selection criteria were favorable market access, suitable site conditions, streamlined permitting, financial incentives, engaged partners, and political support. Siemens ultimately invested in Hull because of the partners' readiness to deliver on critical infrastructure and workforce needs. In addition to the ABP-funded improvement project, ABP, Hull City Council, East Riding of Yorkshire Council, and the University of Hull mobilized funding for Green Port Hull and the Green Port Growth Programme to support strategic cluster growth through site assembly, skills training, R&D, and supply chain assistance. The Hull region is now recognized as "a global powerhouse for offshore wind," and it continues to attract new investments to bolster its industry leadership.

Case Study: The Massachusetts–Israel Innovation Partnership

The Massachusetts–Israel Innovation Partnership offers a creative model for facilitating global connections. Launched in 2011 following the governor's trade mission to Israel, the partnership grew from an industry research collaborative to a joint FDI partnership. Major Israeli companies have expanded operations to the state and Massachusetts companies have invested in Israeli intellectual property and R&D operations. As of 2015, more than 200 Israeli-founded companies have made a home in Massachusetts. These businesses accounted for $9 billion in direct revenue, $18 billion in total economic impact, and 4 percent of the state GDP, as well as 9,000 direct jobs and 27,000 indirect and induced jobs.

Policy 14: Establish a Regional Offshore Wind Memorandum of Understanding

OPPORTUNITY

Regional partnerships are key to overcoming offshore wind's complicated supply chain and logistics needs. For example, offshore wind requires extensive transportation infrastructure, significant port capabilities, and shared best practices to facilitate industry growth. South Carolina has previously collaborated with North Carolina and Georgia on separate U.S. Department of Energy grants for offshore wind, including energy potential and transmission infrastructure studies, a regulatory task force on permitting, and a public awareness campaign. Through a formal partnership, South Carolina could coordinate resources to lower capital costs, boost investor confidence, and distribute economic benefits throughout the region.

SOLUTION

The Governor's Office and State Energy Office could organize a memorandum of understanding (MOU) on the regional offshore wind industry with North Carolina and Georgia. State and local economic development agencies, industry players, port operators, research institutes, potential training providers, and other relevant stakeholders across the three states could participate in the resulting partnership. The MOU's initial objectives could be to tackle viewshed concerns and conduct a regional infrastructure assessment to accelerate development of offshore demonstration projects.

Through the partnership, South Carolina could conduct a variety of inward- and outward-facing activities to support participants and grow the industry. These recommended activities draw on best practices for collaborative regional efforts identified by the 4POWER project (*see case study*), Clean Energy Group, and Navigant. Inward-facing activities could pursue shared interests through internal coordination, such as:

- Engaging with the Southeastern Wind Coalition on mapping the regional supply chain and broader value chain to serve as a business resource, marketing asset, and recruitment tool.
- Hosting industry networking events to facilitate supplier networks and support local businesses that are new to the market.
- Creating coherent and transparent investment plans to upgrade regional ports and transport infrastructure.
- Establishing standard permitting processes and consistent policy drivers across states to streamline regional projects.
- Coordinating with the Bureau of Ocean Energy Management on potential federal-state and interstate permitting and project development activities.
- Exploring alternative regional project financing mechanisms and power procurement options to reduce project development barriers.
- Assessing future workforce needs for project development to encourage training opportunities.

Outward-facing activities could help communicate the industry's economic impacts and market opportunities by:

- Conducting a cohesive and high-impact outreach campaign to dispel misinformation about the industry, emphasize its tourist attraction potential, and draw corporate leaders and new businesses to the region.
- Advocating for favorable federal policies to increase demand for offshore wind and support business development.

Key Players: Governor's Office, State Energy Office, Southeastern Wind Coalition, South Carolina Ports Authority, Clemson University, Coastal Carolina University, Bureau of Ocean Energy Management



Case Study: 4POWER (Policy and Public-Private Partnerships for Offshore Wind Energy)

The 4POWER project was a three-year effort to advance offshore wind in Europe by encouraging knowledge exchanges and collaboration among eleven regions at different stages of development. Project costs totaled €1.5 million, with 78 percent financed by the European Regional Development Fund. Through joint meetings and bilateral study visits, regional stakeholders across government, industry, and academia gathered around two strategic areas: developing a regional policy framework and cultivating a vibrant ecosystem for offshore wind activities. Preliminary regional consultations, PESTEL (Political, Economic, Social, Technological, Environmental, and Legal) analyses, and SWOT (Strengths, Weaknesses, Opportunities, and Threats) analyses identified ten key issues for further exploration, including supply chain, infrastructure, permitting, and public education. The project culminated in policy recommendations at the European Union level and an implementation guide for regions to prepare for offshore wind.

Policy 15: Highlight the Tourist Attraction Potential of Offshore Wind

BARRIER

A major concern of offshore wind farms is that they may harm the tourism industry, which generates over $21 billion per year in economic activity for South Carolina. Generally, some stakeholders misperceive that offshore wind will affect the landscape and hinder maritime tourism, decreasing the recreational value of the coastal region. Case studies in the South Baltic Region, however, reveal no decrease in the number of tourists after project completion, illustrating that public fears were allayed and largely unjustified. These case studies also demonstrate the tourist attraction potential of offshore wind. Communities can fold offshore wind projects into local tourism efforts by leveraging the draw of an advanced technology, opportunities for educational entertainment, potential environmental benefits, and new value creation.

SOLUTION

To prepare for future deployment, South Carolina should consider ways to allay public fears of offshore wind and to highlight its tourist attraction potential. At the initial stage, South Carolina could pursue an open communication strategy that builds strong positive associations with offshore wind, prioritizes project transparency, and embraces community dialogue with residents and tourists. Local leaders and project developers could draw on best practices from Copenhagen where public involvement was key to social acceptance for the Middelgrunden Offshore Wind Farm (*see case study*). Additionally, South Carolina could require that developers engage coastal stakeholders, such as hotel/resort managers and fishermen, for local project assessment. For instance, the University of Maine will not license its floating offshore wind technology to any developer unless they commit to establishing an advisory board that involves the Maine Lobstermen's Association, Maine Coast Fishermen's Association, and at least three public members who are fixed and mobile gear fishing license holders. Similar conditional licenses and permits could ensure that projects are done in collaboration with local communities.

Potential tourist attractions around completed projects include informational exhibits, guided boat tours, sightseeing flights, and observation platforms. There have been many successful educational models that South Carolina could draw from, such as Germany's traveling exhibition "Fascination Offshore" (*see case study*) and Denmark's permanent activity center "The World of Wind." South Carolina could also designate routes through the wind farm for guided boat tours and special areas for divers and sailors. Boat tours can be popular attractions: Project developer Ørsted's offshore wind safari raffle attracted 70,600 participants, more than fifteen times its capacity. Local charter boat companies can also get involved by offering tours and targeting fish drawn to the underwater offshore wind infrastructure, as seen with Rhode Island's Block Island Wind Farm.

Tourism programs could be designed around both offshore wind farms and demonstration projects like North Myrtle Beach's onshore wind turbines. They could also serve as a business attraction tool by being tied to other industry assets such as the drivetrain testing facility. Leveraging offshore wind's tourist attraction potential can foster public acceptance, encourage support from policymakers, and engage potential offshore wind businesses.

Key Players: North Myrtle Beach Chamber of Commerce, South Carolina Office of Tourism



Case Study: Middelgrunden Offshore Wind Farm

Established in 2000, Middelgrunden was the first cooperatively owned offshore wind farm. Local dialogue centered on design considerations regarding concerns about the project's visual impact. Locals also toured an onshore wind demonstration turbine to gauge potential noise issues. Critical reactions to initial siting plans resulted in a change from twenty-seven turbines placed in three rows to twenty larger turbines in a curved line. In order to help stakeholders envision the design, digitally edited photos that show how the turbines would look from shore were used during public hearings and distributed in reports and brochures. The unique shape aligns with the arrangement of Copenhagen's historical fortresses and has helped establish the wind farm as a regional landmark and tourist attraction. A later study concluded that, despite the time and resources required, public involvement was critical for mitigating protests and increasing acceptance of offshore wind.

Case Study: "Fascination Offshore"

The traveling exhibition "Fascination Offshore" was initiated in 2008 by the German Offshore Wind Energy Foundation with support from the German Ministry for Environment and the regional offshore wind business cluster. "Fascination Offshore" featured interactive maps, turbine models, job snapshots, and a quiz, all of which targeted a wide array of stakeholders. The exhibition was hosted in different harbors alongside kickoff events that included related lectures, business presentations, and networking opportunities. It was also shown as part of the German government's annual Open Days weekend in 2011 and was invited back the following year. From 2009 to 2011, this museum ship installation traveled to more than forty ports across the North Sea and Baltic Sea and attracted over 100,000 residents and tourists. Visitor surveys clearly show its positive impact on public perceptions of offshore wind. Given the exhibition's success, an updated version toured several German cities in 2013 and 2014. It also inspired the first permanent boat exhibition about offshore wind in Germany, building upon an existing shipbuilding and maritime museum in the Rostock harbor.

Policy 16: Incorporate Utility Performance-Based Regulation

BARRIER

South Carolina's failed nuclear project has put a spotlight on the state's electric utilities and regulatory process. The current utility model incentivizes large capital investments without strong measures to ensure project reliability and prioritize energy efficiency. When Santee Cooper and SCE&G halted the V.C. Summer expansion in July 2017, construction was six years behind schedule and only a third complete, costing 75 percent more than originally estimated. So far, ratepayers from both utilities have paid a total of over $2.5 billion in higher bills to bankroll the project despite not reaping any benefits from it and they may face more rate hikes. Additionally, while prices are low, South Carolinians still pay about 30 percent more on their electricity bill than the average U.S. customer because of high consumption levels.

This traditional cost-of-service approach is widely disfavored among U.S. utility professionals, with fewer than 10 percent citing it as the most appropriate regulatory model for the twenty-first century. Others largely support at least some level of performance-based regulation (PBR), which compensates utilities for achieving well-defined performance metrics. In fact, fourteen states have open investigations on PBRs, including Hawaii, Minnesota, New Mexico, and Vermont, which have regulated electricity markets like South Carolina's. PBR could encourage utilities to achieve outcomes that are important to customers, regulators, and themselves while fortifying their role in the power sector. It also enables utilities to incorporate right-fit technologies such as offshore wind or make other innovative investments to improve outcomes.

SOLUTION

South Carolina should consider identifying key performance metrics and building earning mechanisms that reward utilities for achieving outcomes within a specific timeline. Investigations into PBR can be initiated by a legislative bill, regulatory proceeding, internal utility plan, or stakeholder collaboration. As part of this exploratory process, South Carolina could survey the needs and interests of ratepayers, utility managers, and regulators to pinpoint significant outcomes. In particular, the state could draw on best practices from Minnesota's e21 Initiative, which demonstrates a methodical, stakeholder-driven approach to utility business model reform in a regulated electricity market (*see case study*). Performance incentives could be initially introduced on a pilot scale and be based on metrics such as electric service reliability, system efficiency, effective resource planning, electric rate affordability, and stakeholder engagement. Although not regulated by the Public Service Commission, electric cooperatives could incorporate PBR concepts into their business models. By bolstering needed data collection and regularly revisiting goals, South Carolina regulators and utilities could gradually account for more desired outcomes or increase utility returns from existing incentives. PBR could level the playing field for innovative solutions like offshore wind with storage capacity and enable objectives such as low project costs and energy system flexibility to play a bigger role in valuing different portfolio options.

Key Players: Public Service Commission, Utilities, Utility Customers

Case Study: Minnesota's e21 Initiative

Minnesota's e21 Initiative is a stakeholder-driven effort to create a utility business model that aligns with customer needs, public policy goals, and technology innovation. Launched by two nonprofits in February 2014, e21 convenes utilities, ratepayers, businesses, and government officials outside the formal regulatory process to build a consensus for change and put ideas into action. After a series of learning and planning meetings, e21 stakeholders published consensus-based recommendations that advance a PBR framework. Specifically, the e21 Initiative recommends that the state allow utilities to propose, adopt, and evaluate a multi-year, PBR framework by filing a business plan and integrated resource analysis. Participants are now actively engaged with regulators and utility partners on identifying appropriate performance metrics and incentives.

Call to Action

South Carolina's nascent offshore wind cluster is a solid foundation upon which the state can grow its economy, support 847 jobs, and become a leader in the production and deployment of advanced energy technology. The policies recommended in this report are complementary and intended to help South Carolina manufacture products within the state, foster entrepreneurship for technological advances, fund innovation with accessible capital, equip workers with needed skills, and grow demand for offshore wind technology.

To fully realize South Carolina's potential in the offshore wind industry and position the state for continued growth, policymakers will need to make a concerted effort to seize the opportunity presented by increasing global demand. Strong leadership plays an important role in promoting South Carolina's competitive advantage in the industry and creating quality jobs. State and local economic development depend on the collective work of many partners across government, universities, industry, and other stakeholders. This report recommends actions that each group can take to support the offshore wind industry. In-state leaders could reconvene previous offshore wind working groups to discuss new findings and prioritize actions by immediate and future industry needs. Continued collaboration is necessary to address barriers to cluster growth and demonstrate that the state is ripe for investment.

South Carolina has the opportunity to support an annual average of 847 jobs in the offshore wind industry from 2018 through 2035. This cluster is well positioned to serve a significant portion of national demand, especially considering its globally competitive drivetrain research facility, robust ports and transmission system, and network of manufacturers able to serve the offshore wind industry.

South Carolina's leaders can draw from among dozens of innovative strategies that city, county, and state governments across the country and abroad have implemented in order to create job opportunities in the advanced energy industry. Examples of these best practices and a fully cited version of this report can be found on the American Jobs Project website at http://americanjobsproject.us/. Furthermore, the American Jobs Project can continue to serve as a partner to South Carolina by organizing working groups and conducting deeper analyses, such as identifying value chain gaps, exploring policy strategies, and evaluating the state's comparative advantage in other advanced industries.

When a state succeeds in building an economic cluster, the benefits are felt throughout the state: a more resilient state economy, a skilled twenty-first century workforce that is trained for the jobs of tomorrow, a firm base of young people optimistic about job opportunities close to home, and a rich hub for innovation and collaboration.

Growing the Offshore Wind Cluster, Growing Jobs

- Foster the Commercialization Culture at Universities
- Facilitate Mentorships for Entrepreneurs Statewide
- Establish a Venture Catalyst Program to Strengthen Rural Entrepreneurship
- Extend and Expand the Angel Tax Credit
- Increase Funding for the SC Launch Program
- Establish an Offshore Wind Business Development Fund for Small Businesses
- Encourage Program-Related Investments in Offshore Wind Businesses
- Create a Simulated Workplace Program for Job Readiness Skills
- Address the STEM Skills Gap to Boost Manufacturing Employment
- Establish Offshore Wind Certificate Programs at Technical Colleges
- Increase Student Engagement in Offshore Wind Research Activities
- Assess the Offshore Wind Readiness of State Ports
- Bolster Foreign Direct Investment in the Offshore Wind Industry
- Establish a Regional Offshore Wind Memorandum of Understanding
- Highlight the Tourist Attraction Potential of Offshore Wind
- Incorporate Utility Performance-Based Regulation

APPENDIX: ECONOMIC IMPACTS, JOBS ESTIMATES, AND MODELING METHODOLOGYY

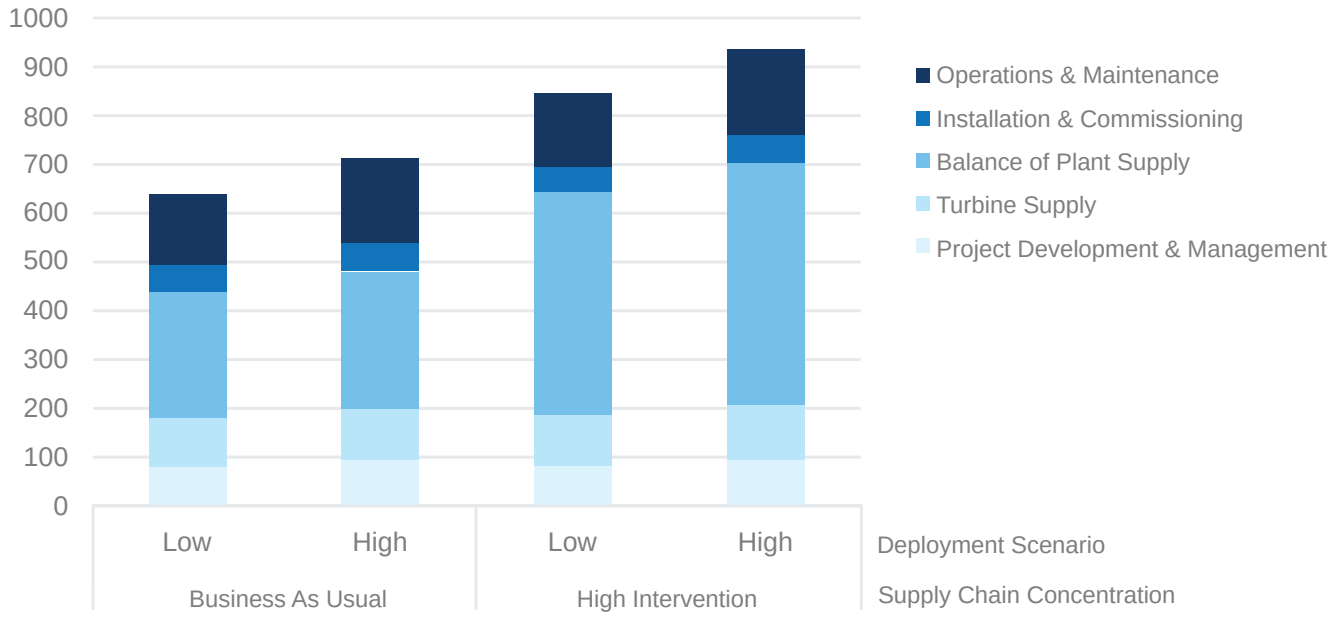
The American Jobs Project believes the key to job creation lies in local action. Our job estimates are intended to start a conversation about how state and local leaders can work together to set goals and evaluate potential economic impacts.

The American Jobs Project and BVG Associates (BVGA) worked together to create realistic scenarios based on research and interviews with local partners. BVGA performed the economic analysis, employing a proprietary methodology that was created in partnership with Steve Westbrook from the University of the Highlands and Islands. This methodology is based on specific offshore wind industry and supply chain data, and is informed by BVGA's extensive experience in this industry; therefore, it is more accurate than conventional economic impact methodologies.

We suggest that achieving a low deployment scenario and a high supply chain concentration are realistic goals for South Carolina. If the state can develop its installed offshore wind capacity and strengthen its supply chain to support local and regional projects to these levels, the industry could support an annual average of 847 jobs from 2018 through 2035. Thus, offshore wind could serve as a major vehicle for future state economic growth while creating quality jobs for South Carolinians.

Conventional Economic Impact Methodologies: Conventional modeling of economic impacts typically relies on government statistics and are often based on industry classification codes. However, this methodology is ill-suited for the nascent U.S. offshore wind industry, as industry classification codes do not easily correspond to the offshore wind industry. The development of new codes for newer sectors, such as offshore wind, takes time. Conventional economic analyses of offshore wind would need to map existing classification code data onto offshore wind activities, which is subject to error. Offshore wind is ideally suited to a more robust approach that considers current and future capability of local supply chains because individual offshore wind projects tend to (1) be large and have distinct procurement processes, and (2) use similar technologies and share supply chains.

AVERAGE ANNUAL JOBS IN SOUTH CAROLINA'S OFFSHORE WIND INDUSTRY, 2018-2035



Modeling Approach

We model economic impacts across two offshore wind deployment scenarios derived by industry experts and based on existing projections. The first scenario (Low) assumes that South Carolina will install 300 MW by 2025 and 550 MW by 2030. The second scenario (High) assumes 400 MW by 2025 and 600 MW by 2030. Both scenarios also assume Atlantic Coast build-out totaling 8 GW by 2030.

To calculate economic impacts, we first analyze the value of goods and services sourced from within the state given two supply chain concentrations (Business As Usual, High Intervention). For each deployment scenario, we calculate this value by assessing potential sales in the local supply chain across five activities.

- **Project development and management:** Project development as well as engineering and management.
- **Turbine supply:** Manufacturing of nacelles, hubs, blades, and towers.
- **Balance of plant supply:** Manufacturing of foundations, array cables, export cables, substations, and operational infrastructure.
- **Installation and commissioning:** Installation of turbines, foundations, array cables, export cables, and other components.
- **Operations and maintenance:** Wind farm operation as well as maintenance and service of turbines, foundations, subsea cables, and substations.

We estimate the proportion of each activity that will be carried out annually over the lifetime of the wind farm deployments. For example, we assume a constant annual expenditure per turbine for operations, maintenance, and service. The value of the local supply chain is measured as earnings from employment and business profits, which makes it a function of current estimated employment and firms.

We then convert the value of the local supply chain into job-years using data on typical profit margins, costs of employment, and annual salaries. Additional job impacts due to increased spending in the local economy are calculated using appropriate multipliers from generic industry analyses.

Model Outputs

We present job estimates as the average number of jobs that the state can sustain on an annual basis. These economic impacts are based on the total job-years, or one full-time equivalent job sustained for one year, that exist within the timeframe of our analysis. Jobs in any given year can vary greatly within the timeframe. Additionally, job losses in industries that compete with those in our analysis are not evaluated. Models do not perfectly predict behavior, so job estimates could vary based on the reality of what is purchased locally and the impact of foreign and domestic competition. The estimates presented in this report are highly dependent on sustained local action towards developing and maintaining the offshore wind industry in South Carolina.

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