



Report 2023

# USA

The Adhemar de Saint Venant installation vessel beside a 6-megawatt wind turbine that is part of Dominion Energy's Coastal Virginia Offshore Wind pilot project. The project is located 27 miles off the coast of Virginia Beach, Virginia.

Photo by Lyfted Media for Dominion Energy

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**Federal incentives continued to support wind energy research and development in the United States in 2023. The country continued to work in support of the goal to deploy 30 gigawatts (GW) of offshore wind capacity by 2030, with progress on the nation's first two commercial-scale offshore wind farms.**

The Inflation Reduction Act (IRA) of 2022 extended production and investment tax credits for wind energy projects through the next decade, tying increased credits to the provision of high-quality jobs [1]. With funding from the U.S. Department of Energy (DOE) through the Infrastructure Investment and Jobs Act of 2021, 15 projects received a total of USD 27 million (EUR 25 million) to address deployment challenges in offshore, land-based, and distributed wind energy [2]. DOE

innovation prizes are also driving innovation in floating offshore wind and wind turbine materials recycling [3].

Wind power facilities account for the largest share of the country's renewable energy production, providing 10.2% of electricity generated in 2023 [4]. Total installed wind power capacity in the United States in 2023 stood at more than 150 GW, with the majority coming from land-based wind turbines [5].

**Table 1. Key National Statistics 2023: United States**

Total (net) installed wind power capacity	150 GW
Total offshore capacity	.04 GW
New wind power capacity installed	6.5 GW
Decommissioned capacity (in 2023)	.33 GW
Total electrical energy output from wind	425 TWh
Wind-generated electricity as percent of national electricity demand	10%
Average national capacity factor	36%
Target	30 GW offshore wind capacity by 2030
National wind energy RD&D budget	123 million EUR

## Highlight(s)

- Tax credits incentivise deployment.
- Federal prizes target technology innovation in floating offshore wind and wind turbine recycling.
- Progress on the nation's first two commercial offshore wind farms: 938 MW.
- First-ever Gulf of Mexico offshore wind lease awarded: 1.66 GW.
- Wind energy was the largest source of electricity in Iowa, South Dakota, Kansas, and Oklahoma and it delivered more than a fifth of the electricity in another eight states.

## Market Development

### Targets and Policy

Despite a slowdown in wind power capacity additions in 2023 that is expected to extend through 2024, the United States, as of the end of 2023, has a strong project pipeline that includes 4,229 megawatts (MW) of offshore wind under construction, 19,426 megawatts (MW) of offshore wind in the permitting phase,

and 26,870 of land-based wind in advanced development and under construction [6]. The offshore wind energy target of 30 GW by 2030 supports an overall goal of 100% clean electricity by 2035 and net-zero carbon emissions by 2050 [7]. Twelve states have set offshore wind targets totalling over 100 GW [8].

In 2023, the U.S. Internal Revenue Service issued guidance on incentives under the IRA. The IRA extends a renewable electricity production tax credit (for projects placed in service in 2023, 0.0275 USD/kWh, or 0.0256 EUR/kWh) and a 30% investment tax credit for projects that meet prevailing wage and apprenticeship requirements [9]. Starting in 2025, the IRA will convert these technology-based energy tax credits into emissions-based, technology-neutral tax credits available to all types of power facilities with zero or net-negative carbon emissions [10].

The 2023 Internal Revenue Service guidance clarified IRA incentive eligibility for offshore wind and battery storage projects, as well as small clean energy projects that need upgrades to connect to the grid [11]. Additional IRA-funded benefits

include credits for eligible wind and solar capacity in low-income communities or on Tribal land, as well as for projects that expand U.S. supply chains for clean energy technologies [12]. Other support includes more than USD 2 billion (EUR 1.86 billion) to support renewable energy projects for rural small businesses through the U.S. Department of Agriculture's Rural Energy for America Program [13], including more than USD 300 million to support "underutilised technologies" such as distributed wind.

### Progress and Operational Details

The United States added a total land-based wind power capacity of 6.5 GW in 2023, and the cumulative operating capacity reached over 150 GW (Figure 1) [14]. Wind energy accounted for over 50% of all electricity generation in Iowa and South Dakota, and it contributed more than a fifth of the electricity in another ten states [8].

The U.S. Department of the Interior held the first-ever offshore wind energy auction for the Gulf of Mexico region in August 2023. The Lake Charles Lease Area offshore Louisiana, which offers approximately 1.66 GW of offshore wind power capacity



**Figure 1: The Iron Star Wind Project, operated by ENGIE North America, is located 5 miles south of Dodge City, Kansas.**

*Photo by Bryan Bechtold, National Renewable Energy Laboratory*

and could power nearly 435,400 homes, had the winning bid [15]. The Interior Department also finalised three wind energy areas in the Central Atlantic region off Delaware, Maryland, and Virginia [16].

### **Matters Affecting Growth and Work to Remove Barriers**

The 6.5 GW of wind power capacity installations for land-based wind energy in 2023 was the lowest since 2014 and a 28% drop from 2022. Reduction in the project pipeline from the expiration of the production tax credit that was scheduled prior to the passage of the IRA is the primary reason for the slowdown, but permitting and development delays, lack of access to transmission, and inflation also contributed. Supply chain and

cost struggles for offshore wind energy contributed to the cancellation of several projects and power purchase agreements [8]. Nonetheless, wind electricity generation is projected to grow 11% from 2023 to 2025, reaching 476,000 gigawatt-hours [17].

A variety of initiatives and funding in 2023, which are also outlined in subsequent sections, are addressing grid modernisation and permitting barriers. The DOE launched the Renewable Energy Siting through the Technical Engagement and Planning program, which will provide more than USD 20 million (EUR 18.6 million) to support capacity building for large-scale renewable energy and energy storage development at the state and local level [18]. For intercon-

nection bottlenecks, DOE has undertaken funding and partnership efforts through its Interconnection Innovation Exchange (I2X) initiative, through which a draft roadmap published in 2023 is aimed at a comprehensive set of reforms for the interconnection process [19].

A USD 10 million (EUR 9.3 million) funding opportunity announced in September 2023 will drive innovation and reduce costs of high-voltage direct current voltage source converter transmission systems, enabling long-distance transmission for offshore wind energy [20]. In addition, the DOE awarded USD 8.4 million (EUR 7.8 million) to four projects that will facilitate grid connection with renewable energy resources [21].

## RD&D Activities

### National Priorities and Budget

The United States has an active, diversified portfolio of wind energy research that encompasses land-based, offshore, and distributed wind energy; grid modernisation; techno-economic analysis; recycling; and community impacts. In Fiscal Year 2023, the federal budget for wind energy research at DOE's Wind Energy Technologies Office (WETO), which funds most of the nation's wind energy research and innovation, was USD 132 million (EUR 123 million). This amount was an increase of USD 18 million (EUR 16.8 million) over 2022 funding. WETO funding increased again in Fiscal Year 2024, growing to USD 137 million (EUR 127.7 million) [22].

DOE organised its 2023 wind energy research priorities into several categories:

**Offshore wind:** Through WETO, four projects received a total of USD 8.5 million (EUR 7.9 million) for high-voltage direct current to transmit large amounts of electricity from offshore wind over long distances. Another five projects received USD 6.5 million (EUR 6 million) for social-science research related to offshore wind [2]. In September 2023, WETO announced a funding opportunity of USD 16.4 million (EUR 15.3 million) for collaborative research on installation noise and reliable moorings [23]. DOE's Advanced Materials and Manufacturing Technologies Office issued separate funding opportunities of nearly USD 30 million (EUR 28 million) for materials and manufacturing related to offshore wind [24]. In late 2023, the Ocean Energy Safety Institute announced it was awarding USD 2.7 million (EUR 2.5 million) to fund six wind energy research projects that will help improve the overall efficiency, operation, and safety of offshore wind energy systems [25]. In addition to reaching 30 GW of offshore wind by 2030, the United States aims to reduce the levelized cost of energy (LCOE) for fixed-bottom and floating offshore wind by 40% to 50% [26].

**Land-based wind:** Among other topics, DOE national labs are investi-

gating advanced manufacturing processes and materials to enable novel wind turbine blade designs that both decrease costs and increase efficiency. A report published in 2023 detailed research on using large-scale, three-dimensional printing technologies to produce wind turbine blade structures [27]. As part of its Wind Energy Equity Series, the National Renewable Energy Laboratory published qualitative data on community decision-making and engagement around land-based wind [28]. DOE's goal is to reduce LCOE for land-based wind by 30% to 35% by 2035 [26].

**Distributed wind:** Ongoing research efforts aim to lower costs and accelerate deployment for distributed wind energy. A project awarded USD 4.5 million (EUR 4.2 million) in 2023 will develop a national outreach, training, and technical assistance program that will help local governments improve permitting processes for distributed wind [2]. DOE's goal is to halve the LCOE for a 100-kilowatt wind turbine by 2030 [29].

**Systems integration:** DOE's Interconnection Innovation e-Xchange [30], along with funding for grid services and cybersecurity research, are supporting DOE's goal of enabling cost-effective, cybersecure, reliable, and resilient operation of the energy system with increasing levels of wind.

**Siting and environmental challenges:** DOE is developing solutions to minimise wildlife and environmental impacts and enable the efficient siting and operation of wind power plants [29]. The new WETO funding announced in 2023 included USD 7.5 million (EUR 7 million) for five projects that will advance bat deterrence at wind turbines [2]. The USD 5.1 million (EUR 4.8 million) Wind Turbine Materials Recycling Prize seeks to develop robust domestic recycling options for fibre-reinforced composites and rare-earth elements used in wind turbines [31]. In addition, the United States announced USD 4 billion (EUR 3.7 million) in tax credits for projects that expand clean energy or critical materials manufacturing or recycling [32].

### National Research Initiatives and Results

- The Floating Offshore Wind Shot, led by DOE and the Departments of Interior, Commerce, and Transportation, continued efforts aimed at reducing the cost of floating offshore wind energy by more than 70% for deep-water sites far from shore [33].
- The West Coast Offshore Wind Transmission Literature Review and Gaps Analysis, published in 2023, cleared the way for the launch of a transmission options study to support offshore wind energy development along the U.S. West Coast through 2050 [34]. A separate offshore wind transmission study on the U.S. Atlantic Coast from Maine to South Carolina was underway in 2023 [35].
- The National Offshore Wind Research and Development Consortium released a roadmap detailing the steps needed to achieve a robust and equitable domestic supply chain for offshore wind [36].
- The National Renewable Energy Laboratory released a technical report in September 2023 analysing challenges and opportunities in developing a West Coast ports network to support different phases of offshore wind energy project development [37].
- Domestically, in Summer 2023, DOE launched the Critical Materials Collaborative to improve and increase communication and coordination among government agencies and stakeholders working on critical materials projects, including wind energy [38]. The Wind Turbine Materials Recycling Prize mentioned earlier is part of this effort. In addition, the Renewable Energy Materials Properties Database and technical report, developed with contributions from multiple DOE national labs and academia, quantified how much and what type of materials are needed to construct wind energy and solar power devices and plants [39].



**Figure 2: At the King Plains Wind Farm in Garber, Oklahoma, researchers and landowners tour one of the American WAKE experiment (AWAKEN) instrument measurement sites. Chris Martin (left) from the U.S. Department of Energy's Atmospheric Radiation Measurement program describes the instruments. AWAKEN leverages the experience, instrumentation, and capabilities of multiple institutions to conduct the most comprehensive wind energy wake experiment to date.**

*Photo by Bryan Bechtold, NREL*

### Test Facilities and Demonstration Projects

Continuous improvement efforts, including the commissioning and troubleshooting of new wind turbines, occurred in 2023 at the Sandia National Laboratories' Scaled Wind Farm Technology (SWiFT) Facility in Lubbock, Texas, which is changing direction to seek non-DOE-sponsored customers for research and development needs. The SWiFT team has already secured funding partnerships from many different companies and expects to expand experimental activities at SWiFT in support of the wind energy industry [40].

The Massachusetts Clean Energy Center's Wind Technology Test Center in 2023 completed testing of three 107-metre blades for the Vineyard Wind I offshore wind project. This effort was made possible by an upgraded system that will be used for fatigue testing of offshore wind turbine blades [41].

DOE also announced USD 33 million (EUR 30.8 million) to reach areas of the country that traditionally have received disproportionately low amounts of federal scientific funding. These areas include marine atmosphere boundary modelling and floating wind turbine test response systems in New Hampshire and Rhode Island, respectively [42].

### Collaborative Research

The United States contributes internationally to wind energy deployment research and solving challenges through the International Energy Agency's Technology Collaboration Programme. In addition to those collaborative efforts, data collection continued in 2023 for the American WAKE experiment (AWAKEN), an international, multi-institutional wind energy field campaign (Figure 2) designed to answer the most pressing science questions about how individual wind turbines interact with one another and the atmosphere in a wind farm [43].



Photo by American Jael, Unsplash

## Impact of Wind Energy

### Economic Benefits and Industry Development

Wind-related job totals in the United States increased by 4.5% in 2023 to 131,327 full-time workers—99% of which were dedicated to land-based wind, with the remaining 1% focused on offshore wind [44]. These jobs include, among others, those in construction (45,397), professional and business services (35,357), and manufacturing (23,884) [14].

Driven by IRA funding, GE Vernova built a new nacelle manufacturing facility in New York state and announced a breakthrough in domestic wind production, completing the

largest onshore wind turbine nacelle ever manufactured in the United States [45].

Ongoing work in the private and public sectors aims to build a pipeline of talent for safe, environmentally sustainable offshore wind energy development and operation. The annual Collegiate Wind Competition, a workforce development event that challenges college and university teams to offer a unique solution to a complex wind energy project, continues to draw undergraduate students from across the country [46].

## Next Term

Another 7 GW of wind energy capacity is expected to come online in 2024 [17]. The nation's first commercial-scale offshore wind farms, Vineyard Wind and South Fork, will begin delivering power to the electric grid in New England and New York, respectively [47] [48]. Continuing research seeks to understand the transmission needs for the West, Atlantic, and Gulf Coasts [49]. Ongoing investments and initiatives—including the newly established National Distributed Wind Network, Distributed Wind Resource Hub [50], and Academic Center for Reliability and Resilience of Offshore Wind [51]—will support equitable wind energy deployment across the United States.

## References

- [1] U.S. Department of Energy (DOE) Wind Energy Technologies Office (WETO) (2023). *Advancing the Growth of the U.S. Wind Industry: Federal Incentives, Funding, and Partnership Opportunities Fact Sheet* <https://www.energy.gov/eere/wind/articles/us-wind-industry-federal-incentives-funding-and-partnership-opportunities-fact>
- [2] WETO (2023). *DOE Wind Energy Technologies Office Selects 15 Projects Totaling \$27 Million to Address Key Deployment Challenges for Offshore, Land-Based, and Distributed Wind* <https://www.energy.gov/eere/wind/articles/doe-wind-energy-technologies-office-selects-15-projects-totaling-27-million>
- [3] WETO (2023). *Change Is in the Wind: Letter from the Wind Energy Technologies Office Deputy Director* <https://www.energy.gov/eere/wind/articles/change-wind-letter-wind-energy-technologies-office-deputy-director>
- [4] U.S. Energy Information Administration (EIA) (undated). *Electricity Data Browser* <https://www.eia.gov/electricity/data/browser/>
- [5] WETO. (undated) *U.S. Installed and Potential Wind Power Capacity and Generation* <https://windexchange.energy.gov/maps-data/321>
- [6] American Clean Power (ACP) (2024) *Clean Power Annual Market Report 2023*. <https://cleanpower.org/resources/clean-power-annual-market-report-2023/>
- [7] U.S. White House (2021). *FACT SHEET: President Biden Sets 2030 Greenhouse Gas Pollution Reduction Target Aimed at Creating Good-Paying Union Jobs and Securing U.S. Leadership on Clean Energy Technologies* <https://www.whitehouse.gov/briefing-room/statements-releases/2021/04/22/fact-sheet-president-biden-sets-2030-greenhouse-gas-pollution-reduction-target-aimed-at-creating-good-paying-union-jobs-and-securing-u-s-leadership-on-clean-energy-technologies/>
- [8] ACP (2024). *Clean Power Annual Market Report 2023*. <https://cleanpower.org/news/market-report-2023/>
- [9] U.S. Department of the Treasury (2023). *FACT SHEET: How the Inflation Reduction Act's Tax Incentives Are Ensuring All Americans Benefit from the Growth of the Clean Energy Economy*. <https://home.treasury.gov/news/press-releases/jy1830>
- [10] U.S. Federal Register (2024). *Section 45Y Clean Electricity Production Credit and Section 48E Clean Electricity Investment Credit*. <https://www.federalregister.gov/documents/2024/06/03/2024-11719/section-45y-clean-electricity-production-credit-and-section-48e-clean-electricity-investment-credit>
- [11] U.S. Department of the Treasury (2023). *U.S. Department of the Treasury, IRS Propose New Rules to Drive Clean Energy Investments*. <https://home.treasury.gov/news/press-releases/jy1920>
- [12] DOE (2023). *Biden-Harris Administration Announces Historic Investments to Support America's Energy and Industrial Communities*. <https://www.energy.gov/articles/biden-harris-administration-announces-historic-investments-support-americas-energy-and>
- [13] U.S. Department of Agriculture (2023). *USDA Announces \$21 Million Investment to Help Lower Energy Costs for Farmers and Rural Business Owners* <https://www.rd.usda.gov/newsroom/news-release/usda-announces-21-million-investment-help-lower-energy-costs-farmers-and-rural-business-owners>
- [14] Lawrence Berkeley National Laboratory (2024). *Land-Based Wind Market Report*. <https://www.energy.gov/eere/wind/land-based-wind-market-report>
- [15] U.S. Department of the Interior (2023). *Biden-Harris Administration Holds First-Ever Gulf of Mexico Offshore Wind Energy Auction*. <https://www.doi.gov/pressreleases/biden-harris-administration-holds-first-ever-gulf-mexico-offshore-wind-energy-auction>
- [16] U.S. Department of the Interior (2023). *BOEM Finalizes Wind Energy Areas in the Central Atlantic*. <https://www.boem.gov/newsroom/press-releases/boem-finalizes-wind-energy-areas-central-atlantic>
- [17] EIA (2024). *Solar and wind to lead growth of U.S. power generation for the next two years*. <https://www.eia.gov/todayinenergy/detail.php?id=61242>
- [18] DOE Office of Energy Efficiency and Renewable Energy (EERE) (2023). *U.S. Department of Energy Launches Program to Expand State and Local Capacity for Renewable Energy Planning, Siting, and Permitting*. <https://www.energy.gov/eere/articles/us-department-energy-launches-program-expand-state-and-local-capacity-renewable>
- [19] EERE (2023). *DOE Releases Draft Roadmap to Improve Interconnection of Clean Energy Resources on the Nation's Transmission Grid*. <https://www.energy.gov/eere/articles/doe-releases-draft-roadmap-improve-interconnection-clean-energy-resources-nations>

- [20] WETO (2023). *DOE Releases Funding Opportunity to Reduce Costs of High-Voltage Direct Current Transmission*. <https://www.energy.gov/eere/wind/articles/doe-releases-funding-opportunity-reduce-costs-high-voltage-direct-current>
- [21] DOE Office of Electricity (2023). *U.S. Department of Energy Invests Nearly \$8.4 Million to Advance Grid-Enhancing Technologies (GETs)*. <https://www.energy.gov/oe/articles/us-department-energy-invests-nearly-84-million-advance-grid-enhancing-technologies-gets>
- [22] WETO (undated). *Wind Energy Technologies Office Budget*. <https://www.energy.gov/eere/wind/wind-energy-technologies-office-budget>
- [23] DOE (2023). *Funding Notice: Installation Noise Reduction and Reliable Moorings for Offshore Wind and Marine Energy*. <https://www.energy.gov/eere/wind/articles/funding-notice-installation-noise-reduction-and-reliable-moorings-offshore-wind>
- [24] DOE Advanced Materials and Manufacturing Office (undated). *Funding Selections: AMMTO Large Wind Turbine Materials and Manufacturing Funding Opportunity Announcement*. <https://www.energy.gov/eere/ammto/funding-selections-ammto-large-wind-turbine-materials-and-manufacturing-funding>
- [25] EERE (2023). *Offshore Energy Safety Institute Invests \$2.7 Million to Advance Offshore Wind Safety*. <https://www.energy.gov/eere/articles/offshore-energy-safety-institute-invests-27-million-advance-offshore-wind-safety>
- [26] National Renewable Energy Laboratory (NREL) (2023). *2022 Cost of Wind Energy Review*. <https://www.nrel.gov/docs/fy24osti/88335.pdf>
- [27] WETO (2023). *New Reports Detail Advanced Manufacturing Methods for Novel Turbine Blade Designs*. <https://www.energy.gov/eere/wind/articles/new-reports-detail-advanced-manufacturing-methods-novel-turbine-blade-designs>
- [28] NREL (2023). *Setting the Baseline: The Current Understanding of Equity in Land-Based Wind Energy Development and Operation*. <https://www.nrel.gov/docs/fy23osti/85185.pdf>
- [29] WETO (2020). *Multi-Year Program Plan Fiscal Years 2021–2025*. <https://www.energy.gov/sites/prod/files/2020/12/f81/weto-multi-year-program-plan-fy21-25-v2.pdf>
- [30] EERE (undated). *Interconnection Innovation e-Xchange*. <https://www.energy.gov/eere/i2x/interconnection-innovation-e-xchange>
- [31] EERE (2023). *Department of Energy Launches Prize to Jumpstart Wind Turbine Materials Recycling Industry*. <https://www.energy.gov/eere/articles/department-energy-launches-prize-jumpstart-wind-turbine-materials-recycling-industry>
- [32] WETO (2023). *New Tax Credit Will Spur Historic Investments in Manufacturing and Critical Materials*. <https://www.energy.gov/eere/wind/articles/new-tax-credit-will-spur-historic-investments-manufacturing-and-critical>
- [33] WETO (undated). *Floating Offshore Wind Shot*. <https://www.energy.gov/eere/wind/floating-offshore-wind-shot>
- [34] WETO (2023). *West Coast Offshore Wind Transmission Literature Review and Gaps Analysis*. <https://www.energy.gov/eere/wind/articles/new-analysis-studying-west-coast-offshore-wind-transmission-options>
- [35] NREL (undated). *Atlantic Offshore Wind Transmission Study*. <https://www.nrel.gov/wind/atlantic-offshore-wind-transmission-study.html>
- [36] EERE (2023). *National Offshore Wind Research and Development Consortium Announces U.S. Offshore Wind Supply Chain Road Map*. <https://www.energy.gov/eere/articles/national-offshore-wind-research-and-development-consortium-announces-us-offshore-wind>
- [37] NREL (2023). *The Impacts of Developing a Port Network for Floating Offshore Wind Energy on the West Coast of the United States*. <https://www.nrel.gov/docs/fy23osti/86864.pdf>
- [38] DOE (undated). *Critical Materials Collaborative*. <https://www.energy.gov/cmm/critical-materials-collaborative>
- [39] NREL (undated). *REMPD: Renewable Energy Materials Properties Database*. <https://www.nrel.gov/wind/materials-database.html>
- [40] Sandia National Laboratories (undated). *Sandia Wind Energy Program FY23 Accomplishments*. <https://energy.sandia.gov/wp-content/uploads/2024/03/Sandia-Wind-Energy-Accomplishments-FY23.pdf>
- [41] WETO (2024). *Wind Technology Testing Center Upgraded to Test Longer Turbine Blades*. <https://www.energy.gov/eere/wind/articles/wind-technology-testing-center-upgraded-test-longer-turbine-blades>
- [42] WETO (2023). *DOE Announces \$33 Million to Advance Energy Research Across America*. <https://www.energy.gov/eere/wind/articles/doe-announces-33-million-advance-energy-research-across-america>



[43] NREL (undated).  
*AWAKEN: The American WAKE experimeNt*.  
<https://www.nrel.gov/wind/awaken.html>

[44] DOE Office of Policy (2024).  
*U.S. Energy & Employment Jobs Report*.  
<https://www.energy.gov/articles/doe-report-shows-clean-energy-jobs-grew-more-twice-rate-overall-us-employment>

[45] EERE (2023).  
*Inflation Reduction Act Spurs Breakthrough in Domestic Wind Production*.  
<https://www.energy.gov/eere/articles/inflation-reduction-act-spurs-breakthrough-domestic-wind-production>

[46] EERE (2023).  
*Thirty-Two Teams Prepare for the 2024 Collegiate Wind Competition*.  
<https://www.energy.gov/eere/collegiatewindcompetition/articles/thirty-two-teams-prepare-2024-collegiate-wind-competition>

[47] Commonwealth of Massachusetts (2024).  
*Vineyard Wind, America's First Large-Scale Offshore Wind Farm, Delivers Full Power from 5 Turbines to the New England Grid*.  
<https://www.mass.gov/news/vineyard-wind-americas-first-large-scale-offshore-wind-farm-delivers-full-power-from-5-turbines-to-the-new-england-grid>

[48] Associated Press (2024).  
*The United States has its first large offshore wind farm, with more to come*.  
<https://apnews.com/article/orsted-offshore-wind-new-york-south-fork-climate-cbb9360388d91be1368dd91ba35aa384>

[49] DOE Grid Deployment Office (undated).  
*Offshore Wind Transmission Federal Planning & Support*.  
<https://www.energy.gov/gdo/offshore-wind-transmission-federal-planning-support>

[50] WETO (2024).  
*New National Network and Information Hub to Provide Resources on Distributed Wind Energy Deployment*.  
<https://www.energy.gov/eere/wind/articles/new-national-network-and-information-hub-provide-resources-distributed-wind>

[51] EERE (2024).  
*U.S. Department of Energy Establishing National Center of Excellence to Accelerate Domestic Offshore Wind Industry*.  
<https://www.energy.gov/eere/articles/us-department-energy-establishing-national-center-excellence-accelerate-domestic>