AUDUBON'S BIRDS AND OFFSHORE WIND REPORT

DEVELOPING THE Offshore Wind THAT BIRDS NEED

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Audubon

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Cover: Off the coast of Rhode Island stand the nation's first five offshore turbines (photographed here during a LightHawk flight).

> **"We believe that developing offshore wind energy is a solvable problem for birds, while unchecked climate change is not."**

Letter from Our Chief Conservation Officer

NOW IN OUR 120TH YEAR, Audubon seeks to advance science-based solutions which have the power to address our most pressing planetary challenges. As found in our 2019 report, *Survival by Degrees: 389 Species on the Brink*, two-thirds of bird species in North America will be vulnerable to extinction unless we slow the rate of global temperature rise. Over the course of my lifetime, more than 3 billion birds have disappeared, driven by habitat loss and a range of increasing factors, including the impacts of climate change. Our strategic vision, *Flight Plan*, calls on us to work to conserve ecosystems to support bird populations and human communities, while working to address the risks of climate change to these critical habits and landscapes. The science is clear that transitioning to wind and solar to power our economy is the one of the most effective ways to accomplish this.

There are many reasons to support diverse sources of clean energy, including offshore wind. Doing so will meet our fast-growing electricity needs, create good-paying jobs, and ensure power reliability, national security, and global competitiveness. Ramping up clean energy generation is also key to stabilizing our climate to ensure the sustainable future birds and people need. This is why Audubon has made a commitment to positively influence the rapid and responsible deployment of 100 gigawatts of utility-scale renewable energy generation and expanded transmission capacity by 2028.

As the U.S. advances the clean energy transition, offshore wind can play a critical role. The open ocean and consistently high windspeeds have the potential to create significant amounts of energy conveniently located near large population centers. In fact, some estimates predict offshore wind resources are plentiful enough to generate up to a quarter of the nation's electricity by 2050. The current reality is that offshore wind development in the U.S. is in its early stages, and we remain far behind the global leaders in production. But studies have concluded that if the U.S. develops even just 10-13% of the nations' offshore wind capacity, it would not only drastically reduce emissions, it would create over 390,000 jobs by 2050.

We believe that developing offshore wind energy is a solvable problem for birds, while unchecked climate change is not. Audubon works alongside communities, developers, and other partners to both advance development and prioritize protections for critical wildlife habitat—and we have the scientific expertise and the relationships to make it happen.

Like all infrastructure, offshore wind turbines can pose a risk to birds, but these risks can be minimized with careful planning informed by science. As discussed in the report, we need to be smart about how we build, what we build, and where we build. It is imperative that we develop using best management practices—for example, avoiding development in places with important bird habitat and conducting long-term monitoring for any ecosystem-wide impacts. In part due to our broad and diverse coalitions, we have proven strategies and a rapidly growing body of research augmented with new technologies to help avoid, minimize, and offset any negative impacts to birds.

With extensive expertise in both the science of bird conservation and the application of this information to real-world challenges, Audubon is in a unique position to advocate for and support science-based decision making for each step of the offshore wind planning, siting, leasing, and permitting processes. Audubon staff, members, and chapters are working directly with regulators, developers, and state and federal lawmakers to make sure that development proceeds efficiently, reduces risks to birds and their habitats, and prioritizes community engagement. This report demonstrates our commitment to using the best available science to advance offshore wind in a manner that protects birds as we move toward a clean energy future.

This report shares offshore wind science, harm-avoidance techniques, ongoing research needs, and the resulting policy framework that will guide us. The stakes are higher than ever for birds, the places they need, and our own communities, but hope remains. With the strength of the Audubon community, we can help ensure a sustainable and prosperous future for both people and birds.

Sincerely,

Marshall Johnson
Chief Conservation Officer

Ørsted South Fork Wind Project, Long Island, New York

Executive Summary

Our core mission is to protect birds and their habitats, and the science is clear that two-thirds of bird species in North America will face extinction unless we tackle climate change. That is why Audubon is supporting the swift deployment of diverse renewable energy resources to decarbonize the economy and stabilize the climate. The projected environmental and economic impacts of climate change on coastal ecosystems and human communities are particularly staggering. Rising sea-levels, increasingly severe storms, marine heat waves, and ocean acidification are already affecting birds and people. Without reducing greenhouse gas emissions, these impacts will become even more severe. Avoiding these climate impacts will require multiple efforts—including the rapid onboarding of clean energy and storage, modernizing and expanding our grid, electrifying much of the transportation and industrial sectors, increasing energy efficiency measures, and implementing practices that absorb significant amounts of carbon dioxide from the atmosphere.

At the same time, a number of factors are increasing our national electricity demands. Investments in manufacturing and industrial facilities, data centers, and the use of AI have sparked this unexpected growth. To meet these demands and ensure reliability, the U.S. must rapidly grow its energy and storage portfolios, and modernize and expand our grid. The expeditious deployment of offshore wind could play a critical role in stabilizing the climate. The open ocean provides consistently high windspeeds, so offshore wind has the potential to provide a steady supply of significant amounts of energy (**Figures 1 & 2**) near large populations. As many states are poised for more offshore wind development, Audubon is committed to continuing our work to protect birds by using the best available scientific and technological data to ensure science-based decision making for each step of the siting, leasing, and permitting processes.

In this report, we examine the potential impacts of offshore wind on birds and how these impacts can be effectively addressed to protect birds and the ecosystems they need. We provide an overview of the permitting process and the pertinent state and federal laws. The report includes Audubon's policy priorities and recommendations that will help ensure that the needs of birds and people are considered. Throughout the report, we illustrate how Audubon's work has supported the responsible siting and operation of offshore wind, and we identify opportunities for individuals, Audubon chapters, and state and regional offices to contribute positively to the debate on offshore wind development. We hope this report equips the reader with the knowledge to support responsible offshore wind development. With the strength of the Audubon network, we can advocate for bird-safe solutions and ensure that community engagement is a priority as we move toward a sustainable future.

"Audubon supports the responsible siting and operation of offshore wind, and emphasizes that this development must be done in a way that both minimizes harm to birds and provides a path toward a more climate-stable future."

While offshore wind energy is a key solution on the path towards a stabilized climate, we recognize that there are potential risks to birds that need to be considered (**Figures 3 & 4**). The report examines the risk of bird collisions with wind turbines, the loss of habitat if birds are displaced from feeding areas or must fly around project areas, and the potential for development to alter ocean ecosystems that provide food for birds. To date, the relatively small number of offshore wind projects in U.S. waters means that we have limited data about the impacts off our own coasts. Fortunately, there is a rapidly growing body of knowledge from the many offshore wind projects in Europe where there is a longer history of operation and monitoring. This information paired with initial surveys of seabird distribution and behavior in the U.S. provide a starting point for understanding and proactively addressing the impacts of offshore wind development.

Responsible wind energy development addresses the potential risks that development poses to birds by employing a four-element mitigation hierarchy (**Figure 3**). The overarching goal of the mitigation hierarchy is to ensure a project has no net impact; in other words, preventing a decrease in the number of seabirds or even promoting an increase. First, planners should avoid critical areas for the most vulnerable species during siting. Second, minimizing measures should be employed if avoidance does not entirely eliminate risks. For example, developers (and operators) may be able to minimize risks by altering structures so birds are not attracted to turbines or by temporarily changing operations during periods when larger numbers of birds fly through the area. Third, we must offset unavoidable impacts to birds by improving conditions at nesting colonies or taking other conservation actions. Finally, it is critical that monitoring is conducted before and after projects are constructed in order to quantify impacts and evaluate the degree to which mitigation efforts have indeed attained the desired outcomes. Assessing the impacts of wind projects on birds will require monitoring in real time how birds interact with wind projects. This will include monitoring birds in and around wind projects with radar, aerial surveys, recordings of bird vocalizations, and tags that track their movement.

A sophisticated planning and permitting process is already in place for offshore wind (**Figure 5**). Offshore wind energy development is governed by a multi-layered regulatory framework involving federal and state agencies, Tribal Nations, and industry and non-profit organizations that represent economic and environmental values of the ocean. This process includes several stages of extensive environmental review and public consultation that are designed to assess and mitigate potential impacts on wildlife, including birds. Throughout this process, Audubon staff and local chapters advocate for bird protections by contributing scientific data, engaging in policy discussions, and informing best practices to ensure that environmental impacts are minimized and conservation measures are incorporated.

We need urgent action on climate, and a rapid build-out of clean energy is a key part of the solution. Audubon supports the responsible siting and operation of offshore wind and emphasizes that this development must be done in a way that both minimizes harm to birds and provides a path toward a more climate-stable future. To achieve both, we need to:

- **Promote offshore wind design and operation that is better for birds**
- **Improve monitoring of wildlife impacts from offshore wind projects**
- **Increase investment in research, mitigation strategies, and net conservation gains for birds**
- **Prepare states for the magnitude of offshore wind development**
- **Improve siting and permitting for offshore wind**
- **Promote interoperability and improve transmission infrastructure for offshore wind projects**
- **Create regulatory and financial certainty for offshore wind projects and developers**

Audubon's goal is, as always, to protect birds and the places they need to thrive. To address the dual crises of climate change and biodiversity loss it is clear that we need to accelerate the development of offshore wind while mitigating unintended negative consequences for people and for wildlife. Working together with other conservation organizations, decision makers, project developers, and our members, we can learn to do both at the same time.

Dunlins and Ruddy Turnstones

SECTION 1

Why We Care: The Need for Offshore Wind Development

We risk losing billions more birds if climate change continues on its current trajectory.

Climate change and biodiversity loss are two of the most pressing issues of our time. North America has already lost nearly three billion birds—one out of four—since 1970.[1] Unless we reduce greenhouse gas pollution and slow the rate of warming, two-thirds of bird species in North America will face significant range loss and potential extinction.[2] We risk losing billions more birds if climate change continues on its current trajectory.

However, it's not too late. By taking meaningful action on climate change now, 76% of bird species vulnerable to climate change will fare better overall under a stabilized climate.[3] Furthermore, people and other wildlife will suffer fewer impacts from extreme weather events, sea level rise, and ocean acidification.

The science is well established and agreed-upon. To avoid the most severe impacts on birds and people, we must stabilize climate change below 2°C globally.[4] There is evidence that changes in climate can become self-perpetuating, irreversible, abrupt, and cascading due to "tipping points," such as massive releases of carbon and methane from the abrupt thaw of the Boreal permafrost and the collapse of polar ice sheets leading to increased sea level rise.[5] These dramatic changes would not only further exacerbate extreme weather, but would also translate to catastrophic consequences for coastal and ocean ecosystems and the human communities and wildlife that rely on them.

1.1 The Impact of Climate Change on Our Oceans and Coasts

Climate change is projected to have a staggering environmental and economic impact on coastal systems. By 2100, rising sea levels and increasingly severe storms across the globe are expected to increase annual flood damages to coastal communities by two to three orders of magnitude.[6] To protect against this catastrophic damage, global adaptation efforts are expected to cost several hundreds of billions of dollars each year.[7]

Seabirds are highly threatened and at risk from multiple challenges in the face of climate change.[8] Evidence of change in migration, dispersal, phenology (the timing of seasonal changes), survivorship, reproduction, and distribution suggest seabirds are already responding to the changing climate.[9] Increasingly frequent marine heatwaves—periods when ocean temperatures become unusually warm—are just one example of such disruption.[10] These events can occur across vast areas of the ocean and lead to dramatic changes in the distribution of fish and other marine life that birds feed on. The impact of elevated ocean temperatures can be seen in what is commonly called the bleaching of coral reefs. To survive marine heat waves, birds will need to travel much longer distances to find food—or face starvation. Extreme ocean heat events have been linked to mass breeding failure and mortality events in seabird species.[11] In the Pacific Ocean, the 2014–2016 marine heatwave is estimated to have caused excess mortality of several million seabirds.[12]

Coastal and marine systems are also impacted by rising atmospheric carbon dioxide levels through ocean acidification. As atmospheric carbon dioxide levels rise, some of the carbon pollution is absorbed into the oceans. Marine waters are becoming more acidic as a result, interfering with the ability of marine organisms, such as oysters and clams, to form calcium-based shells.[13]

With sea level rise, marine heat waves, and ocean acidification, many of the important benefits that ocean ecosystems provide to people—such as fisheries and tourism—are expected to decline if carbon dioxide levels continue to increase.[14]

1.2 The Importance of Renewable Energy

To avoid these climate impacts, we will need global greenhouse gas emissions (sometimes referred to as carbon pollution) to approach net-zero by 2050.[15] Reaching net-zero means balancing produced greenhouse gases with the amount removed from the atmosphere. This will require multiple efforts, including reducing the burning of fossil fuels, electrifying much of the transportation and industrial sectors, increasing energy efficiency measures, and implementing practices that absorb carbon dioxide from the atmosphere (e.g., direct air capture and natural climate solutions).[16]

Rapid deployment of utility scale wind and solar is one of the major steps in stabilizing the climate. The amount of new clean energy needs to double so that nearly 65% of all international energy sources come from renewables by 2050, while existing fossil fuel infrastructure is retired.[17]

"Offshore wind has a unique role in the portfolio of clean energy solutions because it offers multiple advantages over land-based wind or other renewable energy resources. Wind speeds are generally higher and more consistent offshore, which means the turbines can generate more electricity over a longer period of time."

The United States has made a recent push towards reaching net-zero greenhouse gas pollution emissions through the Inflation Reduction Act (IRA) of 2022, which includes $369 billion in funding Energy Security and Climate Change programs through 2025.[18] The IRA includes several provisions to incentivize the buildout of clean energy, including tax credits for developers of solar, wind, and offshore wind energy. This includes a 30% investment tax credit for offshore wind projects that begin construction before January 1, 2026. Starting in 2025, the IRA will replace technology-specific credits with a technology-neutral clean electricity investment tax credit of 6%, which can increase up to 40% if projects meet certain prevailing wage, apprenticeship, and domestic content requirements.[19]

1.3 The Role for Offshore Wind and Addressing Unintended Consequences

Offshore wind has a unique role in the portfolio of clean energy solutions because it offers multiple advantages over land-based wind or other renewable energy resources. Wind speeds are generally higher and more consistent offshore, which means the turbines can generate more electricity over a longer period of time. Offshore turbines are often larger and farther apart than their land-based counterparts, enabling greater economies of scale and more efficient energy generation. And while the ocean offers large areas for wind facilities, turbines can also be located relatively close to population centers, reducing the need for long transmission line corridors.

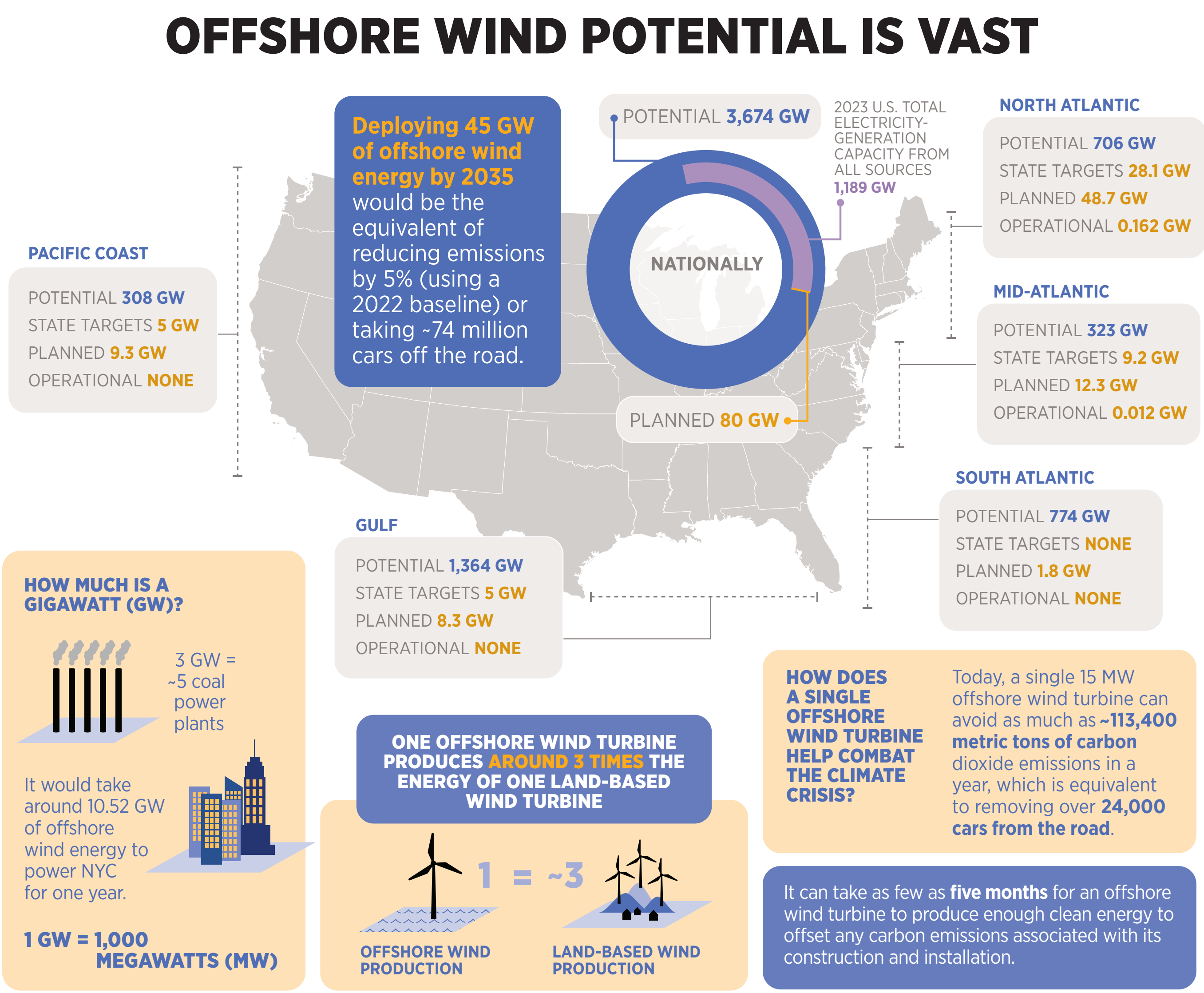
The U.S. has the potential to be a major global player in offshore wind energy production. While many potential offshore areas of the continental U.S. will be excluded from development, the collective wind energy potential in the Pacific, Atlantic, and Gulf of Mexico remains vast (**Figure 1**).

According to one estimate from the National Renewable Energy Laboratory, there is as much as 3,674 gigawatts (GW) of technically available offshore wind energy capacity off the U.S. coasts (not including the Great Lakes).[20] Several states have set goals that together could procure at least 39 GW by 2040.[21] Yet the potential capacity for offshore wind generation represents more than double the combined generating capacity of all U.S. power plants currently in operation.[22] Audubon sees both opportunity and responsibility to develop offshore wind energy in ways that address the potential for negative impacts on birds and ocean ecosystems.

While offshore wind is a key solution on the path towards a stabilized climate, we recognize that there are risks of unintended consequences. Fortunately, there is a rapidly growing body of knowledge from development in Europe, the UK, and other global areas about the impacts offshore wind can have on birds—and the actions we can take to avoid, minimize, mitigate, and monitor those impacts. We must address economic impacts as well, both in terms of potential impacts on offshore livelihoods (such as fishing) and the creation of new jobs and other economic benefits to coastal communities.

Like any major energy infrastructure project, offshore wind needs to be built with consideration for the impacts it could have on people as well as birds and wildlife. Critically, this means listening to the affected constituencies, including historically excluded voices like communities of color, low-income neighborhoods, and Tribal Nations. It also means ensuring that the economic benefits of a clean energy economy are made available to the frontline coastal communities that will host offshore wind energy projects.

Figure 1. The potential for offshore wind to generate clean energy across the United States.



Graphic: Julie Rossman/Audubon. Data: Lopez, Anthony, et al. (2022); McCoy, Angel,et. al (2024)/National Renewable Energy Lab; (2024)/U.S. Energy Information Administration; Walter Musial, et al. (2023)/Department of Energy

1.4 Continuing to Protect Shorebirds & Seabirds

Audubon has a long history of protecting beach-nesting and roosting shorebirds and seabirds (e.g., plovers and terns), especially nearshore habitat for birds protected by the Endangered Species Act, such as the Red Knot, Piping Plover, Western Snowy Plover, Roseate Tern, and California Least Tern. Audubon also hosts "Share the Shore" educational programs in multiple states including Texas, California,[23] and New York.[24] In the offshore environment, Audubon has protected island nesting habitat for seabirds in the Gulf of Maine and elsewhere around the country, and helped to secure advanced protections for important ocean foraging and migratory habitat, such as the Northeast Canyons and Seamounts Marine National Monument and multiple National Marine Sanctuaries. As we look ahead to a future with more rapid offshore wind development, Audubon is committed to continuing this work to protect shorebirds and seabirds by using the best available scientific and technological data to ensure science-based decision making for each step of the siting, leasing, and permitting processes.

Audubon is tracking and engaging on policies that protect wildlife during all development phases of offshore wind energy. To improve the likelihood that offshore renewable wind energy continues to be implemented successfully and with adequate protections, Audubon seeks to inform best management practices in such diverse fields as ocean engineering, survey and monitoring design, applied conservation protocols to evaluate population-scale effects on birds, and even financial instruments that best compensate for otherwise unavoidable impacts.

It is clear that offshore wind will be critical to effectively reduce carbon pollution and achieve a future where both birds and people can thrive. In this report, we examine the potential impacts on birds and how these impacts are being addressed to protect birds and the ecosystems they need. We provide an overview of the permitting process and the pertinent state and federal laws. Drawing on examples from the Atlantic Seaboard, the Gulf of Mexico, and the Pacific Coast, we illustrate how Audubon has engaged to advance least-impact development. The report includes Audubon's policy priorities and recommendations that will help ensure that the needs of birds and people are considered as we plan for a sustainable future with a stabilized climate.

Coastal Bird Monitoring in Florida

1.5 Collective Action and Engagement

Throughout the report, we will identify opportunities for individuals, Audubon chapters, and state and regional offices to contribute positively to the debate on offshore wind development. Collective action and engagement are crucial to ensure that this development prioritizes wildlife and communities. Here are a few examples of ways to get involved:

- **UNDERSTAND THE ISSUES AND SOLUTIONS:** Transitioning to clean energy is essential for protecting frontline communities and the two-thirds of North American bird species threatened by climate change. Offshore wind is a key part of this solution, and it is vital to ensure this infrastructure is developed responsibly, for the benefit of both birds and people.
- **RAISE AWARENESS:** Spread the word about the importance of clean energy for birds and people. Consider sharing this report with local representatives, writing letters to the editor, or discussing it in conversations. Information from a trusted community voice is often the most effective means of communication.
- **ATTEND COMMUNITY MEETINGS:** If an offshore wind project is proposed in your area, attend community meetings to voice your support for bird-safe solutions. Community feedback can influence project design, so your participation is important.
- **GET INVOLVED:** Reach out to local Audubon chapters or state offices to learn about offshore wind projects and engagement opportunities in your area. For specific questions or to get involved with a campaign, contact cleanenergy@audubon.org.

Audubon Love Your Wetlands Beach Cleanup in California

With the strength of the Audubon network, we can advocate for bird-safe solutions and ensure that community engagement is a priority as we move toward a clean energy future.

Audubon Love Your Wetlands Beach Cleanup in California

SECTION 2

Science: Our Current Understanding of Birds and Offshore Wind

Red Knot

To understand the potential impacts of offshore wind development on birds, it is helpful to know the basics of the technology and the construction process.

Offshore wind energy is generated by large turbines that are elevated above the surface of the ocean (**Figure 2**). Most turbines consist of a three-bladed rotor that is attached at the hub to a tank-like structure (the nacelle) that houses the generator. Cables from the generator deliver electricity down the tower to under water transmission cables that carry the electricity to shore. Onshore power stations then transfer the power into the local or regional grid.

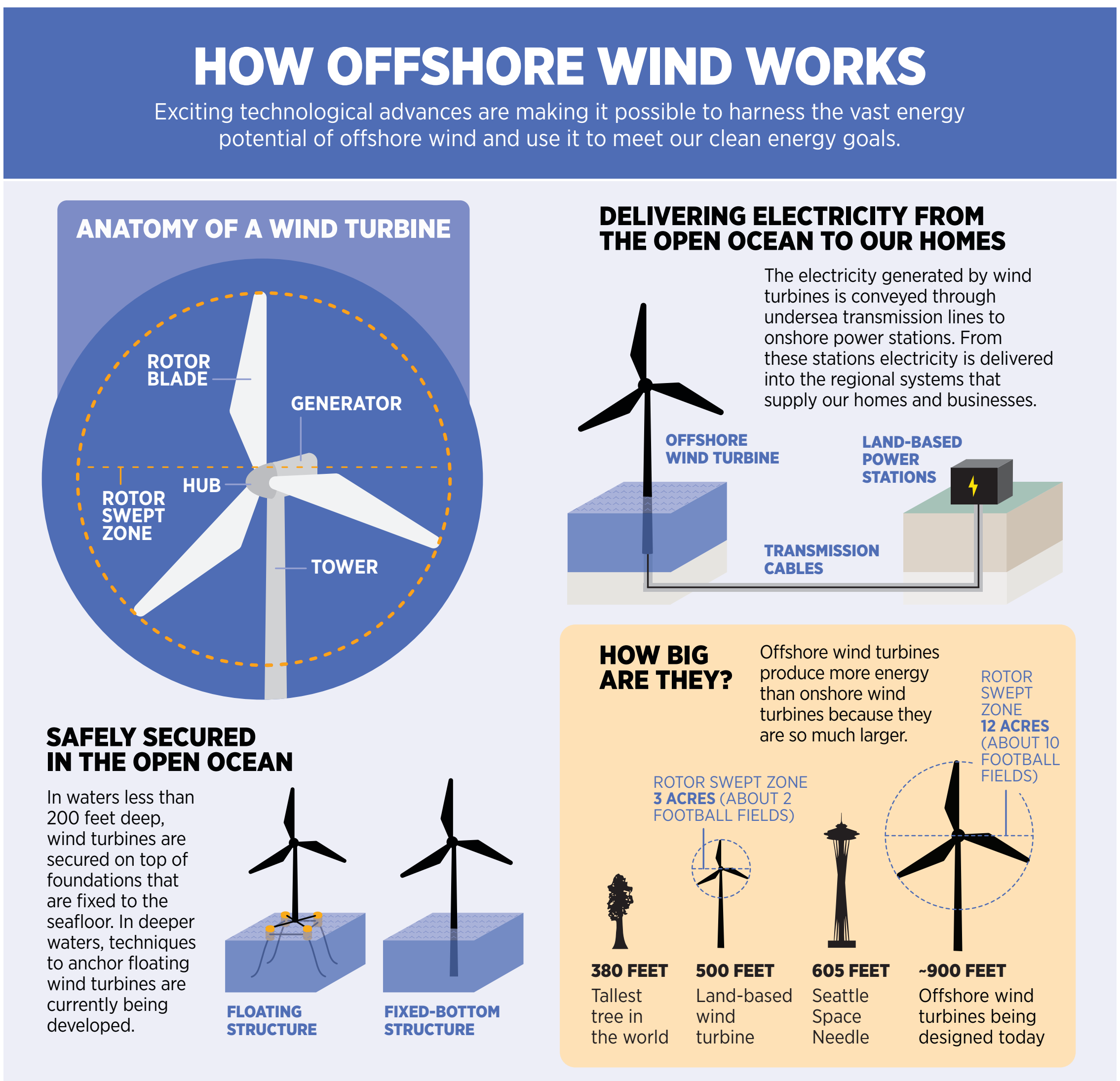


Figure 2. **A visual depiction of the major components of offshore wind.**

Graphic: Julie Rossman/Audubon. Data: Bošnjaković, Mladen et al. (2022)/*Applied Sciences*; Asim, Taimoor et al. (2022)/*Energies*.

Ørsted South Fork Wind Project, Long Island, New York

A single rotor blade can reach lengths of up to about 360 feet (110 meters; about the length of a football field), meaning that the diameter of the rotor can reach up to 720 feet (220 meters), and the total height above the surface of the ocean can reach 820 feet (250 meters).[25] The area that is covered by the rotor blades is referred to as the rotor swept zone. The size of the rotor swept zone and its height above the water are important considerations for calculating the potential collision risk that turbines create for birds. The rotors of the largest wind turbines typically turn 5-8 revolutions per minute; this may appear slow because of their large size, but the tips of the blade can reach speeds of 200 miles per hour.[26]

> **"Up to 46% of all seabird species—and as many as 380 million individual birds—are at risk from the following three threats: invasive species, fishing activity fatalities, and climate change. In stark contrast, all forms of energy production (including offshore wind) and mining were found to impact only 10% of species, typically with medium or low magnitude of impacts."**

Anchoring offshore wind turbines in the open ocean builds upon decades of engineering and safety developed for offshore oil platforms, but without the risk of oil spills or resource depletion. Based on the depth of the sea floor, there are two primary approaches to anchoring wind turbines. Up to a depth of 200 feet (60 meters), most turbines are mounted directly on top of fixed structures that extend down into the sea floor.[27] These fixed-bottom structures have been used in the vast majority of offshore wind farms to date. However, depth limitations constrain where they can be used, especially off the Pacific Coast where the coastal shelf drops rapidly. In waters deeper than 200 feet (60 meters), wind turbines are anchored using floating structures. With this technique, the nacelle is on a tower supported by a buoyant structure anchored to the seafloor with mooring cables.[28] Although floating structures are more expensive and are currently in very limited use, the ability to secure wind turbines in deeper waters has the benefit of positioning the turbines in areas with stronger winds and less visibility from shore. Currently, 4,250 feet (1,300 meters) is considered the maximum depth at which floating turbines can be installed, but this could increase in the future as new technologies are developed.[29]

Building, operating, and maintaining an offshore wind project is a major undertaking. There are extensive permitting and environmental review processes that involve six distinct project phases: planning and analysis, leasing, site assessment, construction and operations, post-construction monitoring, and decommissioning or repowering. The construction and installation process requires a significant investment in specialized equipment, highly trained personnel, and safety protocols.[30] During installation, some operations create short-term environmental impacts like noise and light, and the operation and maintenance phase create longer-term environmental effects to consider. When the turbines are decommissioned or replaced with new turbines (usually after about 25 years), there will once again be short-term impacts to consider in terms of the deconstruction activities and turbine recycling and disposal.[31] These phases are discussed in more detail in **Section Three** of this report.

2.1 The Potential Impacts of Offshore Wind on Birds

Up to 46% of all seabird species—and as many as 380 million individual birds—are at risk from the following three threats: invasive species, fishing activity fatalities, and climate change.[32] In stark contrast, all forms of energy production (including offshore wind) and mining were found to impact only 10% of species, typically with medium or low magnitude of impacts.[33] In part, this reflects the fact that the global footprint of offshore wind is still very small. So, while Audubon supports the rapid deployment of offshore wind to address climate change, we also urge that development avoids, minimizes, offsets, and monitors any negative impacts on birds and ocean ecosystems.

The first offshore wind facility was built in Denmark in 1991,

turbines are installed. While we still lack much of the information needed to quantitatively compare the risk across species, the studies that have been conducted to date suggest that species such as songbirds, alcids, and storm-petrels spend relatively little (<5%) of their time flying within the rotor swept zone, and sea ducks and loons spend a relatively small amount of time (5-20%) within this height range. Species such as waterfowl, terns, gulls, pelicans, and gannets, however, spend more than 20% of their time flying within in the rotor swept zone, making them especially vulnerable to collisions (**Figure 4**).[38] While this preliminary information provides a means to assess broad patterns in vulnerability, the amount of time birds spend flying within the rotor swept zone will also vary dramatically across locations and seasons.

and since that time many more have been deployed in Europe, the UK, and Asia. Currently, there are only four operating offshore wind projects in the United States—off the coasts of Rhode Island, Massachusetts, Virginia, and New York.[34] Although there is a significant body of literature on the impacts of wind facilities on birds, most of it has been generated outside of the U.S. This presents an opportunity to learn from experiences across the world while transitioning to greater reliance on offshore wind power in the U.S. Below we outline both direct (injury and mortality from collisions) and indirect (barrier effects, displacement, and ecosystem degradation) impacts on birds (**Figure 3**). We then provide a summary of some practices that are being employed or tested to minimize the potential negative impacts of offshore wind development on birds in the U.S.

2.1.1 Collisions

Bird collisions are not unique to offshore wind turbines. Birds collide with buildings, communications towers, vehicles, and other infrastructure. On land, building collisions alone are estimated to kill over one billion birds each year in the U.S.[35] The potential for offshore wind to contribute to the risk that birds already face from collisions makes it imperative that we use the latest science to understand and minimize the risks.

On the open ocean, birds can be killed or injured when they collide with ships or offshore oil platforms. Similarly, offshore wind infrastructure—including turbine blades, towers, electrical platforms, and construction equipment on boats—all pose potential threats.[36] Even when they do not directly strike a rotor blade, birds can be killed or injured when they pass through the strong wind currents (vortices) created by turbines.[37]

However, not all birds face the same risk of collisions. The foremost metric for quantifying collision risk is the amount of time that birds spend flying at the same altitude of the rotor swept zone and at the same distance from shore where turbines are installed.

For birds that do spend time within the vicinity of wind turbines, their risk of collisions is associated with their ability to avoid the infrastructure. These abilities have been defined in terms of macro-avoidance (avoiding turbine areas completely), meso-avoidance (avoiding turbines within wind projects), and micro-avoidance (last-minute movements to avoid collisions with rotor blades when flying within the rotor swept zone).[39]

Some birds actively fly around entire areas with wind turbines (macro-avoidance), reducing their risk of collision. Consistent macro-avoidance behavior has been documented for gannets, loons, and grebes.[40] Other species, such as Brown Pelicans, are less likely to avoid areas with wind turbines, which make them more vulnerable to collisions.[41] However, even within a species, the degree of macro-avoidance may vary depending on many factors, including the location, season, time of day, turbine spacing, and construction activities.[42]

The vulnerability of species that do not avoid wind projects may be still low if they avoid turbines as they move within wind projects (meso-avoidance). Patterns of meso-avoidance have been well-documented for several species of gulls.[43] Because meso-avoidance can have both vertical (above or below turbines) and horizontal (around turbines) components, advances in three-dimensional tracking will provide additional information on which species exhibit the strongest meso-avoidance behavior.

Within the rotor swept zone, the ability of birds to make last-minute movements to avoid rotor blade collisions (micro-avoidance) depends on several factors. Micro-avoidance is not yet well-documented because it requires detailed observational data or tracking to quantify. However, there is some information about characteristics that limit the potential for micro-avoidance. Species with long and narrow wings that fly by gliding with prevailing winds (e.g., petrels and albatross) cannot quickly adjust direction and altitude to avoid collisions.[44]

SCIENCE-BASED SOLUTIONS

Potential impacts of offshore wind projects on birds can be reduced through responsible siting and operation.

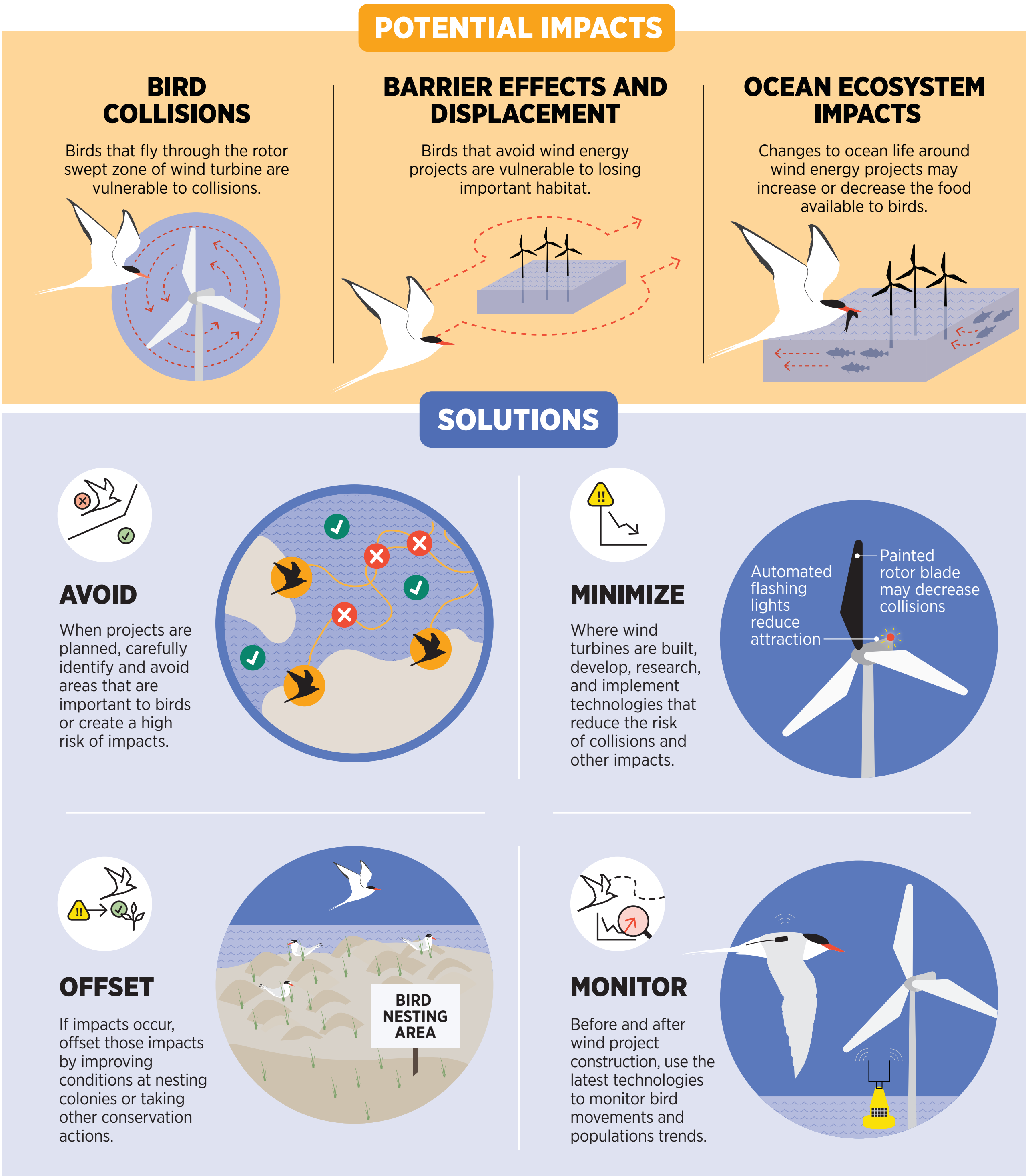


Figure 3. The potential impacts of offshore wind energy developments on birds and a four element mitigation hierarchy by which these impacts can be addressed.

Graphic: Julie Rossman/Audubon. Data: Croll, Donald A., et al. (2022)/Biological Conservation; Isaksson, Natalie, et al. (2023)/*ICES Journal of Marine Science*; Fox, Anthony D., et al. (2006)/Ibis; May et al. 2020/Ecology and Evolution.

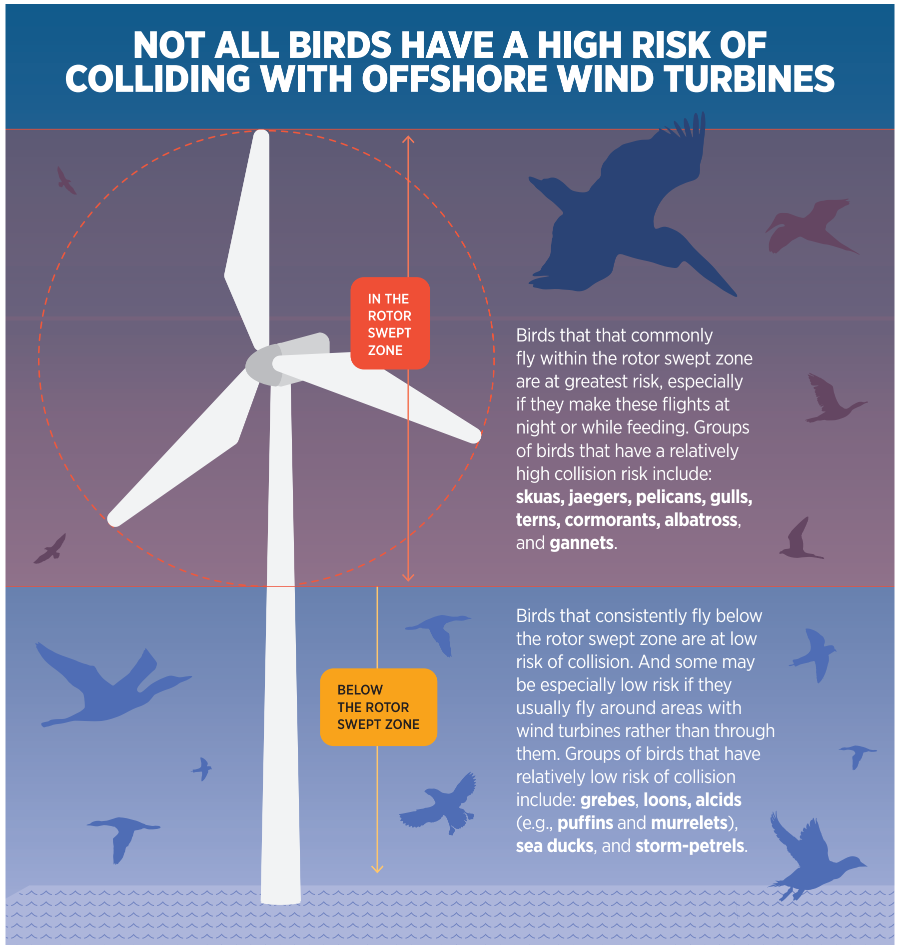


Figure 4. The relative collision vulnerability of marine birds.

Graphic: Julie Rossman/Audubon. Data: Kelsey, Emma C., et al. (2018)/*Journal of Environmental Management*; Robinson Willmot, et al. (2013)/BOEM.

The ability to see rotor blades can also play a role in micro-avoidance, potentially putting species with a limited field of view or those that can be distracted while pursuing prey or chasing other birds at risk (e.g., skuas, gulls, terns, and gannets).[45]

When flight altitudes and avoidance behaviors are considered together, groups of birds that have been identified as especially vulnerable to collisions are jaegers, skuas, pelicans, terns, and gulls.[46]

While some species are at a reduced risk of collisions because they avoid offshore wind facilities, others are at increased risk because they are attracted to wind farms. Attraction behavior is considered two to three times less common than avoidance in birds,[47] but attraction may occur when birds are drawn to light or because the wind turbines provide increased foraging or roosting opportunities.[48] Accordingly, the potential for attraction is an important consideration in designing actions to minimize the impacts of offshore wind on birds.

Nocturnal migration is a significant risk factor for migratory seabirds, shorebirds, and even landbirds that make over-water flights. Any time migratory birds fly within the rotor swept zone they are at risk of collisions, and this risk may be exacerbated by poor weather and attraction to illuminated structures.[49] In particular, risk of collision can increase when migrants take off during favorable onshore conditions but face unexpectedly poor conditions offshore. These hazards can also compound on one another; for example, terrestrial migrants can be more attracted to illuminated offshore structures when weather conditions impair visibility.

All these factors contribute to our understanding of which bird species may be at risk of collisions with offshore wind infrastructure. Ultimately, this information must be combined with the extent and location of offshore wind development to calculate the projected impacts on bird populations. To develop these projections, scientists use collision risk models (that describe the expected number of fatalities from a given number of wind turbines) with population models (that describe the change in population as a function of adult survival and reproductive success). Using these modeling approaches, ecologists can calculate the number of fatalities a population can sustain annually without beginning to decline. This modeling is especially important because seabirds are typically long-lived and raise relatively few offspring each year. For these species, changes in population size are often influenced more strongly by adult survival rather than reproductive success.[50] As a result, understanding the potential impacts of collision-related fatality on population trends is critical for evaluating the long-term impacts of offshore wind energy on seabird populations.

2.1.2 Barrier Effects and Displacement

As described above, some birds can avoid offshore wind projects entirely, and avoidance is considered two to three times more common than attraction behavior.[51] This behavior is advantageous in that it reduces risk of collision. However, when birds avoid wind projects in areas where they regularly travel, forage, or use for other activities, this avoidance behavior can have other negative impacts.

For these birds, the wind projects act as barriers to movement (like detours) that cause them to expend more energy, which could negatively impact individuals and populations.[52] The negative impacts of barrier effects are thought to be greatest for species that regularly commute between breeding and foraging habitat (e.g., some cormorants and terns).[53]

In contrast, the impacts of these extra movements may be minimal for migratory birds that detour around wind projects only once or twice each year.[54]

Avoidance behaviors can also result in more permanent displacement. Displacement is when installation of wind projects causes birds that use an area for foraging or other activities to abandon the area permanently.[55] Displacement is of concern because it impacts birds throughout the entire lifetime of a wind project. Displacement during construction may also occur for a limited time (e.g., from the sounds of pile-driving and boat and helicopter traffic).

The impact that displacement has on marine birds depends on the birds' ability to use other habitats. Birds that have a limited range of prey or use specific habitat types are thought to be at the greatest risk, whereas generalist feeders can more easily adjust by shifting to other habitats. Species that are believed to be especially sensitive to habitat displacement include sea ducks, loons, some alcids, and grebes.[56]

Quantifying the impact that barrier effects and displacement have on populations is more difficult than quantifying the impact of collisions because barrier effects and displacement are indirect and slowly impact reproductive success or survival of individuals over long time periods. Research is ongoing and new methods are being developed to help quantify barrier effects and inform mitigation measures.[57]

2.2 Ocean Ecosystem Impacts

In addition to the impacts described above, there is also the need to understand the effects that offshore wind projects may have on ocean ecosystems that would then impact patterns of bird distribution and abundance.

An intuitive example of ecosystem impacts is the reef effect. This describes the potential for the underwater turbine support structures to act as reefs, increasing populations of fish attracted to rocky habitats.[58] This in turn could attract foraging seabirds and expose them to collision risk. In addition, the modified ocean currents created by the underwater structures of offshore wind turbines could cause small fish or other resources to concentrate in the vicinity of wind turbines and attract foraging birds.[59]

More broadly, extensive areas of wind turbines may change the interaction between the atmosphere and the ocean, leading to changes in nutrient upwelling, primary production, and ocean oxygen levels.[60] The potential for these ecosystem level impacts makes it imperative that efforts to monitor and mitigate the effects of wind energy development do not focus exclusively on birds, but also evaluate changes lower on the food chain (e.g., forage fish) in order to evaluate and address the potential impacts of ecosystem effects.[61]

Brown Pelicans

2.3 Impacts of Transmission

While most of the offshore wind footprint will occur miles from shore, a smaller footprint of transmission lines and facilities will need to be constructed in shallower waters and on land. These facilities will need to be located in coastal ecosystems that are important for people and wildlife. Because many of these ecosystems have been extensively altered by coastal development and are increasingly impacted by sea level rise, birds such as the Saltmarsh Sparrow, Black Rail, Piping Plover, and Snowy Plover are already at risk in these areas.

On land, the construction of transmission infrastructure can pose challenges related to habitat disturbance and an increased risk of collision with overhead wires. In coastal areas, the installation of underwater cables and increased boat traffic between port infrastructure and offshore wind projects may pose additional challenges for birds that rely on shallow water or shoreline habitat. Just as it is important to consider the impacts of new transmission needed to support land-based clean energy,[62] considering and addressing the impacts from transmission for offshore wind, especially those that occur on land, will be an important aspect of responsible offshore wind development. For more about risks to birds from the development of transmission on land, see Audubon's 2023 report, ***Birds and Transmission: Building the Grid Birds Need***.

2.4 Best Practices: Avoid, Minimize, Offset, and Monitor

Responsible wind energy development addresses the potential risks these projects pose to birds by employing a four-element mitigation hierarchy (**Figure 3**). First, planners should avoid critical areas for the most vulnerable species during siting. This is the highest in the hierarchy because there is the least uncertainty regarding impacts to birds. Second, developers (and operators) should minimize risks by altering structures or temporarily changing operations during periods with high risk. Minimizing measures should be employed if avoidance does not eliminate risks. Third, offset any impacts to birds that cannot be prevented with compensatory mitigation. Finally, it is critical that monitoring is conducted before and after project construction is completed in order to quantify impacts and evaluate the degree to which mitigation efforts have indeed attained the desired outcomes. The overarching goal of the mitigation hierarchy is to have no net impact—in other words, to prevent a decrease in the number of seabirds or even promote an increase.

> **"The overarching goal of the mitigation hierarchy is to have no net impact—in other words, to prevent a decrease in the number of seabirds or even promote an increase."**

2.4.1 Avoiding Impacts

At the first step of the offshore wind planning process, information about seabird distribution should be used to avoid siting projects in areas with greatest bird abundance. If spatial data on birds are not available, maps of oceanographic conditions can be used to identify important areas for seabirds. For example, in the Atlantic and Gulf of Mexico, high productivity and seabird abundance largely fall near shore (0-15 miles [25 km]) and on the edge of the continental shelf; therefore, the middle continental shelf may provide safer siting areas for offshore wind in these regions.[63] These planning efforts could also consider Marine Protected Areas and Important Bird Areas to avoid conflict with areas that are already documented important to seabirds and ocean ecosystems.

In addition to detailed information about birds, spatial analyses can reveal tradeoffs among different uses of the ocean and marine resources.[64] This information can be combined into decision support frameworks to identify areas that have the greatest wind energy potential and the least overlap with critical avian and marine wildlife habitat.[65]

After identifying the best places for wind energy development at a broad spatial scale, finer scale information within these areas can be used to identify where risks to vulnerable species can be avoided by rearranging the spatial distribution of turbines within lease areas.[66] For these regional or local analyses, more detailed information about the distribution and movements of individual species, such as collision risk models and population models, may be necessary.

2.4.2 Minimizing Impacts

After wind energy project sites have been selected to avoid as many impacts as possible, there are numerous opportunities to minimize remaining impacts during construction and operation. Although a number of practices to minimize impacts of land-based wind energy have been developed, these practices must be proven safe and effective in a marine environment before they are deployed at scale.

First, the layout of turbines can be designed to reduce the impact of barrier effects and displacement. Avoiding dense construction perpendicular to flight paths or aligning the turbines parallel to flight paths may minimize barrier effects. In other situations, spacing out fewer and larger turbines over an area to create flight corridors may be the best strategy.[67] However, reducing barrier effects or increasing permeability may reduce displacement but increase the risk of collisions. Therefore, the best alternative will depend on the location of projects and the vulnerability characteristics of the species in the area.[68]

Although installation is a relatively brief period in the full life of a wind project, this phase presents a high-level of activity and noise that has the potential to displace seabirds. During construction, there are multiple ways to reduce vessel and noise-related disturbances. These include postponing construction activities during sensitive periods (e.g., nesting, staging, migration), refraining from the use of particularly noisy construction techniques, and avoiding driving vessels through aggregations of birds. Lighting abatement recommendations are addressed below. Oversight by professional wildlife biologists, which many developers already employ, helps to identify the most appropriate actions to minimize impacts to birds and other wildlife.[69]

Once a wind project enters operation, there are strategies for minimizing the risk of collisions. These strategies include eliminating factors that attract birds to turbines, increasing visibility of the rotor blades, and changing the operation schedule of turbines to reduce risk during critical periods.

Several techniques are proven safe and effective and are being employed to minimize the number of birds that are attracted to turbines. Any lighting on or around turbines should be Federal Aviation Administration (FAA) and U.S. Coast Guard (USCG) compliant, be reduced to a minimum, and include bird-safe features.[70] These impacts can be further addressed with the FAA-approved aircraft detection lighting systems that utilize automated red flashing lights when approaching aircraft enter and leave the area.[71] To prevent roosting, anti-perching devices can be used, including those that are radar-activated when approaching birds are detected. Anti-perching and roosting devices can be visual (e.g., peregrine falcon decoys, strobe lights), audible (e.g., speakers and other noise-making devices), and/or physical (e.g., spikes, reflectors, ribbons, wires, or nets).

Several practices that have shown potential to minimize impacts of land-based wind energy may also be applicable to offshore wind energy, but they require further testing before wide-spread adoption. Practices that can increase the ability of birds to perceive rotor blades and their movement are an area of active research. One possible approach is to increase visibility of rotor blades using achromatic, high-contrast patterns or ultra-violet light visible paint.[72] While slowing rotor blades may increase visibility for birds, this may be ineffective or counterproductive for some species[73] and should be evaluated further.

Finally, curtailment, or temporarily slowing or stopping the rotation of turbines, is a promising strategy, especially during high-risk scenarios, such as high-density nocturnal migration events.[74] Timing of curtailment can be informed by radar monitoring, digital cameras, or birds tagged with transmitters to detect migrating birds in the vicinity of turbines.[75]

2.4.3 Offsetting Impacts

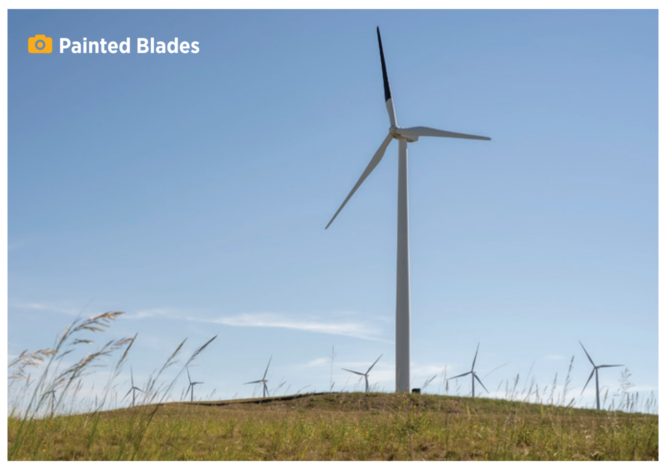
After avoidance and minimization strategies have been thoroughly employed, unavoidable impacts within a wind project can be offset through conservation actions that benefit impacted bird populations elsewhere.[76] Compensatory mitigation is based on the unfortunate fact that seabird populations are negatively impacted by many ongoing stressors, especially on the beaches or islands where they nest. Compensatory mitigation involves quantifying the negative impacts expected at a wind project site, and then implementing conservation actions at another site to offset the impacts.[77] These strategies require both thorough preparation and long-term maintenance and monitoring in order to be effective.[78] Below we describe some of the specific conservation actions that can be employed to compensate for impacts to seabird populations.

One approach to compensatory mitigation is investing in stewardship activities that improve reproductive success at nesting colonies. Invasive species are considered among the top three threats faced by seabirds across the globe, and they are particularly problematic at nesting colonies.[79] Seabird nesting colonies are especially vulnerable to mammalian predators such as mice, rats, foxes, and feral cats that have been introduced to islands where they did not historically occur. When introduced predators are removed from nesting islands, there is a predictable increase in reproductive success for most seabirds.[80] Seabird nesting can also be negatively impacted by invasive or incompatible vegetation that makes nests vulnerable to predation, storms, and erosion.[81] Vegetation management has improved reproductive success of seabirds, especially terns.[82]

Birds need space to nest, and when people or dogs get too close this causes stress and can cause nests to fail.[83] These impacts are especially severe for beach-nesting birds, such as terns, gulls, skimmers, and pelicans.[84] Several stewardship techniques have been developed to reduce the impacts of human disturbance on beach-nesting birds, including signage, fencing, steward patrols, education, and beach access restrictions (e.g., people, dogs, vehicles).[85] Ideally, a tailored portfolio of multiple stewardship measures can be applied over long periods of time to ensure success.[86]

The conservation actions described above work best where seabird colonies are already active. However, in some cases more active measures may be necessary to re-establish nesting at seabird colonies.[87] These efforts, including moving birds from active colonies (translocation) and setting out decoys and playing taped calls of breeding birds (social attraction), have been highly successful in restoring colonies of seabirds, such as puffins, terns, and petrels.[88]

For any compensatory mitigation, it will be important to consider long-term efficacy given the projected impacts of climate change. Climate change will increasingly impact seabirds through extreme weather events, sea level rise, alterations to local marine ecology (e.g., food availability), and increasing pathogenic transmission due to warming climates.[89] Care needs to be taken to ensure that conservation actions, especially at low-lying nesting sites, are robust to account for projected changes in sea-level rise and increasingly severe storms.[90]


Painted Blades

2.5 Monitoring

For the best practices discussed above to be effective, it is critical that effective monitoring methods are developed and implemented before, during, and after offshore wind projects are constructed. However, effective on-site monitoring is logistically and financially difficult because it requires observing birds over the ocean, during the day and night, and under inclement weather conditions. Capturing direct observations of fatality and avoidance rates from offshore wind is extraordinarily difficult due to logistical constraints and the high cost of data collection.[91]

Thus, it is critical that offshore wind projects consider both information from long-term monitoring of seabirds (e.g., at nesting colonies) and the application of cutting-edge technologies that can overcome the logistical and financial constraints. Examples of these technologies include radar, thermal detection, range finders, and cameras, though most of these have only been deployed recently and are still experimental.[92] The information collected with these techniques can be used to improve collision risk models which will inform where wind turbines can be sited and operated to avoid and minimize collision risks.[93]

In addition to monitoring at offshore wind projects, it will also be important to monitor the long-term trends of bird populations. This monitoring will help to assess the efficacy of compensatory mitigation actions. Some examples include ongoing Bureau of Ocean Energy Management (BOEM) biological monitoring, such as the compilation of monitoring data through the New York Offshore Wind Master Plan,[94] and long-term population monitoring programs, such as those conducted by Audubon's Seabird Institute.

> **"Ideally, a tailored portfolio of multiple stewardship measures would be applied over long periods of time to ensure success."**

2.6 Priorities for Future Research

As the information needs for siting offshore wind come into focus, efforts are underway to identify regional priority species and research topics.[95] These priorities will vary across oceans and depend on the types of wind turbines that are considered for installation. Below are some of the frontiers of bird research where recent technological developments now provide the means of collecting information that will help ensure that offshore wind is responsibly sited and operated.

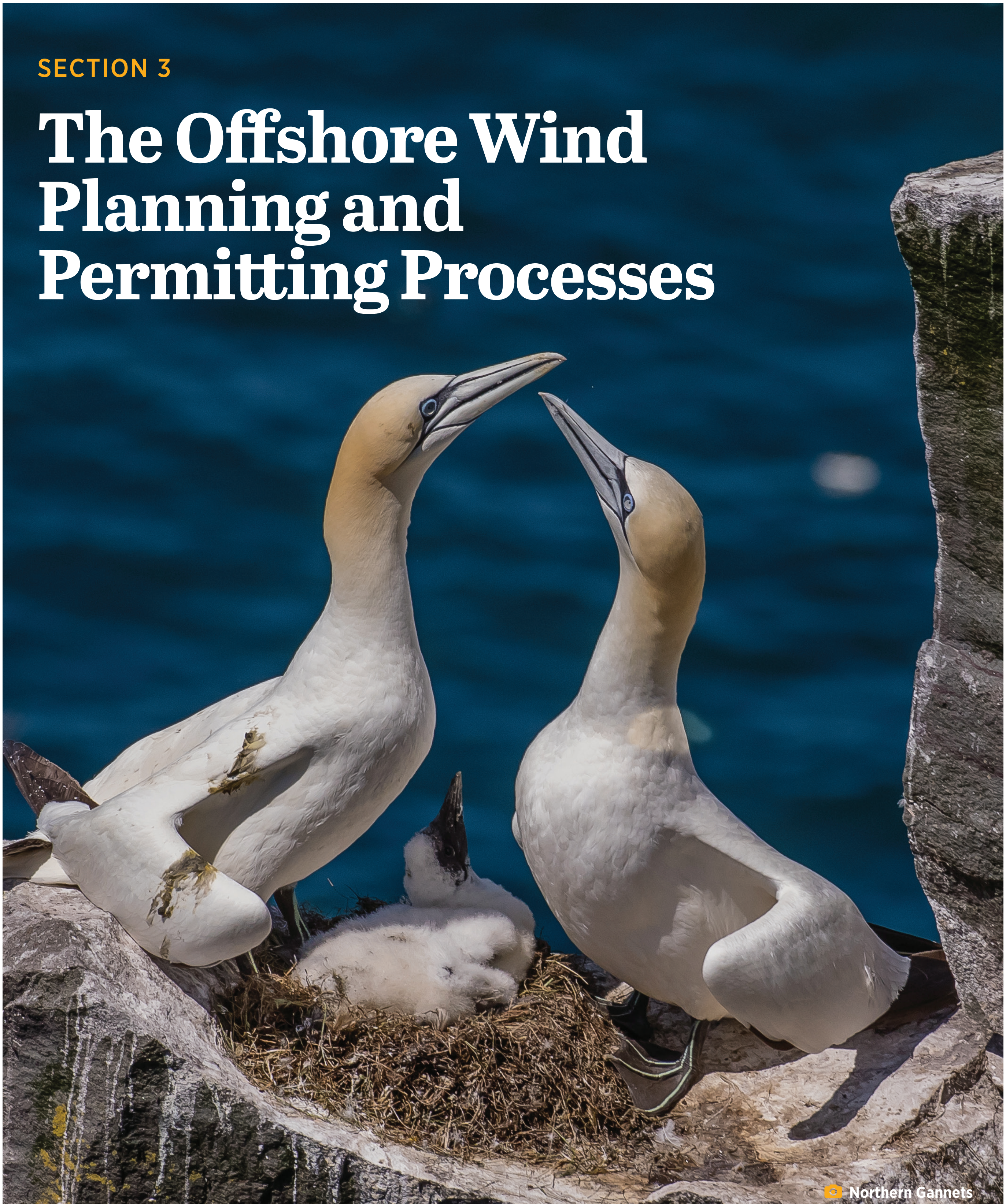
- **INFORMATION ON NOCTURNAL MIGRATION FLIGHT ALTITUDES.** We still know relatively little about the flight altitudes of small migratory landbirds in areas where they would encounter offshore wind projects. New tracking technologies, such as geolocators and satellite transmitters,[96] provide opportunities to generate this information and identify where and when offshore wind poses risks to migrating landbirds. This information will be especially critical for informing the development of offshore wind on the Great Lakes and in the Gulf of Mexico.
- **DATA TO DRIVE EFFECTIVE COLLISION RISK AND POPULATION MODELS.** While collision risk models can be extremely useful and are currently the only option for modeling offshore wind impacts, they make several assumptions regarding avian characteristics. Unfortunately, these assumptions have not been tested in actual offshore wind projects (e.g., comparing models to real world collision monitoring). Thus, these models need to be re-evaluated and improved as more data become available.[97]
- **MITIGATION STRATEGIES FOR TRANSMISSION FACILITIES AND OTHER ONSHORE INFRASTRUCTURE.** In addition to offshore impacts, we must avoid, minimize, and/or offset terrestrial impacts of wind projects. This could include identifying areas where transmission facilities avoid sensitive habitats and construction techniques that minimize impacts.
- **TRACKING FINE-SCALE BIRD MOVEMENTS IN AND AROUND OFFSHORE WIND PROJECTS.** As tracking technologies continue to improve, the number of bird species that have been tracked—and our understanding of their movements—has greatly increased. However, in the context of offshore wind development, greater temporal and spatial resolution is needed to understand how these distributions and movements are impacted by environmental variables, or how they will respond to climate change. As technology advances, collecting information on the three-dimensional movements of smaller birds will be especially important for understanding interactions of birds and offshore wind facilities.[98] More information on tracking of migratory birds and applying this information to bird conservation is available on the Bird Migration Explorer website.[99]
- **PROJECTING THE EFFECTS OF CLIMATE CHANGE TO IMPROVE MITIGATION EFFORTS.** Climate change is driving rapid changes in bird distribution and population trends.[100] Projecting these changes will help to anticipate where offshore wind may conflict with seabird conservation in the future and where investments in colony restoration will be most robust. More information on these modeling techniques and their applications to bird conservation is available at the Survival by Degrees page.[101]

2.7 Putting Science into Action

As illustrated above, there is a large and growing body of knowledge about how we can develop offshore wind in a responsible manner that recognizes the potential adverse impacts and takes steps to avoid and minimize them. Where uncertainty remains, it will be critical to have monitoring techniques in place to detect any unintended impacts and adapt operations to address them. To do so will require a robust set of policies that promote the rapid development of offshore wind while using the latest science and monitoring to protect birds and ocean ecosystems. In the section that follows, we present the current regulatory process for developing wind on the open ocean and how Audubon is working to ensure that development is supported by the policies that ensure the greatest benefits for birds and people.

SECTION 3

The Offshore Wind Planning and Permitting Processes



Northern Gannets

Although the open ocean is vast, it is not empty.

In addition to being home for diverse and thriving ecosystems, the open ocean is used as a highway for commercial fishing and shipping, hosts a complicated maze of undersea communication cables and an energy extraction system with oil wells and pipelines, and plays a critical role in military activities for national security. As a result, large areas of the ocean are already off limits for wind energy development (**Figure 5**), and planning processes involve a broad group of ocean users to minimize the potential for conflict and unintended consequences.

WORKING OFFSHORE: WHERE WE ENGAGE ON BIRDS AND WIND ENERGY

Many areas of the ocean are low priority for wind energy development, either because windspeeds are low or because the area available for projects is limited. Audubon will continue to engage anywhere offshore wind is planned, under construction, or operational.

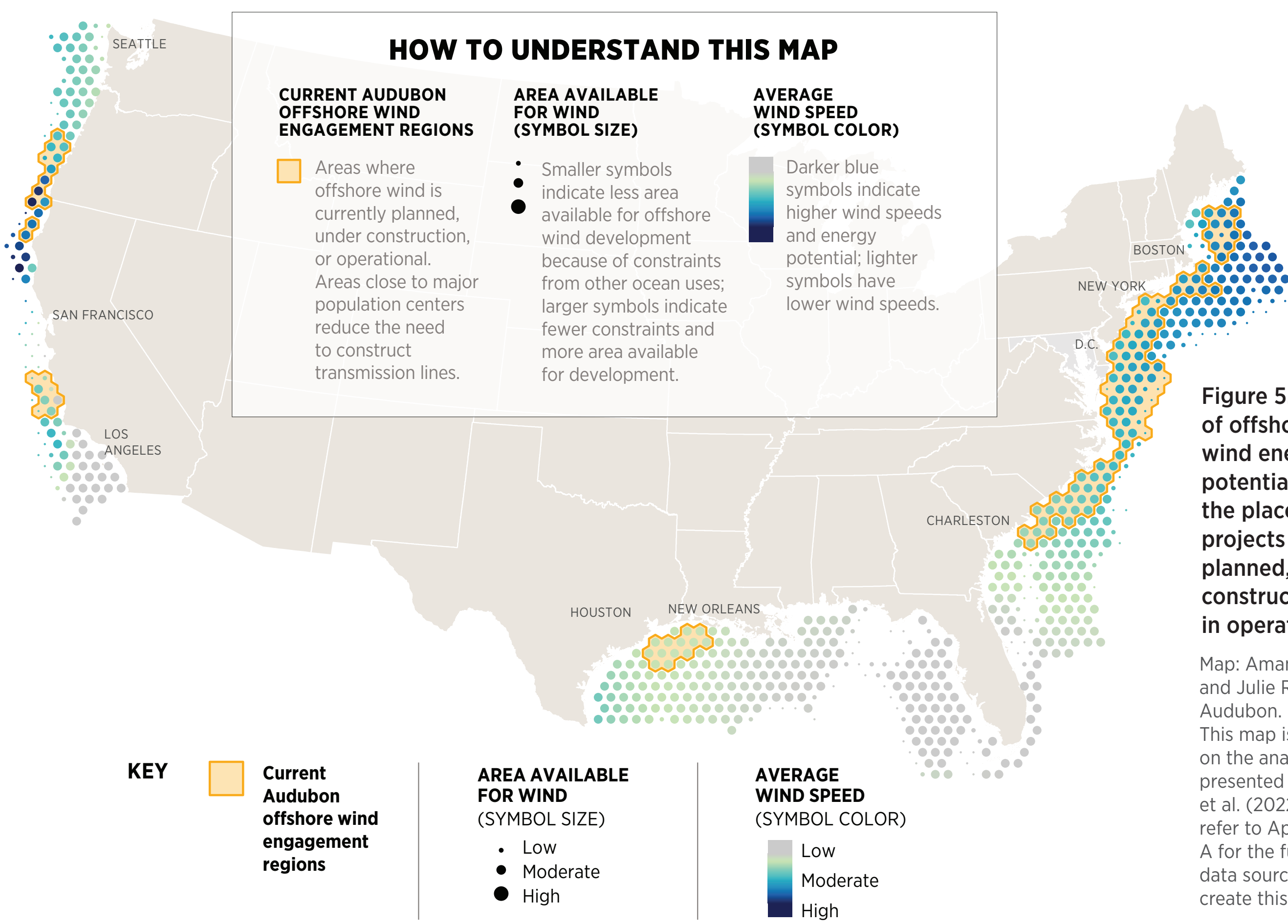


Figure 5. Map of offshore wind energy potential and the places where projects are planned, under construction, or in operation.

Map: Amanda Long and Julie Rossman/ Audubon. Data: This map is based on the analyses presented in Lopez et al. (2022). Please refer to Appendix A for the full list of data sources used to create this map.

There is a sophisticated planning and permitting process already in place for offshore wind (**Figure 6**). The regulatory jurisdiction and processes are determined in part by the distance of projects from shore. The federal government regulates the leasing of energy production in the Outer Continental Shelf (waters beyond the state seaward boundary to 200 nautical miles of the coastline).[102] However, under the Coastal Zone Management Act and other laws, the states are responsible for permitting infrastructure, such as undersea cables and cables on the ocean floor, within three nautical miles of their coast line (with the exceptions of Texas and the Gulf side of Florida, which manage waters within nine nautical miles). In this capacity, the states respond to a "consistency determination" from BOEM on whether the agency's decisions have coordinated with state policies and laws. Because coastal waters have a much higher concentration of unique wildlife resources and economic uses than the further offshore federal waters lease areas, projects planned within state waters present a more complicated set of challenges. Any development of offshore wind in the Great Lakes would be regulated by the relevant state.

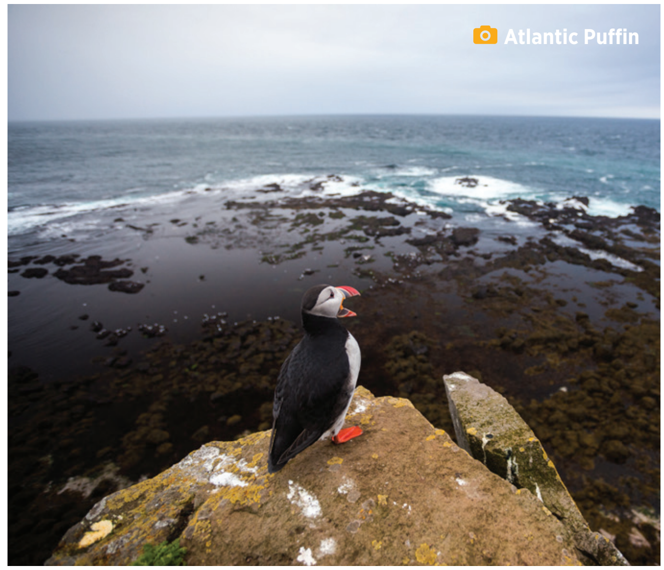
In this section, we begin by reviewing the planning and regulatory processes for offshore wind development in federal and state waters, how Audubon engages in that process, and how we will engage with our members throughout our work in this process.

A more detailed description of the federal siting, permitting, installation, and decommissioning process for offshore wind infrastructure can be found in **Appendix B**.

3.1 The Process for Federal Waters

The planning, permitting, construction, operation, and decommissioning of an offshore wind project is a long and complex process informed by federal law and regulations (**Figure 6**). This process can begin in multiple ways, but typically is driven by either interest from state governments that want to incorporate offshore wind energy into their portfolio or direct solicitations from offshore wind developers. To initiate the federal permitting and planning process, a state government can submit to the federal government a proposal for a specific area off their coast, or an offshore wind developer can file an unsolicited lease application with the federal government. The federal government can also decide to initiate the planning process without a request from either a state or developer. These events trigger a detailed regulatory process across numerous jurisdictions and agencies.

Primarily, this process is handled by BOEM, which is part of the Department of the Interior. BOEM is responsible for regulating renewable energy activities on the Outer Continental Shelf (OCS) in an economically and environmentally responsible manner, including through implementing the regulations for the OCS Renewable Energy Program (authorized by the Energy Policy Act of 2005).


Atlantic Puffin

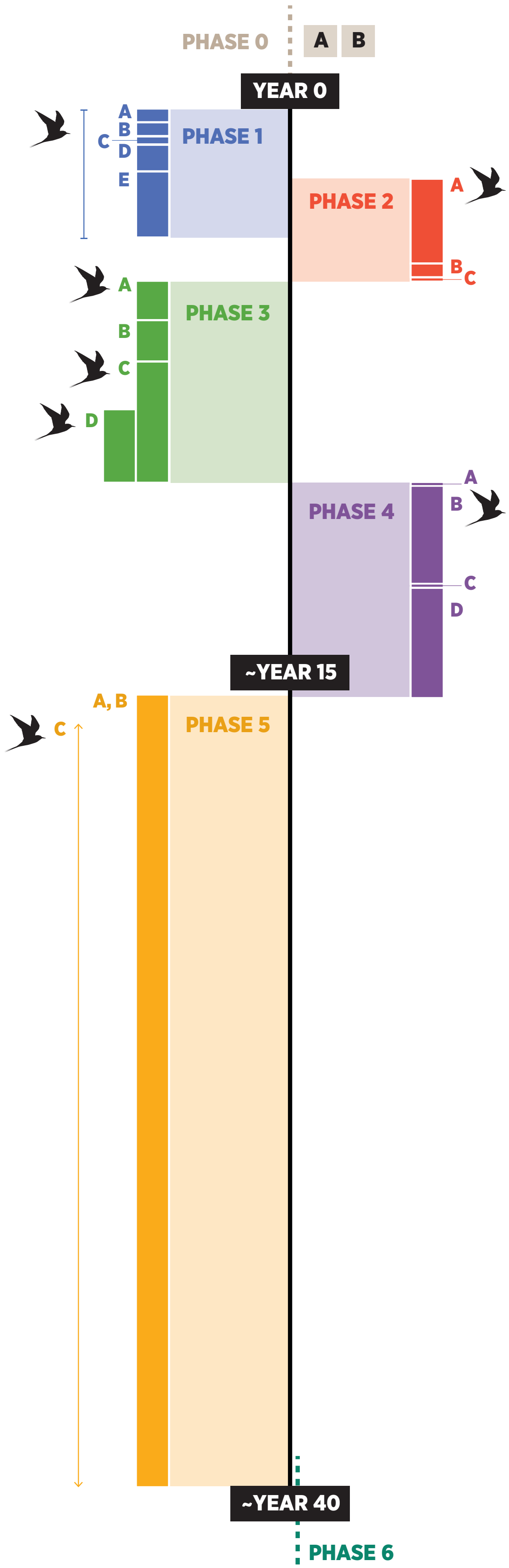
Before the formal process begins, BOEM will initiate an Intergovernmental Renewable Energy Task Force.[103] To date, BOEM is working closely with several states regarding offshore energy development and coordinates intergovernmental task forces in and across certain coastal states. The task force is composed of representatives from federally recognized tribes, federal agencies involved in the permitting and management of offshore wind resources, state governments, and local governments. The task force serves as a forum through which the federal government can coordinate planning, solicit feedback, exchange relevant scientific and ecological data, and provide information about the process as it proceeds.

While the pre-planning process can take significant time before BOEM feels comfortable moving forward with the formal process described below, the agency has taken steps to help forecast its activities to the offshore wind industry and states to provide greater long-term certainty. In April 2024, BOEM released a schedule of anticipated offshore wind lease sales, naming general areas that are already moving or expected to move through the planning and analysis phase over the next five years.[104]

Once the task force is established, BOEM may initiate a formal planning and permitting process that will guide the siting, installation, and ultimate decommissioning of offshore wind projects. The BOEM commercial leasing program has six distinct phases: 1) planning and analysis, 2) lease issuance, 3) site assessment, 4) construction and operations, 5) post-construction monitoring, and 6) decommissioning or repowering (**Figure 6**).

3.1.1 Planning and Analysis

Before the leasing, permitting, and ultimate installation of an offshore wind project can move forward, BOEM undergoes a series of planning steps designed to refine and deconflict the regions of OCS that will be made available to lease for



LIFE CYCLE TIMELINE

Figure 6. The planning and permitting process for offshore wind projects.

Graphic: Julie Rossman/Audubon. Data: Bureau of Ocean Energy Management and Bureau of Safety and Environmental Enforcement (2024); Council on Environmental Quality (2024).

= AUDUBON ENGAGEMENT

PHASE 0: PRE-PLANNING

A. Interested Offshore Wind Developer Files Unsolicited Lease Application
B. BOEM initiates an Intergovernmental Renewable Energy Task Force

PHASE 1: PLANNING AND ANALYSIS

APPROXIMATELY 2-4 YEARS

A. Request for Interest Issued as BOEM seeks Public Comment
B. Call for Information and Nominations
C. Draft Area ID Memo Released and Public Comment Requested
D. Final Wind Energy Area Identified
E. Environmental Review of the Draft Area

PHASE 2: LEASING

1 YEAR AND 7 MONTHS

A. Public Sale Notice
B. Final Sale Notice
C. Auction Held

PHASE 3: SITE ASSESSMENT

2-5 YEARS

A. BOEM Conducts Pre-Survey Meetings and Planning
B. BOEM Reviews Survey Plans
C. Lease Holders Conduct Site Assessments
D. Programmatic Environmental Review (if applicable)

PHASE 4: CONSTRUCTION

APPROXIMATELY 4-8 YEARS

A. Lease Holders Submit a Construction and Operations Plan (COP)
B. Environmental and Technical Review of COP
C. BOEM Approves COP and Lease Holders Submit Design and Installation Plan
D. Construction and Connection to the Onshore Grid

PHASE 5: OPERATION & POST CONSTRUCTION MONITORING

25 YEARS

A. Turbine Operates for Lease Term
B. Bureau of Safety and Environmental Enforcement, U.S. Fish and Wildlife Service, and other agencies monitor species impacts directly and indirectly
C. Lease Holder Submits Decommissioning Plan

PHASE 6: DECOMMISSIONING OR REPOWERING

APPROXIMATELY 4 YEARS

offshore wind energy development.[105] Through three steps—the Request for Information, the Call for Information and Nominations (the Call), and the Draft Area Identification (Draft Area ID) Memo—BOEM solicits comments from a wide array of interested parties, including state and local governments, Tribal governments, environmental and conservation organizations, impacted communities, and the general public.[106,107]

BOEM solicits feedback on several factors including commercial interest and viability, avoiding well-known environmentally sensitive regions, and potential impacts on other commercial interests (such as shipping lanes and commercial fishing). In addition to the public and offshore wind developers, many public-interest organizations, including Audubon, will comment on proposed areas during this period to help inform which areas of the OCS are best suited for offshore wind development and will have the least impact on bird species and their habitats. The feedback provided during these stages helps the agency determine whether a competitive leasing process is required to lease the areas under consideration. The agency will also generally refine the areas under consideration in response to concerns raised by the public and industry, limiting the areas proposed for leasing by either states or developers to a smaller area that avoids cultural, environmental, economic, and technical conflicts.[108]

After BOEM receives feedback and makes any necessary changes to the proposed area, the agency will publish the final Wind Energy Areas (WEAs).[109,110] At this point, BOEM will undergo its first of two environmental reviews under the National Environmental Policy Act (NEPA). Under NEPA, BOEM is required to conduct a public review process that details potential impacts of leasing within the final WEAs for offshore wind development on wildlife, ocean ecosystems, human health, and any other reasonably foreseeable significant environmental impacts.[111,112] This process, which can take between one and three years, is critically important for the removal of wind lease areas that could be potentially harmful to birds or the habitat they need to thrive.[113] Audubon and other conservation organizations consult with on-the-ground experts and utilize the best available science and data to help guide BOEM through the environmental review process to a conclusion that best protects our environment and wildlife. Once finalized, the environmental review process can result in additional refinements to the final area available for leasing.


Arctic Tern

3.1.2 Leasing

Once an environmental review is completed and a final wind area has been designated, BOEM will move forward with the process of leasing parcels of the OCS for development. In most cases where there is interest from multiple companies for developing offshore wind in the designated areas, BOEM will conduct an auction. Before it can do so, BOEM is required by law to publish a *Proposed Sale Notice* (PSN).[114] The PSN provides a detailed description of the lease areas and the competitive process that will be used to lease these areas, including draft rules for the lease auction.[115]

The PSN will also detail whether BOEM plans to use "bidding credits." Bidding credits are incentives provided during a lease auction to developers that commit to making monetary contributions to certain programs or initiatives outlined by the agency.[116,117] Typically, these bidding credits are for programs or initiatives that help strengthen the offshore wind domestic industry, such as programs that support workforce training, build domestic supply chains for offshore wind energy infrastructure, or benefit communities or the environment near the proposed lease area.[118]

Once the public provides comments on the PSN, the agency will issue a Final Sale Notice (FSN) and set a date for the auction.[119] While the auction grants the winning bidder the exclusive right to move forward, the winning bidder still needs to complete additional steps to demonstrate their ability to responsibly develop and operate offshore wind energy infrastructure on the lease site before they can begin construction.[120]

3.1.3 Site Assessment

Once a commercial lease for offshore wind development is awarded to a winning bidder, BOEM and the lease holder begin the process of conducting site-specific assessments to determine how to best deploy offshore wind infrastructure.[121] These activities can take up to five years to complete.[122] Site specific considerations can include weather conditions, ocean current patterns, migratory patterns for bird species, and more.

During this phase, BOEM can elect to undertake regional environmental reviews in situations where multiple offshore wind leases have been issued within the vicinity of one another. These reviews, called Programmatic Environmental Impact Statements (PEISs), are important emerging tools that help the agency understand any cumulative impacts from development on communities, marine wildlife, birds, and the ocean environment across a region. The PEIS results can

Construction of South Fork Wind Turbines

be used to inform requirements on how lease holders install and operate offshore wind turbines on their leases, while also helping the agency streamline subsequent lease-specific environmental reviews.[123,124]

3.1.4 Construction and Operations

After developers are confident that they have collected the information required to move forward with the actual installation of offshore wind infrastructure at their lease site, they submit a *Construction and Operations Plan (COP)* to BOEM. The COP provides BOEM with a detailed plan about how a developer intends to construct and operate offshore wind infrastructure within the lease area.[125]

Once submitted, the COP undergoes an environmental review under NEPA.[126,127] Under NEPA, BOEM is required to solicit public input on the potential impacts of the COP on wildlife, ocean ecosystems, human health, and any other reasonably foreseeable significant environmental impacts. This review provides Audubon and other conservation organizations with an opportunity to ensure that the operation and construction of offshore wind infrastructure within the area follows the mitigation hierarchy to avoid, minimize, mitigate, and monitor any negative impacts on birds and other wildlife. This review of the COP can last up to three years before BOEM reaches a final decision and completes review under NEPA.[128]

If BOEM approves the COP, the lease holder must submit a *Facility Design Report (FDR)* and *Fabrication and Installation Report (FIR)* to Bureau of Safety and Environmental Enforcement (BSEE)[129]. If the FDR and FIR are approved by BSEE, construction can begin. Once construction is complete, the commercial operations of the project can begin along with the 25-year lease term.

3.1.5 Post Construction Monitoring

As noted in **Section 2** of this report, effective monitoring of the installation and operation of an offshore wind project is critical for ensuring the success of mitigation efforts designed to protect birds and other wildlife. The regulatory regime governing how the COP submitted by developers are enforced and operations monitored for compliance is still evolving as the domestic offshore wind industry grows. However, recently published regulations have begun to create additional guidance for the offshore wind industry. In 2023, the Biden Administration granted authority over enforcement, monitoring, and decommissioning to BSEE. This sister agency to BOEM is now responsible for ensuring the safe construction, installation, and operation of offshore wind infrastructure over its lifetime. In addition to monitoring the compliance of offshore wind operators with their submitted COP and relevant regulations, BSEE is also tasked with developing and monitoring worker safety and environmental compliance strategies for offshore wind operators.[130,131]

While inspections will be a necessary component of monitoring and enforcement of offshore wind compliance, BSEE, BOEM, and other agencies cannot rely on in-person inspections to monitor the quickly growing number of turbines in federal waters. While searching for bird carcasses in a standard radius around land-based wind turbines can help estimate overall impacts on specific bird species, such activities are entirely impractical in the context of offshore wind. Instead, different methods will be required to fully capture the impacts on birds while also ensuring compliance with federal environmental and conservation laws.

To date, modeling to predict species impacts has been primarily explored by federal agencies like the U.S. Fish and Wildlife Service that are responsible for compliance with environmental laws, such as the Endangered Species Act.[132] However, these models are only predictions of risk, and none of the models have been verified for their accuracy in the marine environment. Technologies are also quickly being developed that can supplement what in-person inspections and risk modeling can tell us about the impacts of offshore infrastructure on birds. More information on these technologies and offshore wind monitoring can be found in **Appendix B.**

Additional transparency from the relevant agencies is needed to clarify how the implementation of the COP and decommissioning plan submitted by project developers will be monitored and enforced when necessary. Regulators should also work towards the creation of industry-wide technology standards for protecting birds. Specific policy recommendations to improve the monitoring of offshore wind operations and construction can be found in **Section 4** of this report.

3.1.6 Decommissioning and Repowering

At the end of the lease term, offshore wind projects are required to undergo decommissioning. The decommissioning process is governed by BSEE and BOEM, but the decommissioning obligations are held by the lessee upon acceptance of the lease term.[133,134] The decommissioning process begins two years before the expiration of a lease and continues for a period after the expiration of the lease as the offshore wind infrastructure is dismantled, recycled, repurposed, or otherwise disposed. While the formal decommissioning process begins near the end of a lease term, it is important to note that offshore wind lease holders are required to provide financial assurance and detailed information related to decommissioning in their COP and other documents provided ahead of the operation and construction of an offshore wind project (see **Appendix B** for additional details).[135] The decommissioning process is divided into three distinct stages: the *Decommissioning Application, Decommissioning Notice*, and the *Final Decommissioning Notice* (See **Figure 6**).[136]

It is important to note that, to date, the decommissioning of offshore wind infrastructure has yet to occur in the OCS of the United States.[137] Lessons may be learned from Europe, where a more mature offshore wind industry has allowed for greater analysis into real decommissioning efforts over a number of years.[138] However, additional policy guidance at both the state and federal level will be required (see policy recommendations included in **Section 4** of this report). Likewise, it is likely that many offshore wind projects may ultimately undergo *repowering* at least once before being ultimately decommissioned (See **Figure 6**). Repowering is the process by which existing wind turbines are either refurbished or dismantled and replaced by new ones to extend the life of a project.[139] While repowering is a more common occurrence in the on-land wind industry, there is very little guidance provided by BSEE and BOEM on the process for repowering in the offshore wind context. Additional information about the decommissioning process can be found in **Appendix B**.

3.2 How Audubon engages on offshore wind

Since 2016, Audubon has provided extensive written comments on every step of every BOEM process for offshore wind, including information gathering, siting, and NEPA processes. This work is done both in coalition and independently. Audubon staff meet regularly with BOEM and state agencies (outside of the public comment process) to provide extensive science-based recommendations on siting, leasing, and operating offshore wind and the impact on marine and coastal birds. As we look ahead to a future with more rapid offshore wind development, Audubon is committed to continuing this work to protect birds by using the best available scientific and technological data to ensure science-based decision making for each step of the siting, leasing, and permitting processes.

Audubon Seabird Fly-In

Our approach to engaging on offshore wind is based on shared principles that responsible development uses the mitigation hierarchy in addressing impacts such that we:

- Avoid first, minimize second, mitigate impacts that cannot be minimized, and monitor for adverse impacts on marine and coastal habitats and the wildlife that rely on them;
- Minimize negative impacts on other ocean uses;
- Meaningfully engage Tribal Nations, state and local governments, and other impacted communities from the outset—including robust consultation with frontline communities;
- Include comprehensive efforts to avoid negative impacts and ensure shared economic benefits with underserved communities.

To ensure Audubon's values and goals are incorporated, Audubon engages on individual projects with specific bird conservation objectives. We initiate meetings with developers on their offshore wind projects to provide scientific references

> **"Technologies are also quickly being developed that can supplement what in-person inspections and risk modeling can tell us about the impacts of offshore infrastructure on birds."**

and data on seabirds and their behavior and make recommendations for micro-siting, mitigation, and research funding.

At times, Audubon weighs in on core research and development programs sponsored by the Department of Energy (DOE), BOEM, and other federal agencies to promote new technologies that support the mitigation hierarchy. Audubon lends strong support to emerging technologies for detecting wildlife impacts. To increase performance of mitigation approaches, Audubon staff review and advise individual projects, such as the California Blade Strike Test Plan.

Audubon regularly furnishes key avian content for sign-on comment letters jointly crafted by environmental non-governmental organizations (NGOs) during the lengthy permitting and environmental review process. In some cases, Audubon crafts its own comment letters and even communicates directly to advise an agency's top scientists. Across the many stages of agency review, Audubon emphasizes key junctures where protections for birds are most vital. We work early in the NEPA timeline using spatial data about birds to find least-conflict areas where offshore wind energy infrastructure can be safely sited and operated. The Planning and Analysis Phase is the most crucial step implementing a strategy designed to avoid harm to birds; this is where comments from Audubon and other organizations can be very impactful (see **Section 3.1.1)**. As noted in **Sections 3.1.1** and **3.1.4**, both the draft WEA designations and COPs undergo review under NEPA, allowing Audubon to advocate for site-specific bird protections through direct comments to BOEM and BSEE.

Using our longstanding strength as a trusted convener, Audubon hosts a monthly meeting of bird conservation organizations and scientists addressing the challenges of offshore wind and birds. Audubon staff also attend and present their findings at professional conferences that cover wind energy and wildlife, including New York State Energy Research and Development Authority (NYSERDA) State of the Science workshops, Conference on Wind energy and Wildlife impacts, and Gulf of Mexico Conference. These conferences provide opportunities to communicate with federal and state agencies, scientists and researchers, and energy developers.

Audubon staff play a lead role on the Steering Committee of the Regional Wildlife Scientific Collaboration[140] for offshore wind development in the Atlantic, as well as in planning for similar collaborations in the Gulf of Mexico and the Pacific.

In addition to roles in NGO partnerships, Audubon staff serve as core permanent, steering committee, or even founding members of a number of diverse advisory groups like the Gulf of Mexico Avian Monitoring Network, the Renewable Energy Working Group, the Atlantic Marine Bird Cooperative, and the NYSERDA Environmental-Technical Working Group. Through information-sharing and consensus-building during each phase of build-out for offshore wind energy, our expectation is that these collaborations will result in finding the optimal outcomes for both energy generation and wildlife conservation.


Ashy Storm Petrel

Least Terns

3.2.1 Audubon in Action

The following three examples of our work showcase Audubon's influence on offshore wind development.

1 Audubon Advocacy for Offshore Wind in North Carolina

Audubon is a founding member of the Offshore Wind for North Carolina Coalition,[141] which has helped lay the groundwork for responsible wind energy growth in the state through both policy efforts and grassroots organizing.

In partnership with North Carolina chapters, Audubon worked to educate chapter members and communities about the benefits of offshore wind and how it can be developed responsibly for wildlife and people. Notably, in 2022, Audubon hosted the Wind and Wildlife Summit in Wilmington near ongoing offshore wind energy planning. These education efforts galvanized grassroots action across the state, generating hundreds of comment letters in support of offshore wind leases. Audubon members and chapters in North Carolina spoke up loud and clear during two critical public comment hearings for a new offshore Wind Energy Area, accounting for 95% of all comments submitted.

Earlier, members not only helped defeat a counterproductive bill in the North Carolina legislature that would have been a pathway for more dirty fossil fuels; they set the stage for historic, bipartisan carbon emissions legislation passed in 2021. House Bill 951 requires North Carolina to slash carbon emissions at the speed and scale birds need.[142]

As offshore wind development planning has continued, Audubon has submitted comments on every step of the proposed WEAs, highlighting the need to protect globally endangered species of birds that use the Gulf Stream, such as Black-capped Petrel, Bermuda Petrel, and other seabirds, as well as other Mid-Atlantic migratory seabirds.

Offshore wind development still has a long way to go in North Carolina, but Audubon and partners will continue working to help the industry grow in ways that benefit birds and people.

2 The Importance of Early Outreach and Respecting Tribal Sovereignty: Chumash National Marine Sanctuary and Morro Bay Wind Energy Area

Early outreach, meaningful consultation, and involvement of Tribes and Indigenous communities are essential to the success of offshore wind projects. These processes build relationships, trust, and public support for offshore wind development. They also uncover and reduce potential conflicts that can lead to opposition, delays, and litigation. The need for early and meaningful engagement is illustrated in the case of a proposed offshore wind development near the Chumash Heritage National Marine Sanctuary (CHNMS).

In 2015, following years of advocacy by the Northern Chumash Tribal Council and a collection of community and environmental organizations that included Audubon, the National Oceanic and Atmospheric Administration (NOAA) accepted the nomination for the designation of a National Marine Sanctuary in an area off California's central coast. The recently designated CHNMS[143] stretches along 116 miles of coastline and includes over 4,500 square miles of water. The CHNMS includes a rich array of biodiversity, supporting many species of birds, marine mammals, sea turtles, fishes, and other marine organisms, like algae and kelp. Critically, the sanctuary will also allow for connectivity between two existing marine protected areas.

Since 2016, offshore wind developers have expressed interest in Morro Bay as a possible area for offshore wind development. This is in part because there is existing coastal infrastructure where developers can easily connect offshore transmission to the grid. After an initial process to identify wind areas outside the CHNMS, BOEM auctioned three leases in the Morro Bay WEA in December 2022. These leases cover approximately 376 square miles off the coast and are projected to supply as much as three GW of electricity to the grid.

Following the wind auction, NOAA released a draft management plan presenting various boundary alternatives for the sanctuary, including their preferred alternative that would carve out a corridor on the north side of the proposed area for transmission infrastructure that could be buried in the seafloor to connect to the California grid.

Since NOAA released this plan, developers have expressed concerns about whether the corridor was large enough to allow the access to the grid necessary to support full development in the Morro Bay WEA. According to developers, in order to connect all three GW of potential offshore wind energy to the grid, additional areas would need to be carved out from the CHNMS, at least temporarily. And while there is a legal process to permit transmission cables through a National Marine Sanctuary, developers have expressed concerns that the process is untested and may invite lengthy litigation.

Short-Tailed Albatrosses

Throughout this process, Audubon has both supported the Northern Chumash Tribal Council and has publicly expressed support for responsibly sited offshore wind development in the Morro Bay WEA. Audubon encouraged further dialogue between the Northern Chumash Tribal Council and the offshore wind industry, deferring to the Tribal Council on how to best balance the needs of the Tribe and community with the ongoing need for clean energy.

The Tribal Council and the offshore wind industry eventually released a Letter of Agreement[144] that outlines a phased approach that would allow for undersea cables to be sited in federal waters before a second phase of the sanctuary would be designated to incorporate that area in the sanctuary. The Letter of Agreement was accepted and incorporated into the final management plan for the sanctuary, which states that Phase 2 and the process to expand the sanctuary will begin in 2032. However, without early engagement with the Northern Chumash Tribal Council, it is unlikely that the Letter of Agreement could have been produced in a timely fashion.

The experience of working to establish the CHMNS and accommodate offshore wind, culminating in the development of the Letter of Agreement, provides lessons learned and an evolving model for respecting Tribal rights while advancing clean energy. Even after the letter, the issue remains controversial. Audubon knows that reducing conflicts to responsible offshore wind development requires applying lessons learned from early projects and, most importantly, robust investment in collaborative, community-led processes that respect Tribal sovereignty, incorporate community input, and protect birds, other wildlife, and the environment.

3 Providing Bird Data to Maximize Avoidance in the Gulf of Maine Wind Energy Area

The Gulf of Maine illustrates both why Audubon supports a rapid transition to clean energy and how Audubon engages in offshore wind planning.

As the climate warms, marine heat waves in the Gulf of Maine are becoming increasingly severe. Warmer water temperatures are driving changes in the abundance of fish that Atlantic Puffins, terns, and other seabirds rely on to feed their nestlings. The long-term future of these birds depends on a transition to clean energy.

In addition to being an important place for seabirds, the Gulf of Maine is also a promising location for offshore wind energy development, with strong winds and proximity to major population centers. Combining high-resolution tracking data from Audubon's own Seabird Institute with seabird distribution data compiled by others, conflict avoidance in wind energy siting was implemented in unprecedented fashion.

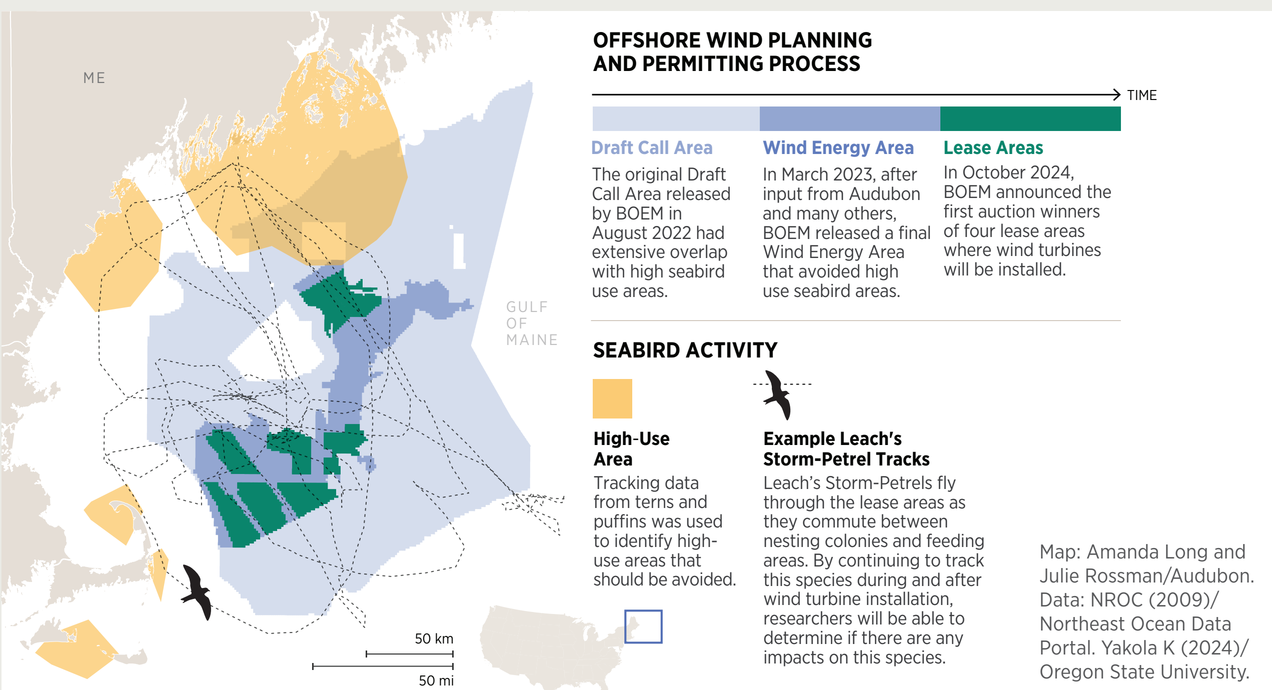
In 2019, BOEM assembled a Gulf of Maine Task Force, including federal officials and elected Tribal, state, and local officials from Maine, New Hampshire, and Massachusetts. With the Task Force in place, BOEM has been able to rapidly move through the process of charting a course for wind energy development in the Gulf of Maine.

In August 2022, BOEM initiated this process by releasing a draft call area for the Gulf of Maine that covered ~13.7 million acres (**Figure 7**). Call areas serve as a way for BOEM to evaluate potential leasing interest and conflict areas within a larger geography. In response to the request for information, Audubon worked with partner organizations to provide bird tracking data demonstrating the overlap of the proposed area with foraging trips of nesting seabirds (**Figure 7**).

As a result of the subsequent public review process, BOEM released a draft WEA in October 2023 that had been reduced to ~6.3 million acres. In response to the draft WEA, Audubon and partners offered further comments based on a unique synthesis of tracking and other spatial data, specifically encouraging the avoidance of the remaining high-use areas for birds, whales, and other marine life. In March 2024, BOEM released the final Gulf of Maine WEA, which had been reduced to only ~2 million acres and maximized avoidance of the areas used by nesting seabirds throughout the Gulf of Maine (**Figure 7**).

In April 2024, BOEM announced its proposal to sell leases for up to eight wind projects that would cover ~1 million acres and have the potential to generate approximately 15 GW of electricity (enough to power 5 million homes). With these proposed lease areas defined, BOEM released a draft Environmental Assessment for these planned sales. Audubon remains committed to robust monitoring of species where some overlap still exists. Tracking data indicate that for some species it will be important to monitor for potential impacts (**Figure 7**). If negative impacts are detected, Audubon will advocate for additional actions to minimize these impacts or provide compensatory mitigation, such as removing invasive plants or deterring predators from nesting colonies, to offset them.

Figure 7. Map depicting how the planning process for wind energy in the Gulf of Maine reduced the potential for impacts to nesting seabirds.



3.3 Despite Benefits to Local Communities, Some Opposition Persists

Power produced by offshore wind benefits local communities from both an economic and a public health perspective. Unlike fossil fuels, there is no resultant air or water pollution. Further, communities see increased employment and job training for coastal workers, contracts with local unions, port revitalization, an increase in local tax income, as well as lower costs for energy.

Local communities can also benefit from the use of "community benefit agreements" with developers in bid credits authorized by BOEM. For example, the Sunrise Wind project has a Host Community Agreement with the town of Brookhaven, Long Island, that provides local investments in exchange for the 18 miles needed for its cable to carry the electricity. These investments include $10 million for a National Offshore Wind Training Center in Brentwood; an operations and maintenance hub in East Setauket that will create up to 100 new jobs; $5 million for a research and development partnership with Stony Brook University; and hundreds of union construction jobs to build the underground transmission infrastructure and interconnection facilities.[145]

Despite potential benefits, offshore wind often draws some opposition based on viewshed impacts and perceived impacts on wildlife or the fishing industry, among other issues. Opposition campaigns can appear locally organized but are sometimes funded by donors to fossil fuel associations or lobbyists. One study by Brown University found $72 million in contributions from six major anti-offshore wind donors to groups in an anti-offshore wind network on the Atlantic coast between 2017 and 2021.

The opposition has often taken the form of litigation on BOEM's NEPA analyses. Vineyard Wind, the first operational commercial-scale offshore wind project in the U.S., is fending off four lawsuits alleging improper approval by the federal government. As of December 2024, Vineyard has clinched three victories in federal court rejecting an attempt by fishermen to halt its 800 megawatt offshore wind project off Massachusetts.[146] To counter litigant claims that offshore wind will kill many birds, Audubon has formed a collaboration with Columbia Law School's Sabin Center Renewable Energy Defense Initiative to consider filing amici briefs to counter these claims. Two cases made these claims on birds so far, but one case dropped the claims and the other claim on birds was thrown out by the judge. But claims that wind energy "kills all those birds" continue in opposition circles.

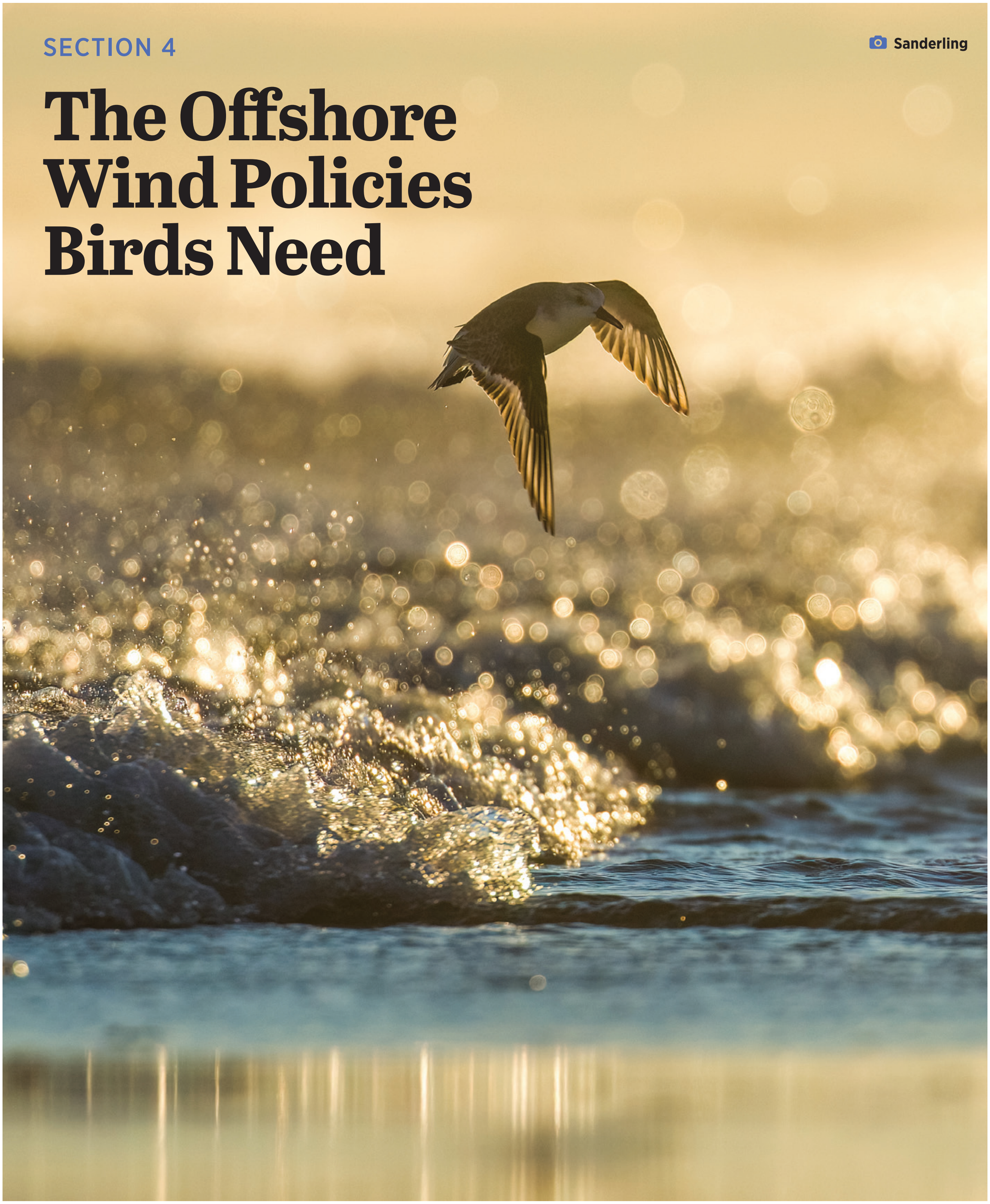
Opposition may also take the form of local ordinances or ballot measures opposing offshore wind. Two counties in Oregon put initiatives on the ballot for November 2024 that oppose offshore wind in the hopes of negatively affecting permitting and community support and to discourage developers from bidding on leases in recently announced WEAs.

Meanwhile, recent public polls show support for offshore wind statewide in most areas. An overwhelming majority of Californians (72%) support allowing wind power and wave energy projects off the California coast.[147] In New Jersey, more residents support wind farms than oppose them, with 50% in favor of plans to build wind turbines at sea to generate electricity, 33% opposed, and 16% unsure. Beacon Research surveyed 1,013 Massachusetts voters online. Sponsored by Vineyard Offshore, the poll found that 77% of Bay State voters favor building offshore wind projects—42% "somewhat favor" offshore wind development, 35% were "strongly" favorable, and 14% opposed. In June 2024, over 1,200 registered Connecticut, Massachusetts, and Rhode Island voters participated in a survey by Barr Foundation of Boston of their perspectives on offshore wind. This survey showed strong support for offshore wind across all three states. Vocal support is present in both coastal and inland communities.[148]

With such a large constituency of coastal members and chapters and strong state coastal offices, Audubon is positioned to help address unwarranted local opposition, especially regarding impacts to birds, and to lean locally into support for environmentally responsible well-sited offshore wind projects that benefit climate, communities, and conservation.

SECTION 4

The Offshore Wind Policies Birds Need



Sanderling

To meet our offshore wind targets in a manner that protects birds and people, we must have planning processes and policies that are informed by science and the voices of local communities.

Offshore wind offers an important opportunity to rapidly decarbonize the U.S. energy sector, meet growing electricity demand, and provide thousands of high-quality jobs. According to research from the Energy Innovation Foundation, by utilizing offshore wind to supply 10 to 25 percent of national electricity demand (on the scale of 400-500 GW), the U.S. can feasibly reach net-zero greenhouse gas emissions economy-wide while supporting high levels of electrification for vehicles and other mobile emissions sources.[149] Such an investment would not only reduce emissions dramatically but could create as many as 390,000 jobs by 2050.[150]

Yet despite this potential, offshore wind energy buildout in the U.S. is still in its early stages, and we are far behind the global leaders in production. As of 2023, China leads the world with over 31 GW of operating offshore wind capacity, followed by the United Kingdom with approximately 14.7 GW of offshore wind capacity.[151] Conversely, there are only three operational wind projects in U.S. waters to date (off Massachusetts, Virginia, and New York's Long Island), which collectively produce approximately 0.174 GW. There is, however, an ambitious planning process underway and over the next 10 years, we will see exciting projects launched in every ocean (**Figure 5**). To ensure that our targets for offshore wind are met in a manner that protects birds and people, we must ensure that this planning process and the policies that support it are informed by science and the voices of local communities. With this opportunity in mind, Audubon is working with regulators, developers, and state and federal lawmakers to ensure the development of offshore wind proceeds efficiently and is safe for birds.

In addition to working directly with offshore wind regulators and developers on siting, construction, and operations that avoid and minimize bird impacts, Audubon recognizes that policy improvements are required to speed the rate of offshore wind deployment, create regulatory certainty for developers, and foster community support for offshore wind projects, all while ensuring adequate protections for vulnerable bird species and the habitats they depend on.

Already, federal and state legislators across the country have introduced many policies that would help advance responsible offshore wind development and protect birds and other wildlife. Notable federal legislation already proposed to address these issues include the Clean Electricity and Transmission Acceleration Act (CETA) introduced by Representatives Sean Casten (D-IL) and Mike Levin (D-CA); the Offshore Wind Modernization Act introduced by Representative Paul Tonko (D-NY); the COLLABORATE Act introduced by Senator Sheldon Whitehouse (D-RI); the RISEE Act introduced by Senators Bill Cassidy (R-LA) and Sheldon Whitehouse (D-RI) and Representatives Lizzie Fletcher (D-TX) and Randy Weber (R-TX); and the Nonrestrictive Offshore Wind Act 2023 introduced by Representatives Alexandria Ocasio-Cortez (D-NY) and Deborah Ross (D-NC).

Audubon is actively engaged with state and federal lawmakers, governors, regulatory agencies, NGOs, utilities, clean energy developers, and other decisions makers to promote policy priorities with the goal of quickly increasing bird-friendly offshore wind infrastructure deployment.

In the section below, we provide high-level policy considerations and recommendations to meet these goals. For a more detailed set of policy recommendations, please review our companion document, **Offshore Wind and Birds: Summary and Recommendations for Policymakers**.

4.1 Promoting Design and Operation that is Better for Birds

As offshore wind infrastructure is deployed, it is essential that it is designed and operated with birds in mind. Through the Department of Energy's Wind Energy Technology Office, California Energy Commission, RWSC, and other agencies, there is ongoing research into real time monitoring of direct and indirect avian impacts from offshore wind as well as techniques and technologies to mitigate, minimize, and avoid these impacts. However, many low-cost strategies for reducing avian impacts from offshore wind already exist and have been successfully implemented by a handful of offshore wind developers across the world. As highlighted in **Section 2.4.3** of this report, these include strategies to eliminate factors that attract birds to turbines, increase the visibility of the rotor blades, and change the operation schedule of turbines to reduce risk during critical periods. Audubon supports policies that encourage the adoption of these best management and technology practices as regionally appropriate and prioritize the need for real time monitoring for collision and displacement of birds by offshore wind.

4.2 Improving Monitoring of Wildlife Impacts from Offshore Wind Projects

Compared to land-based wind energy, monitoring avian and other wildlife impacts from offshore wind infrastructure poses unique challenges. While direct monitoring of all offshore wind infrastructure is not practical or economical, new monitoring techniques continue to be developed to help better quantify impacts, including avian mortalities from collisions, avoidance behaviors, perching behaviors, and changes in other behaviors. In addition, NOAA's limited fleet capacity for survey ships has made it difficult to meet the greatly-increased demand for marine resource surveys necessary to facilitate new offshore wind. These surveys address marine conditions at potential sites for offshore wind development and help further understand interactions between birds and offshore wind. Policies should be enacted to encourage best practices for bird monitoring, and additional research is needed to further improve monitoring and bird detection technologies around offshore wind infrastructure. Further, as appropriate, the federal government should explore opportunities to incorporate partnerships with state and Tribal governments to supplement monitoring activities for offshore leases. Finally, federal investments should be increased for research infrastructure, including dedicated ships, needed to better understand impacts on birds and other wildlife.

4.3 Increasing Investment in Research, Mitigation Strategies, and Net Conservation Gains for Birds

Mitigation of impacts on avian and other wildlife populations from offshore wind infrastructure poses a unique set of challenges. Funding is needed to develop additional mitigation strategies for bird populations where direct impacts from offshore wind infrastructure is not otherwise avoidable. This includes funding for federal programs and staffing to research these impacts and develop appropriate mitigation strategies. Likewise, federal funding should be increased for research into offshore wind technologies and designs that can help reduce the impacts on wildlife and birds. Funding for research should also target enhancements of offshore wind infrastructure that can improve turbine efficiency and reduce energy loss, thus minimizing the overall footprint of offshore wind turbines. This includes continuing support for development of floating wind turbines that can be deployed further from the coast or in areas with a deeper sea floor. A full list of suggested topics for federal and state research can be found in **Section 2.6** of this report.

4.4 Preparing States for the Magnitude of Offshore Wind Development

While the vast majority of offshore wind energy currently planned or in operation is located in the portion of the Outer Continental Shelf that is under federal jurisdiction, states play an important role in the deployment, development, and ultimate success of offshore wind energy. Additional resources will be necessary across all states to ensure effective and efficient siting, permitting, and deployment of infrastructure supporting offshore wind facilities both in and out of the water. This includes support for transmission planning and siting that reflects the integration of existing and future offshore wind energy onto the grid. In addition, the federal government can help states with the burden of implementing policies to speed the deployment of offshore wind energy. Finally, the federal government should play a role in facilitating learning of best practices between states regarding community engagement, planning, and effective permitting, integration, and siting of offshore wind energy.

> **"Audubon supports efforts to expand the federal permitting workforce to ensure the timely and effective permitting of energy infrastructure."**

4.5 Improving Siting and Permitting for Offshore Wind

Dramatically expanding the footprint of offshore wind projects off the U.S. coast will require improving the existing siting and permitting process in an environmentally sensitive manner that ensures meaningful and early engagement with impacted communities, Tribal governments, and local wildlife organizations. Building on BOEM's existing process, more can be done to provide certainty and efficiency for offshore wind developers and communities alike. Audubon supports policies to improve timely siting and permitting and to increase agency coordination and engagement with interested parties and other governments, including other federal agencies, state and local governments, Tribal governments, and impacted communities. In particular, BOEM should work to expand and strengthen government-to-government consultation with Tribal governments, including through direct investments in building Tribal capacity for engagement with the permitting process.[152] Audubon also supports the continued use of PEIS under the NEPA to ensure a holistic understanding of potential impacts to vulnerable species while enabling greater efficiency in subsequent site-specific environmental reviews. Capacity building is also critical in the context of impacted communities that may not have the experience or expertise needed to fully participate in the BOEM permitting process. Audubon also supports policies that ensure a portion of the benefits from a project's development flow to communities that may be impacted by the project and that are informed by the needs and wants of the impacted communities. Finally, Audubon supports efforts to expand the federal permitting workforce to ensure the timely and effective permitting of energy infrastructure.

4.6 Promoting Interoperability and Improving Transmission Infrastructure for Offshore Wind Projects

Despite nearly 23 GW of offshore wind energy currently in the permitting stage or beyond, decades of poor planning at the regional and interregional levels have resulted in a transmission network that is ill-equipped to handle this new generation. As noted in **Audubon's Birds and Transmission Report**,[153] there are many challenges facing the planning, siting, permitting, and ultimate deployment of transmission infrastructure nationwide at the necessary scope and scale. However, the offshore wind industry faces unique challenges in building out transmission capacity capable of connecting offshore infrastructure to the grid.

In addition, the rapid growth of the domestic offshore wind industry has resulted in poor coordination between project developers and grid operators. Consequently, siloed infrastructure development can be incompatible with projects, and the offshore grid built to harness energy from turbines is not always compatible with the onshore grid designed to distribute the power.

Deployment of transmission infrastructure to connect offshore wind energy to the grid will require considerable coordination between federal agencies. Audubon is encouraged by the recent publication of the Offshore Wind Transmission Development in the U.S. Atlantic Region,[154] and encourages the Grid Deployment Office at DOE to continue its work with BOEM to develop action plans for the Pacific and Gulf Coasts. In addition, Audubon encourages coordination between BOEM and other federal agencies on implementation of funding and support programs for transmission infrastructure, including the National Interest Electric Transmission Corridor (NIETC) Program.

Audubon supports several policy recommendations to hasten the development of offshore transmission infrastructure and promote interoperability of offshore wind technologies, all while protecting birds from the impacts of these new lines. Specific recommendations can be found in our companion document, **Offshore Wind and Birds: Summary and Recommendations for Policymakers**.

4.7 Creating Regulatory and Financial Certainty for Offshore Wind Projects and Developers

Regulatory and financial uncertainty have been major obstacles to the expansion of offshore wind energy in the United States. This uncertainty has been fueled by prolonged inflation, supply chain disruptions, policy reversals fueled by partisan decision-making, irregularity in federal leasing practices, and inconsistent tax policies. In addition, as offshore wind develops from a nascent to more mature industry in the United States, federal agencies and Congress must work together to provide guidance for untested or underdeveloped policy areas, such as the decommissioning or repowering of offshore wind projects. Lessons learned from more mature offshore wind industries abroad will be invaluable for this process. A federal policy regime which provides regulatory and financial certainty for developers will help bolster private investment in and loaning activities for offshore wind developers, insulating projects from regular market uncertainties that are more difficult to avoid. As such, Audubon strongly supports maintaining investments made and incentives provided by Congress through the Inflation Reduction Act, Infrastructure Jobs and Investment Act, and other legislation. Building on these investments, Congress should examine whether existing requirements, such as intellectual property requirements, included in federal grant and loan programs for offshore wind and related technologies could present a disincentive to industry participation in the programs.

In addition, financial certainty can be bolstered for offshore wind developers through federal and state policies that invest in building out domestic manufacturing of offshore wind technology, components, and other infrastructure needed to support the industry, such as specialized ships. Policy should also aim to help bolster a skilled domestic workforce that can support growth of a domestic offshore wind industry. According to a 2021 study from National Renewable Energy Laboratory, to reach a 30 GW by 2030 target, the offshore wind energy industry must employ over 44,000 more workers by 2030, with nearly 33,000 of those workers clustered in communities near offshore infrastructure.[155,156] Some steps could include federal funding for registered apprenticeships in the offshore wind industry, a regularly conducted assessment of workforce needs within the offshore wind industry, and the continued offering of bid credits for projects that invest in building a domestic workforce.

Brown Pelicans

5. Conclusion

Birds tell us that the time to act on climate is now. This report highlights the urgent need for climate action and why Audubon supports a rapid onboarding of clean energy resources as a critical part of the solution. The abundance of offshore wind capacity could provide a significant leap toward rapid decarbonization of the U.S. energy sector. While there is no single action to guarantee the worst impacts will be avoided, most experts agree that decarbonization of our economy is an essential step. The alternative is a climate future where two-thirds of birds in North America will suffer dramatic range loss and extinction. The U.S. must transition to clean energy as quickly as possible, with the goal of reaching 100% clean energy by 2040. The timeline is urgent and a rapid deployment of offshore wind with significant gains in gigawatts of clean energy is a critical tool to quickly reduce emissions. Doing this the right way will require finding equitable and environmentally sound ways to significantly speed the development of offshore wind while minimizing impacts to birds. We have to move more quickly to prevent the worst impacts of climate change on people and birds. And Audubon is committed to engaging and sharing the latest science and data to ensure the rapid yet responsible expansion of our nation's offshore wind potential.

Endnotes

1 Rosenberg et al. 2019
2 Bateman et al. 2020; Wilsey et al. 2019
3 Bateman et al. 2020; Wilsey et al. 2019
4 Bateman et al. 2020; Saunders et al. 2023
5 Armstrong McKay et al. 2022
6 Oppenheimer et al. 2019
7 Oppenheimer et al. 2019
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List of Appendices

Please visit audubon.org/offshorewind for Appendices and additional resources.

Appendix A.
Mapping Audubon offshore wind engagement areas.

Appendix B.
The regulatory and permitting process for offshore wind projects.

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